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INTEGRAL ANALYSIS OF SELECTED LABOUR MARKET INDICATORS IN THE CONTEXT OF A COVID-19 PANDEMIC*

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Abstract. Individual indicators linked to labour market developments during the COVID-19 pandemic provide a view of a particular area but fail to capture the issue of the impact of the crisis comprehensively. This problem can be addressed by integrating them using multicriteria methods, resulting in a synthetic indicator of a specific labour market. Thus, the issue of the impact of the pandemic on important macroeconomic and labour market indicators can be evaluated by calculating a single indicator. The main objective of this study is to identify the labour market with the highest positive flexibility in relation to the impacts of the pandemic and thus reveal the critical factor that fundamentally reduces the resistance of the labour market to negative pandemic externalities. During the first wave of the COVID-19 pandemic (2020-Q2), Slovakia reached the highest value of the integral indicator, but in the last recorded wave (2022-Q1), it moved to the last place. Its average integral indicator for all three waves reached the highest average value. However, the highest value of the integral indicator and thus the highest positive flexibility of the labour market during the third wave was recorded by Germany, which evokes the assumption that the approach of the local government and authorities in the mentioned period most effectively protected the labour market from negative fluctuations. The results of the countries during the third wave of the pandemic consider the impact of the most current measures that were implemented at the time of the pandemic.

Keywords: labour market; COVID-19 pandemic; macroeconomic indicators; integral analysis

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1. Introduction

The pandemic affected the global economy and individual countries for almost three years. The mix of its effects, impacts, measures to contain or eliminate it, as well as the subsequent socio-economic development in the affected countries is extensive (Adamowicz, 2022; Halmai, 2021; Jain et al., 2022; Ingham, 2022 and others). Various opinions, estimates, expectations, or predictions have come to the fore in the past period. The currents of opinion regarding the COVID-19 pandemic in relation to the labour market have made it possible to understand its opportunities and threats. They have expanded the set of contexts in which the impact of the pandemic can be identified - whether on the labour demand or labour supply side. As a consequence of the

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multifaceted nature of the pandemic's impact, there are a number of issues and questions that should be addressed and answered - e.g. the impact of labour productivity levels on the overall resilience of the labour market to the negative effects of the crisis, the accelerating effects of the pandemic on the development of selected areas of the labour market (home office, ICT work, the shift towards automated production, the introduction of artificial intelligence elements in production and non-production processes, etc.), or the deepening problems of the current labour market (clash of generations, worker turnover, shortage of skilled labour, etc.), these and many others are indicated by several studies (Kapička & Rupert, 2022; Milanović et al., 2023; Casarico & Lattanzio, 2022 and others). The views presented in the preceding section are undoubtedly those of relevant experts in academia and practice, but they were often based on different assumptions, expectations and beliefs, or historical experiences in analogous situations, which to a significant extent determined their narrative value. However, given the topicality of the topic in the recent period, these views cannot be ignored - for a long time after the global outbreak of the COVID-19 pandemic, they were the only source of information and an important factor in economic and political decision-making. But now, after almost four years of monitoring and analyzing this societal issue, it is possible to speak of knowledge confirmed by science and practice.

The data integrated in this study come from public statistical databases, which is due to the nature of the multicriteria methods used in the calculations. The databases of institutions such as Eurostat, OECD, or WHO already have a relatively large set of indicators reflecting the evolution of the pandemic in relation to the functioning of the labour market. The existing data, when further processed, can provide a statistically accurate and scientifically interesting view of the past period of the pandemic crisis. The present study draws on these databases and integrates the individual indicators into a synthetic indicator through scientific quantitative methods. The reason for data integration is the absence of such a scientific approach in similar studies, whose explanatory value is then usually limited by the horizon of the indicator under study. The absence in terms of local research poses an interesting research problem, which implies the existence of a research gap; the need for comprehensive research on labour market resilience by a set of a larger number of indicators is justified, for example, by a Serbian study (Milanović et al., 2023).

When discussing the need to identify the impact of the COVID-19 pandemic on the labour market, it is important to recognize that these impacts and influences are multifaceted, which relates to broad labour market issues. It is well-known that its functioning is closely linked to macroeconomic developments. As the pandemic has affected countries' economies in a cardinal way, it has also affected the various areas of the labour market. We can talk here about the impact on employment, labour productivity, employers' labour costs, the number of vacancies, the organization of work and many other areas. Multicriteria methods capable of integrating disparate data from different areas into an indicator, generalizing the impact of the pandemic, are an option for assessing the impact of the pandemic in an aggregated way.

The main objective of this study is to identify the labour market with the highest positive flexibility in relation to the impacts of the pandemic and thus reveal the critical factor that fundamentally reduces the resistance of the labour market to negative pandemic externalities.

The structure of the paper consists of an introduction, where the rationale for the study and the background of the research are presented. It continues with a literature search, discussing the existing findings of other authors that address the confirmed impacts of the COVID-19 pandemic on the labour market in different regions of the world. This is followed by a methodological section oriented to familiarize with the research parameters and an empirical section where the standardized variable method is applied independently across the three waves of the COVID-19 pandemic through a selected set of eight indicators. The application of the method does not consider absolute values of the indicators, it works with their dynamic expression (most often a fixed-base index). This transformation of the indicator values ensures that the results of the calculation can easily identify the labour market with the smallest negative and the largest positive fluctuations of the indicators under study, i.e. the most positively flexible labour market. The study concludes with a brief discussion, a summary, and a list of bibliographical references.

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2. Theoretical background

The COVID-19 pandemic has become perhaps the most widely used term of the early 2000s. Its impact on human health has been the subject of numerous studies. However, at least as much scientific and research attention has been given to its impact on the global economy or on individual countries. Probably the most significant manifestation of the economic consequences of this crisis has been the fluctuations in major macroeconomic indicators, caused primarily by the introduction of restrictive measures by national governments to minimize its negative manifestations or to address the deepening negative phenomena (rising unemployment, falling GDP, slowing economic growth, rising price levels). The International Labour Organization (ILO) was quite quick to label the COVID-19 pandemic as not only a health crisis but also an economic and labour market crisis (Walter, 2020). As Kollmann (2021) states, the COVID epidemic is a very large, truly unexpected, and exogenous disturbance. According to Lemieux et al. (2020), the COVID-19-related crisis had a key impact on the labour market, household incomes, and changes in gross domestic product. Global disruptions in the supply chain, in turn, played a significant role in the development of inflation, which was related to. i. with the growth of the producer price index (Santacreu, LaBelle, 2022). The labour market and human capital were the first to feel these effects due to rising unemployment, job insecurity and shrinking career opportunities because of the spread of COVID-19 worldwide (Costa Dias et al., 2020). It was often optimal to close businesses and order a quarantine even before the wave reached its peak, but the tax was, e.g., a higher number of vacant jobs (Kapička, Rupert, 2022).

During a pandemic, the labour market cannot function efficiently - it has often been shown to be more effective to close businesses and implement quarantine measures before the peak of the pandemic (Kapička & Rupert, 2022). A negative phenomenon affecting a large proportion of workers was the physical closure of national borders to prevent the spread of the COVID-19 virus. The implementation of this decision cardinally affected the international labour market. Legislative but also de facto barriers posed a major problem for cross-border workers, but also for the companies and society itself (Medeiros et al., 2021). The number of these workers declined rapidly in 2020 - reasons such as concerns about SARS-CoV-2 infection, a preference for home offices or the termination of employment relationships (Böhm, 2021). However, the main reason, which in many ways influenced the previous ones, was the desire to minimize the number of people crossing the border (Novotny, 2021). The restrictions associated with border restrictions are a typical ambivalent impact of the COVID-19 pandemic. On the one hand, they are a major tool for countries seeking to insulate themselves from the external effects of pandemics and new variants of the virus, thereby pursuing the positive goal of protecting the population of a given country. On the negative side, there are the inherent economic problems associated with the restricted international movement of people, but also of capital, goods and services. The application of this policy inevitably leads to the debate as to whether the effects of closed borders do not, in the end, pose greater risks and damage than the potential spread of the virus in society. "Never before has the world faced such a direct conflict between sustaining livelihoods and saving lives, a conflict fraught with ethical, moral, economic and life challenges and pitfalls" (Jain et al., 2022). Over time, this has raised the question of how resilient countries' labour markets are to the impacts of the COVID-19 pandemic (Milanović et al., 2023).

Epidemiological realities at critical stages of the pandemic limited the scope for protracted decision-making. Thus, despite the outlined problem of benefits and risks of measures, most countries focused on developing a legislative framework to implement the programmes and tools needed to minimize further impacts and address emerging problems. In practice, this has meant more intensive government activities oriented towards direct financial support for selected actors in the labour market. Governments that prioritized wage subsidies over other forms of income support were able to reduce labour market instability (Soares & Berg, 2022). It is important to note here that the effects of the pandemic varied across countries, which is related to country heterogeneity. Thus, the impacts of the COVID-19 pandemic were also heterogeneous, e.g. depending on demographic groups (Cortes & Forsythe, 2022). This forced country governments to take a differentiated approach to developing relevant policies - indeed, the target group of beneficiaries was heterogeneous. For example, the most vulnerable groups of workers (young people, temporary workers, low-skilled workers, workers without the possibility to work from home, etc.) were better protected by government policies against

labour market recessions (Casarico & Lattanzio, 2022). Of course, they are only talking about a period when aid and support schemes had already been in practice for some time.

The COVID-19 pandemic has restructured labour markets with lasting consequences for both firms and workers. In 2020, there was a change in the composition of employment as low-wage workers - many of whom were employed in hard-hit sectors with limited teleworking opportunities - were disproportionately affected by job losses (ILO, 2022). Of the 43% of small businesses that closed during the first weeks of the pandemic, most of these were businesses where introducing home office elements was not feasible (ILO, 2022). It is evident that the work of low-skilled workers is heavily dependent on the specific location of the workplace, and thus, businesses with this type of workforce were more severely affected by the pandemic, which also had an impact on the employees themselves. Particularly affected were temporary workers (i.e. fixed-term contracts, short-term contracts, performance contracts, etc.), workers in low-paid occupations (i.e. low-skilled) and migrants (ILO, 2022). Workers laid off during the pandemic were most often women, migrants, and workers with less than secondary education (Beland et al., 2022). A specific group heavily affected by the COVID-19 pandemic was young workers - a trend confirmed in Northern Europe, where their share of total job losses was as high as 77% in 2020 (ILO, 2022). The authors of a study carried out in Italy also find the same findings - they identify the key groups at risk in the labour market: young workers, low-skilled workers, those on fixed-term contracts and those who do not have the option of working in a home office (Casarico & Lattanzio, 2022).

Labour market inequalities have increased, especially for women, young people, the less educated, lower earners and workers on temporary contracts (Soares & Berg, 2022). A group of authors from Singapore also note existing differences between the impacts of the pandemic on young workers with lower and higher wages, with the lower earning group more likely to experience job loss, a drop in wages, but also feelings of frustration, discouragement, or even chronic anxiety disorders (Ng Yue Hoong al., 2022). The assumption of a lower resilience of the secondary labour market to the impacts of the COVID-19 pandemic is confirmed by other studies. Occupations at higher risk of automation show a more pronounced decline in employment (Egana-delSol et al., 2022). According to them, this also explains the question of why emerging economies are more significantly affected from a labour market perspective compared to developed countries. In emerging economies, it is still the secondary labour market that is still the majority, with a predominantly low-skilled labour force. These workers generally occupy the jobs most vulnerable to the automation of production. If one adds to this the assumption that crises are a catalyst for technological change (Kopytov et al., 2018), which is also confirmed by the research of other authors (e.g., Jaimovich & Siu, 2020; Micco Aguayo, 2019), then the threat of automation to low-skilled labour is very intense in times of crises. The pandemic has precipitated several technological changes related to automation (using chatbots, virtual agents, automated financial messaging, and intermediaries in the supply or purchasing chain) (Autor & Reynolds, 2020). However, to see increasing automation in times of crisis only as a factor threatening a certain part of the workforce would be too one-sided. Indeed, the COVID-19 pandemic has thus also contributed to optimizing workloads and reducing the amount of unnecessary work in many large and small business companies and public institutions (Dvořák et al., 2020).

However, the efforts to stabilize the epidemiological situation in the countries, coupled with, among other things, the closure of businesses, inevitably implied a deterioration in many macroeconomic indicators. As Bloom et al. (2023) reported, the COVID-19 pandemic generally led economies to decline, negatively affecting living standards, public finances and productivity. Balkan & Akyuz (2023) recall the intense deterioration and identify the decline in economic growth and increasing budget deficits of countries as reasons for this. For example, according to an international study, the pandemic, in the context of disrupting the continuity of economic processes, had a significantly negative impact on productivity and labour costs - the cumulative global economic loss amounted to roughly $10.4 trillion in 2020-2022, of which the economic losses of the EU, the US and China amounted to 30.44%, 18.74% and 15.44%, respectively (Cui et al., 2023).

Halmai (2021) warns of the risk that the decline in investment and other labour market problems will have a long-term impact on economic growth and productivity, ultimately exacerbating existing inequalities and negatively affecting social cohesion across social classes. On the other hand, the pandemic may also accelerate the economy and its growth - this is particularly linked to the accelerated implementation of new technologies.

In addition, a more efficient health system can be envisaged, as such a crisis requires increasing investment in health care. Indeed, all policies implemented during the pandemic were dependent on, among others, the number of infected (Kapička, Rupert, 2022).

Teruel et al. (2023) investigated the correlation between the adoption of digital technologies and the response of firms to the COVID-19 pandemic, considering several factors, including the productivity of the firms in question, their level of digitalization, and the period of economic growth prior to the crisis. They found that firms with higher levels of productivity were less likely to reduce headcount - a finding that the authors argue is valid in both the short and long term. Błaszczyk (2023) examined the effects of the pandemic in Poland compared to the EU and found a sharp deterioration, while the main determinants of this situation were a decline in economic growth and an increase in the budget deficit, with relatively stable unemployment and inflation.

Based on the studies cited and the views presented, it can be concluded that individual authors have examined the various areas of the labour market and macroeconomic development in isolation rather than as a complex area of the economy and society. They focused, for example, on labour productivity, GDP growth, employment, the skills structure of workers, changes in how work is organized or the impact of the pandemic on the development of ICT skills. However, assessing overall labour market flexibility in response to the anti-pandemic measures taken based on separately assessed data is impossible. The only way to evaluate large amounts of disparate data in a mass and simultaneous way is to apply multivariate statistics. For this purpose, the multicriteria standardized variable method was chosen, which makes it possible to measure the overall labour market flexibility in a limited time and space using dynamic values of indicators.

3. Research objective and methodology

The main objective of this study is to identify the labour market with the highest positive flexibility in relation to the pandemic impacts (i.e. with the lowest negative and highest positive fluctuations of the examined indicators) based on the integration of sub-indicators and thus reveal the critical factor that fundamentally reduces the resistance of the labour market to negative pandemic externalities. With the possible analogy of the last pandemic crisis in the future, this study can contribute to a better orientation when making important decisions. Revealing the critical factor will help direct adequate responses to areas that fundamentally distort the flexibility of the labour market and, thus, its overall resilience. Considering the current global interdependence, global threats and the last pandemic experience, the risk of a new pandemic appears to be a completely realistic eventuality of future developments.

To identify the most positively flexible labour market, a number of individual labour market indicators need to be evaluated in aggregate. The calculation of the overall labour market flexibility during the duration of the pandemic is conditional on knowing the flexibility in the active phases of the crisis - for this reason, the results first go through the individual flexibility calculations in each wave. The overall flexibility results for the entire duration of the COVID-19 pandemic form only the final part of the research. Based on the studies presented in the previous section and the intention to make the results as comprehensive as possible, eight labour market indicators were selected to illustrate labour market developments from the perspective of different areas. The list of indicators is contained in Table 1.

Table 1. List of selected indicators

No.	Indicator	Acronym	Source of data	Input value
1.	gross domestic product	GDP	Eurostat	current prices in million €
2.	employment	EMP	Eurostat	percentage of 15–64-year-olds
3.	job vacancy	JV	Eurostat	number of job vacancies
4.	inflation	INF	OECD	consumer price index (CPI)
5.	labour costs	LC	Eurostat	labour cost index (LCI)
6.	work productivity	WP	Eurostat	GDP per hour worked in €
7.	part-time work	P-TW	Eurostat	number of part-time workers
8.	COVID-19 cases	CC-19	WHO	number of Covid-19 cases

Source: own creating

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Since the study works with a wide range of labour market indicators and with different countries, it requires appropriate unification and comparability of the included indicators.

The methodological procedure for the transformation of input data was as follows. First, we converted the input data that did not meet the condition of comparability (due to the different number of inhabitants of the countries or their size) into relative data, which are more suitable for international comparison as follows:
- gross domestic product as GDP per inhabitant of the given country,
- job vacancy as the number of vacant jobs per 100,000 economically active inhabitants of the given country,
- part-time work as the number of part-time workers per 100,000 employed persons in a given country,
- work productivity as the volume of GDP produced in one hour converted per inhabitant of the given country,
- COVID-19 cases as the number of people infected with the disease COVID-19 per 100,000 inhabitants of a given country.

Subsequently (apart from the CPI and LC indices) we recalculated these relative values of the indicators into basic indices according to the formula as follows:

$$S = \frac{X_t}{X_z}$$

where:
Xt – the value of the variable X in period t
X_z - the value of the variable X in base period z (the first quarter of 2020)

The exceptions are inflation and labour costs - in the case of the presented mix of indicators - in this case, the values of the year-on-year percentage change have been retained, as further recalculation is not necessary in view of the relativity of the data and the dynamics of the indicator (the value already meets the parameters of relativity and dynamics when reported, unlike the other indicators). The use of a fixed-base index reflects the intention of the researchers of the present study. The aim is not to identify the best but the most flexible labour market - i.e. the market that, in aggregate, has experienced the best flexibility. The use of a fixed-base index makes this possible, as it does not work with the primary values of the indicators, but with their percentage changes compared to a certain fixed-base period.

For the integration of the sub-indicators, the standardized variable method was chosen. Multicriteria methods, which include the normalized variable method, have been used in the past to assess the performance of enterprises, and later they began to appear in the assessment of the economic level of different units. In many cases, it is not enough to observe only one statistical feature or indicator, but it is necessary to examine the observed entity from several aspects. The characteristics of these methods - universality of use, comparability of results or complexity of findings - led the authors' team to the idea of using their potential also in the assessment of labour market flexibility. With a similar intention, the standardized variable method was applied in a study from 2020, dealing with socio-economic and demographic indicators, where the aim was to identify the arrangement of countries in the EU according to these indicators (Hurbánková, 2020). However, precisely due to the identified research gap, the use of this type of methods is currently sporadic; from this perspective, the use of the standardized variable method represents an opportunity to obtain previously unknown data and a more realistic picture of the labour market based on more than one indicator.

The application of the standardized variable method results in a synthetic indicator for each of the countries studied for a specific quarter. The country with the highest value of the synthetic indicator (the so-called integral indicator) represents the economy with the highest labour market flexibility in the quarter under consideration. For completeness, the calculation of the standardized variable method is carried out separately in three quarters that represent the intense phases of the pandemic (the so-called waves): these are the second quarter of 2020 (2020-Q2), the first quarter of 2021 (2021-Q1) and the first quarter of 2022 (2022-Q1).

For the application of the chosen multicriteria method, the mathematical-statistical methods arithmetic mean and standard deviation were also used.

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We calculate the standard deviation according to the formula:

$$s_{xj} = \sqrt{\frac{1}{n}\sum_{i=1}^{n}\left(x_{ij} - \bar{x}\right)^2} = \sqrt{s_x^2}$$

The calculation of the two aforementioned methods provided the necessary source data for further calculation of the integral indicator values (both the arithmetic mean and standard deviation were calculated for each of the eight selected indicators and each of the three pandemic waves).

Subsequent data processing was carried out according to the formulas of the normalized variable method, which belongs to the group of multicriteria methods: for its calculation we needed to know the formula for the maximizing indicators (GDP, EMP, WP, P-TW indicators):

$$u_{ij} = \frac{x_{ij} - \bar{x}}{s_{xj}} \; x\, 100$$

and minimizing indicators (indicators JV, LC, CC-19):

$$uij = \frac{\bar{x} - x_{ij}}{s_{xj}} \; x\, 100,$$

where:

- x_j is the arithmetic mean of the values of the *j-th* indicator,
- x_{ij} is the value of the *j-th* indicator in the *i-th* country,
- s_{xj} is the standard deviation of the *j-th* indicator,
- u_{ij} is the rating of the *i-th* country for the *j-th* indicator.

The calculation of the value of the integral indicator itself subsequently works with the transformed values of the indices, where the result of the examined countries represents a simple arithmetic average of the minimizing and maximizing indicators of the given country in the given quarter according to the formula:

$$\bar{x} = \frac{\sum_{i=1}^{n} x_i}{n}$$

The specific indicator within the minimizing and maximizing indicators is inflation, which was classified as one or the other group according to whether it was positive or negative.

With the aim of objectivity and relevance of the results, the following countries were selected: Czech Republic (CZ), Germany (DE), Poland (PL) and Slovakia (SK). These are countries with similar culture, geographic location, composition of the national economy, and legislative frameworks and processes. They are also strongly interconnected business partners. In addition to the above-mentioned reasons, the authors' collective also considered the fact that the representation of European local research in scientific databases is rather marginal when choosing countries. This represents a limited possibility to evaluate the effectiveness of individual national policies and to identify appropriate and inappropriate instruments for similar situations in the future.

The input data are drawn from Eurostat, OECD and WHO databases and are quarterly values in the interval 2020-Q1 to 2022-Q2, where the peaks of all three pandemic waves are dated. The starting value of the indices (base period) is the first quarter of 2020, i.e. j. the first quarter of the outbreak of the COVID-19 pandemic in these countries.

The key findings and outputs of the empirical analysis are presented in the following section of this study.

4. Results and discussion

The application of the methods and the interpretation of the results are presented according to the sequence of the individual pandemic waves for clarity. The base period is the first quarter of 2020.

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4.1 The first wave of the COVID-19 pandemic - 2020-Q2

Table 2 below shows the values of the of fixed-base indexes for each indicator in each country, including the calculated value of the arithmetic mean and standard deviation over the period of interest (2020-Q2).

Table 2. Values of the fixed-base indexes and inflation rates in selected countries in the period 2020-Q2 and the values of the arithmetic mean and standard deviation for the indicators

Indicator/Country	GDP	EMP	JV	INF	LC	WP	P-TW	CC-19
CZ	93,38	99,06	92,62	-6,40	136,20	107,29	92,81	172,97
DE	90,82	99,57	68,78	-8,20	121,90	94,46	97,41	96,84
PL	90,89	99,27	106,36	-7,80	127,50	117,01	94,21	634,11
SK	99,50	98,24	86,05	-4,60	129,00	103,56	106,02	230,87
arithmetic mean	93,65	99,03	88,45	-6,75	128,65	105,58	97,62	283,70
standard deviation	4,0777	0,5722	15,6100	1,6279	5,8881	9,3326	5,9279	239,9697

Source: Eurostat, OECD, WHO, own calculations

The calculated values presented in Figure 1 represent a dimensionless number that is an integral indicator covering all the areas under study. Its calculation works with the values presented in the previous table, with a slight variation for the maximizing and minimizing indicators respectively.

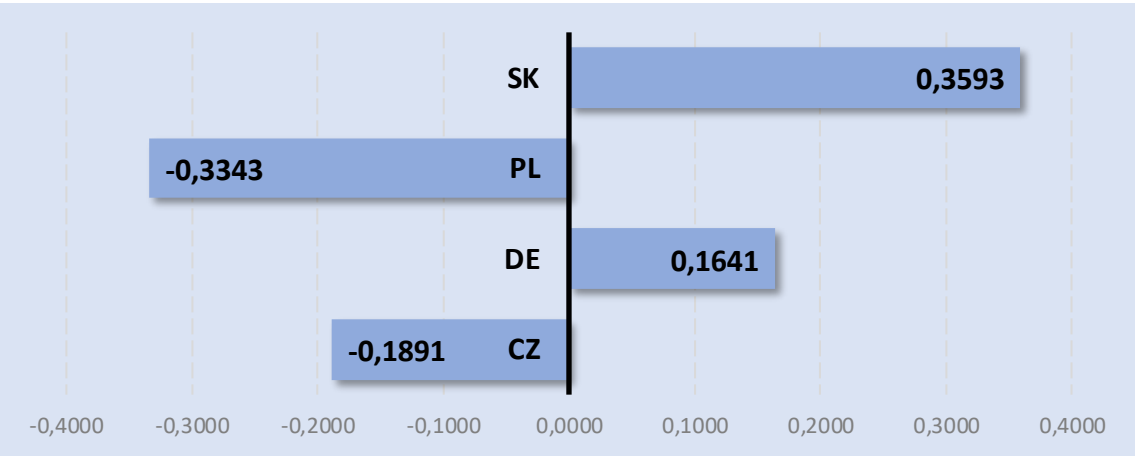

Figure 1. Integral indicator values for selected countries in 2020-Q2

Source: Eurostat, OECD, WHO, calculated by the authors

Figure 1 shows that the highest value of the integral indicator, and thus the most positively flexible labour market, during the first wave of the COVID-19 pandemic was achieved by the Slovak Republic, with a score of 0.3593. The second highest value achieved was 0.1641 points for Germany, followed by the Czech Republic with -0.1891 points and Poland with the lowest value, -0.3343 points. The use of benchmarks allows tracking labour market flexibility and dynamics, as it works with values that are a percentage change compared to the fixed-base quarter (2020-Q1) of each indicator. Simply put, the highest value of 0.3593 points in the case of Slovakia means that in the second quarter of 2020 (2020-Q2), it experienced the smallest negative and the largest positive fluctuations in the eight indicators tracked - depending on whether it was a minimizing or maximizing indicator - compared to other countries. This result was mainly due to partial positive results in the indicators GDP, inflation, and number of part-time jobs. In Poland, the negative result for the integral indicator was mainly due to the indicators number of vacancies and number of cases of COVID-19.

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4.2 The second wave of the COVID-19 pandemic - 2021-Q1

Table 3 shows the values of the benchmark indices for the individual indicators in the selected countries, including the calculated value of the arithmetic mean and standard deviation over the reference period (2021-Q1).

Table 3. Values of the fixed-base indexes and inflation rates in selected countries in the period 2021-Q1 and the values of the arithmetic mean and standard deviation for the indicators

Indicator/Country	GDP	EMP	JV	INF	LC	WP	P-TW	CC-19
CZ	99,32	98,40	85,16	-0,70	125,90	107,73	90,52	17575,78
DE	99,44	99,93	92,17	7,80	99,40	103,57	98,36	1107,80
PL	100,03	101,17	143,79	8,50	130,60	122,13	91,02	27341,03
SK	100,81	99,85	85,86	-2,10	121,10	104,26	97,59	75026,43
arithmetic mean	99,90	99,84	101,74	3,38	119,25	109,43	94,37	30262,76
standard deviation	0,6844	1,1347	28,2053	5,5506	13,7900	8,6652	4,1755	31745,3113

Source: Eurostat, OECD, WHO, own calculations

Based on the data presented in the previous table, the values of the integral indicators have been calculated for each country. The result is Figure 2, which also identifies the change in the notional ranking of countries in terms of the value of the standardized variable in the period 2021-Q1 compared to the previous (first) wave.

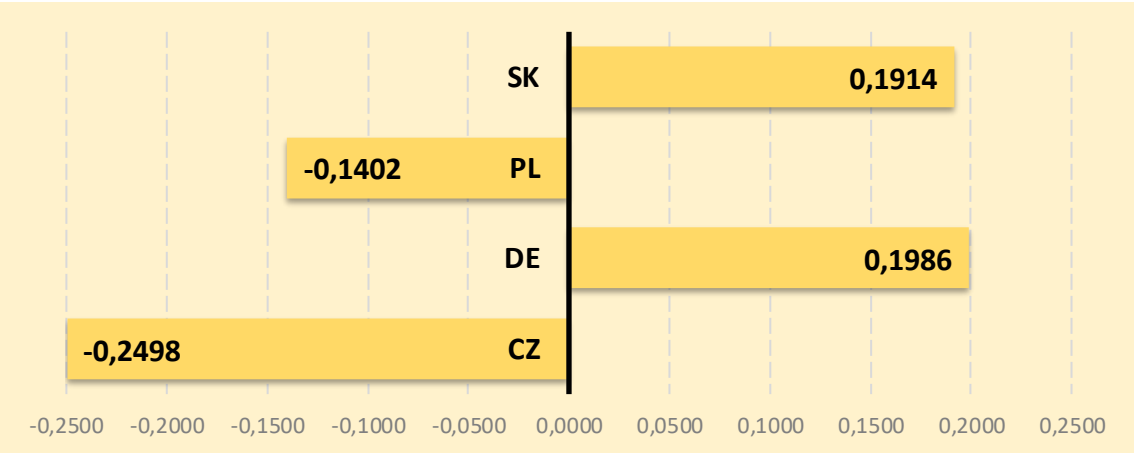

Figure 2. Integral indicator values for selected countries in 2021-Q1

Source: Eurostat, OECD, WHO, calculated by the authors

According to Figure 2, the highest value of the integral indicator during the second wave of the COVID-19 pandemic was reached by the labour market in Germany, at 0.1986 points, closely followed by the Slovak labour market (0.1914 points). Poland and the Czech Republic scored -0.1402 and -0.2498 points respectively. In the case of Germany, its position (as the most positively flexible labour market) was mainly helped by the indicators of labour costs, the number of part-time workers and the number of COVID-19 cases. The Czech Republic's negative ranking was due to negative developments in the indicators of GDP, employment rate and the number of part-time workers.

4.3 The third wave of the COVID-19 pandemic - 2022-Q1

The last period in which the partial results of the selected economies are integrated through the application of the normalized variable method is the first quarter of 2022 (2022-Q1), corresponding to the so-called third wave of the COVID-19 pandemic. At the same time, it is the last period during the duration of the crisis under study in which statistically significant shifts in the development of the indicators under study occurred solely due to

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the impact of the pandemic (in the following quarters the socio-economic development, and thus the situation on the labour market, was already determined by other crises, while the impact of the pandemic itself was only marginal).

Table 4. Values of the fixed-base indexes and inflation rates in selected countries in the period 2022-Q1 and the values of the arithmetic mean and standard deviation for the indicators

Indicator/Country	GDP	EMP	JV	INF	LC	WP	P-TW	CC-19
CZ	116,79	100,27	90,19	23,20	132,90	111,32	94,44	29239,51
DE	107,99	103,29	142,40	26,30	102,20	106,01	101,54	14486,39
PL	114,38	103,80	207,45	18,00	144,70	130,69	88,52	43444,19
SK	110,17	103,82	117,93	14,30	132,50	105,30	97,59	181473,20
arithmetic mean	112,33	102,79	139,49	20,45	128,08	113,33	95,52	67160,82
standard deviation	3,9807	1,7030	50,0752	5,3420	18,1546	11,8824	5,4950	77119,8633

Source: Eurostat, OECD, WHO, own calculations

By analogy with the previous sections, Table 4 presents the input data for the calculation of the standardized variable method. Based on the summarised data, the calculation of the values of the integral indicators for each country is again proceeded - thus, Figure 3 reflects the measured values in the last recorded pandemic wave (2022-Q1) and identifies a notional change in the ranking of the countries.

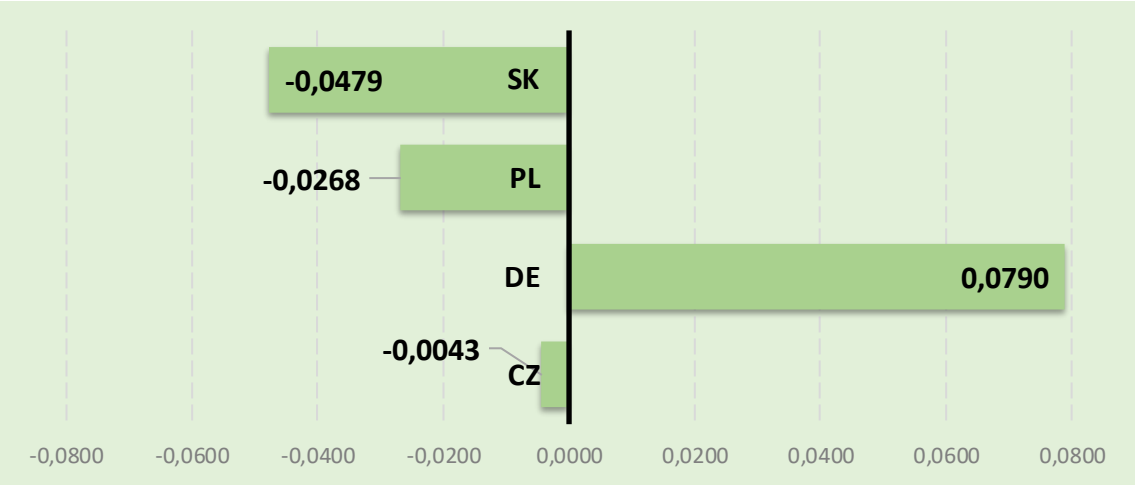

Figure 3. Integral indicator values for selected countries in **2022-Q1**

Source: Eurostat, OECD, WHO, calculated by the authors

Germany was again the labour market with the highest score on the integral indicator during the last recorded wave of the COVID-19 pandemic, with a score of 0.0790 over the period. All three other countries scored negative values. The Czech labour market was closest to Germany's level, with a score of -0.0043, followed by Poland (-0.0268). Slovakia came in last place, where the value of the integral indicator was -0.0479 points. Slovakia's position was mainly driven by negative sub-indicators on labour productivity and the number of COVID-19 cases. Labour costs, the number of part-time workers and the number of COVID-19 cases developed in favour of the German labour market, which thus became the most positively flexible in the third wave.

Comparisons of countries' integral indicator values between pandemic waves have not been made. This is because each quarter studied behaves as a separate calculation in terms of the application of multicriteria methods, i.e. there are no boundaries to the imaginary interval (the highest and lowest calculated values are always a reflection of the fixed-base data of a given quarter, and these differ from quarter to quarter). Thus, if Slovakia scores 0.3593 in 2020-Q2 and 0.1914 in 2021-Q1, this does not mean that it has statistically

underperformed by the difference between the two values - each value is based on different input data and comparisons.

4.4 Total results (2020-Q1 – 2022-Q2)

Table 5 shows the average values of the integral indicators over the entire pandemic period, represented by three waves. The normalized variable method identifies Slovakia as the statistically best labour market, with an integral indicator value of 0.1676 points, followed by Germany (0.1472 points) by a slight margin of 0.0204 points. In the negative range, the Czech Republic (-0.1478 points) and Poland (-0.1671 points) were ranked in the same order, with a difference of up to 0.3347 points compared to the best value. Overall, the highest integral indicator was 0.3593 points (Slovakia, 2020-Q2) and the lowest integral indicator was -0.3343 points (Poland, 2020-Q2); thus, the distance between the interval boundaries for this value was up to 0.6936 points.

Table 5. Average values of integral indicators of countries during all pandemic waves

Country	the average value of the standardized variable method	difference compared to the best result
CZ	-0,1478	-0,3154 p.
DE	0,1472	0,0204 p.
PL	-0,1671	-0,3347 p.
SK	0,1676	best result

Source: Eurostat, OECD, WHO, own calculations

The position of Slovakia in the analysis suggests that our labour market has responded to the pandemic and its resulting impacts at a comparable level to other countries and even performed statistically better in several indicators, especially during the first wave (2020-Q2). This finding is in line with the results of the analyses of the Institute of Economics of the Slovak Academy of Sciences, which generally describe the impacts of the crisis on the Slovak labour market in that period as smaller than expected and the labour market response as milder than in past economic shocks (Frank & Morvay, 2021).

Discussion

Individual national governments have undoubtedly had a significant impact on the fluctuations of the indicators. It is the importance of the state as a labour market regulator, or the link between state interventions in the labour market and its evolution during a pandemic, that has been demonstrated by several authors (e.g. Milanović et al., 2023; Spencer et al., 2022; Aldieri et al., 2022; Soares & Berg, 2022; Ingham, 2022; Adamowicz, 2022). Other studies have linked the intensity of the pandemic's labour market impacts to the nature of the labour force - consistently arguing that labour markets of countries with a higher share of low-skilled workers were more negatively affected by the COVID-19 pandemic than more flexible labour markets (Cortes & Forsythe, 2022; Kramer & Kramer, 2020; ILO, 2022; Beland et al., 2022; Casarico & Lattanzio, 2022; Egana-delSol et al., 2022). The present study confirms this assumption since the lowest level of labour productivity in the period under study was recorded in Poland, which ranked last in the average results of the standardized variable method (lowest value of the integral indicator).

At this point, it is worth recalling that the analyses' outcome identifies the resilience of the labour market response to an unexpected crisis, rather than long-run developmental differences in indicators relativized in different ways. Therefore, the significance of the present study for science and practice lies primarily in its approach to the use of multicriteria methods, where otherwise, the standard static expressions of indicators have been replaced by a dynamic variant in the form of a base index. The results obtained using multicriteria methods allow the identification of the country with the most effective macroeconomic measures during the COVID-19 pandemic, which would not have been possible if individual developments in labour market indicators had been examined (as they would necessarily only reflect the impact of the measures on a given area, not on the labour market as a whole). In turn, the indicators' dynamic expression ensures the measurement's objectivity as it reflects the change from the base period. From a practical perspective, the most effective measures during the

COVID-19 pandemic were those implemented during the last wave in Germany. It can thus be assumed that in the case of a similar event, they would have protected the labour market, characteristic of the selected four countries, most effectively.

The present study also has its limitations. The final output of the implementation of the standardized variable method must be viewed strictly in terms of the selection of sub-indicators, the countries, the quarterly periodicity, and finally, the calculation methodology itself - a different composition of indicators, objects compared, or data processing method may lead to different results. To maintain the objectivity of any comparison of results with current labour market changes, it is therefore necessary to strictly be based on this study's research settings.

Conclusions

Interpretation of the results of the application of the standardized variable method indicates that during the observed intervals (individual waves of the COVID-19 pandemic) the labour market situation in the Czech Republic, Germany, Poland and Slovakia was very similar in terms of the regularities of the development of individual indicators. In all four countries, for example, during the intense phases of the pandemic, there were declines in GDP, employment, rising inflation and labour costs, and fluctuations in labour productivity. Job vacancies, the number of part-time workers and the number of people infected with COVID-19 have followed a similar pattern, with some variations. If we are talking about finding some similarities in the evolution of the indicators under study, this is certainly no longer the case for the quantitative nature of their shifts. It is thus evident that there were differences between countries (in the epidemiological evolution, in the response to the crisis, in the economic health of the private sector, etc.) that had a major impact on the evolution of the labour market during the crisis.

Germany is the country where our study has identified the most positively flexible labour market now. In the most recent (third) wave (2022-Q1), the value of the integral indicator reached 0.0790 points, the highest among the four countries compared. For the average values of the countries' integral indicators (average of the first, second and third waves), Slovakia achieved the highest value of the integral indicator (0.1676 points), which was mainly due to the high score difference during the first wave (2020-Q2). The country with the worst average result within the comparison set was Poland, whose average integral indicator reached -0.1671 points (the difference from the highest achieved value was up to 0.3347 points).

Based on the multicriteria analysis conducted, it is possible to identify labour productivity as the main critical factor among the eight indicators examined. The least positively flexible labour market in Poland was characterized by the lowest level of labour productivity among the compared countries during the individual pandemic waves (labour productivity here reached on average 80.9% of the Slovak, 66.2% of the Czech and only 34.1% of the German labour productivity level). As lower levels of labour productivity are associated with a higher share of low-skilled labour, the findings of this study confirm the assumption of greater vulnerability of this type of labour market. Conversely, labour markets with a higher share of highly skilled labour become more stable and are more flexible in adapting to negative externalities, such as the COVID-19 pandemic. This means that decisions taken at the national and international level should, in a comparable situation, be directed mainly towards areas that stimulate the growth of the skill level of the future and current workforce. However, it is obvious that the experience gained and the indefinite time that separates society from the next crisis should lead to adequate decisions and changes today. Initiatives in this area can help to reduce the distorting effects of future crises on labour markets and thus increase their resilience.

Efforts to comprehensively assess the labour market during each wave of the pandemic inevitably generalize to individual developments in input indicators. To some extent, this may obscure the outbreak of problems in specific areas and their severity. On the other hand, tracking the evolution of individual indicators without some form of integration cannot provide a comprehensive view of the evolution of a given labour market, as it is always only one aspect of the market. The integration of multiple data should therefore be seen as an opportunity to look at the labour market under analysis with an emphasis on its overall evolution, considering many otherwise relatively separate areas and processes (e.g. at-risk groups of workers, hiring and firing of

workers, labour market performance, labour market flexibility or macroeconomic developments). As the study focuses on the changes caused by the pandemic, the indicator of the number of cases of COVID-19 captured in the analysis also illustrates the epidemiological factor of the crisis under study.

Unanswered questions remain in areas of the study that could not be pursued further due to objective limitations. It is clear from the research results that Germany has had the most effectively protected labour market, at least in the recent period - but it is unclear which policies and instruments have contributed most to this outcome; indeed, many of the measures have been identical across countries. It is also uncertain whether the sample of indicators is hypothesized to be influenced by a latent variable that acted in parallel with the impact of the COVID-19 pandemic. As the pandemic itself is a non-cyclical and sudden event, the applicability of the experience to future work is questionable. In the case of Slovakia, although, on average, it achieved the best result, it would be useful to identify the state decisions that caused the dramatic drop in indicators in the last wave. There is also the possibility of recalculating the indicators after further revision of the data in statistical databases, which may affect the overall results of the standardized variable method, or of verifying the results of this study by applying a different multicriteria method. These and many other unanswered questions or problems outlined are potential suggestions for further scientific research.

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ON SOME ASPECTS OF THE GROWING POPULARITY OF CONSPIRACY THEORIES*

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Abstract. This study aims to investigate some aspects that contribute to the growing popularity of conspiracy theories in the 21st century. They have gained so much popularity among the public in recent years that an age of conspiracies. Conspiracy theories are increasingly responding to several socially significant events occurring around us, coming up with an alternative explanation, especially for those political, social, tragic, or other events that concern a more significant number of people. Thanks to the rapid expansion of access to the Internet and rapid development in information and communication technologies, systems, and means, conspiracy theories are significantly penetrating the mass media and especially the sphere of new media. Currently, social networks are the medium with the most incredible spread of various conspiracy theories. It is one of the primary reasons why conspiracy theories have become the subject of our scientific interest. Using relevant methods of qualitative theoretical scientific research, in this work, we present our research findings and a view on some selected aspects contributing to the growing popularity of conspiracy theories to readers from the professional and lay public.

Keywords: conspiracy theories; growing popularity; aspects; social networks; Internet

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1. Introduction

In the last few years, we have increasingly encountered various conspiracy theories that respond to several socially significant events around us (Radnitz, 2022; Harris, 2022; Stamatiadis-Brehier, 2023). Immediately after their media coverage, a series of significant events are the object of alternative explanations that challenge official positions or explanations. Conspiracy theories come up with an alternative explanation, especially for those events that involve a more significant number of people. The belief that conspiracies are happening is based on human

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mistrust and doubt. Conspiracy theories also include a certain amount of mystery, which makes them even more attractive. Among several, let's mention, for example, the assassination of President John F. Kennedy, the events of September 11, 2001, the global financial and economic crisis, the disappearance of Malaysia Airlines flight MH370, the origin of the refugee crisis or the spread of the coronavirus around the world. Soon after their publication, these and other events received "new explanations" that sought to reveal their "true meaning, origin or causes".

Conspiracy theories today represent a phenomenon that, especially since the terrorist attacks in the United States of America that happened on September 11, 2001, has gained considerable popularity and has begun to permeate society. This situation has stimulated research into conspiracy theories and the emergence of publications that deal with the popularity of these theories and their impact on society. It is, therefore, a bit surprising that this topic, with exceptions (Panczová, 2017), is absent from professional literature written in Slovak that would deal with this phenomenon. This absence was one of the inspirations for choosing this topic for our research. This situation changed only in the 21st century.

However, the need for research in this area is now indisputable. Conspiracy theories and the belief in these theories represent a phenomenon that significantly impacts contemporary society. Conspiracies have had and still influence the content component of the production of popular culture. They also considerably penetrate the field of mass media and especially the field of new media.

Today, social networks are the medium with the most incredible spread of various conspiracy theories. In the same way, society influences how a given population approaches conspiracy thinking and positions itself to believe in these theories. The topics mentioned above have become the subject of our interest. Therefore, in this article, using relevant qualitative theoretical scientific research methods, we bring our findings and a view of some selected aspects closely related to the issue of conspiracy theories to readers from the professional and lay public.

2. The spread and rise in popularity of conspiracy theories

An essential aspect of conspiracy thinking, and the theories based on it, is the method of their dissemination, that is, how their creators can spread their theory to the rest of the population. Although conspiracy theories have existed for a long time, new media is crucial to their spread and popularity. Over time, interest in conspiracy theories has also been strengthened by the mass media - newspapers, television broadcasts, and cinematography (Arnold, 2008, p. 9). While for the 50s and 60s of the 20th century, television broadcasting and the production of the film industry were an essential factor in the spread of conspiracies, for the 21st century, the Internet and its more massive expansion, as well as the mass active use of social networks (Figure 1), have a crucial influence. Thanks to them, supporters of conspiracy theories have gained a powerful tool to spread their theories and to band together (Byford, 2011, p. 11).

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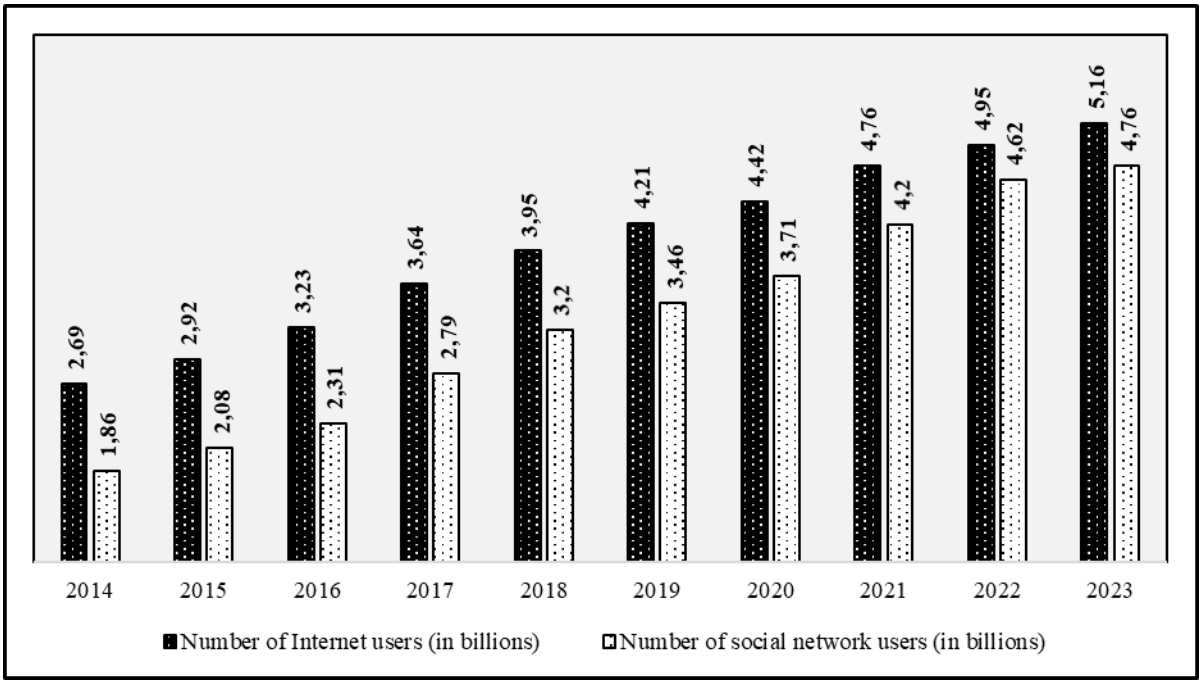

Fig.1. Overview of the growth of the number of Internet and social network users over the last 10 years (in billions)
Source: DataReportal (2023)

A significant influence on the spread and rise in popularity of conspiracy theories was also had by substantial events with a societal impact, which took place under circumstances that part of the population considered unclear and not very convincing, thus arousing interest in their alternative interpretation or explanation. It was, for example, the landing of Apollo on the moon, the murder of John Fitzgerald Kennedy, or the fatal car accident of Princess Diana. A national poll conducted by the New York Times in 1992 revealed that only 10% of the American population believed the official version that the assassination of Kennedy was the result of an independent individual action by Lee Hervey Oswald. At the same time, 77% of respondents were convinced that this act was the work of a more significant number of persons, and 12% per cent of respondents said they did not know or did not want to answer (Krauss, 1992).

Time also plays a vital role in spreading conspiracy theories and their rise in popularity in society. That is, the amount of time that has passed since the event that is the object of the conspiracy theory. As already mentioned, in 1992, only 10% of respondents believed in the official version of the assassination of the American president, while in 1966 (3 years after this event), 36% believed in the official version; during surveys carried out later, 11% of respondents in 1976 and 1983, and 13% during a study in 1988. So, as is clear, the number of sceptics rejecting the official version increased noticeably 13 years after the assassination, and until the 1990s, their number remained constant at similar numbers (Goertzel, 1994). This increase in belief in the conspiracy theory was noted even though, in the years following the assassination, more and more evidence was collected in favour of the version that Oswald was behind the assassination alone.

Let's stay with the assassination of J.F. Kennedy. This act significantly shifted how the American public perceived conspiracy theories. The catalyst unleashed another flurry of conspiracy theories in American culture, primarily on television. Since then, the phenomenon of conspiracy theories has reached an iconic status, occupying people's minds with many other related thoughts and events. And so, at the beginning of the 21st century, conspiracy and

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associated theories became a fixed part of the culture. This was also reflected in the content of films, television shows, books, and political debates.

Belief in conspiracies has also reached the highest levels of American politics. This is evidenced by the fact that their belief that the assassination of Kennedy was not the work of one person but that it was a conspiracy was publicly expressed, for example, by former US Secretary of State John Kerry (Parade, 2013) or former Pennsylvania state senator Richard Schweiker. Schweiker said that "the investigative report of the Warren Commission was like a house of cards about to collapse" (Olmsted, 2010, p. 168). He came to this opinion after becoming a member of the Committee for the Investigation of Political Assassinations in 1976. As part of this committee, Schweiker was present at re-investigating the circumstances surrounding President Kennedy's death and the activist Martin Luther King (Simkin, 2014).

Participation in this committee left him with the impression that the investigators at the time did not do a faultless job and ignored specific facts. For example, they left out the possibility that the assassination was not the work of a lone shooter but could be an act behind a more significant number of people. Senator Richard Russell, who directly participated in the investigation of the Warren Commission as a member, had similar doubts. Although he signed the investigation's final report, the personal notes he wrote during the commission's investigation indicate that he had trouble accepting the lone gunman version of the assassination (Rome News Tribune, 1993).

These ambiguities and doubts, which accompanied the investigation of this highly publicized case in the media, convinced many people that the officially presented reports were not entirely sufficient to explain the events surrounding the assassination. This situation then led to a series of conspiracy theories that were supposed to clarify this act and bring a desirable explanation.

The process by which conspiracy theories moved from the fringes of interest to the centre of television attention was a gradual one. The permeation of American culture by conspiracies also had an impact on the politics of the time. During this time, several films and television productions appeared, which composed diverse themes that shaped the status of conspiracy theories even more strongly and sharply, whether based on historical facts or assumptions and fantasy. The emergence of many movies and TV shows with this basic theme could hardly have been coincidental (Arnold, 2008, p. 9).

In the late 1990s, but especially in the early 2000s, it was not unusual to come across conspiracies as an explanation for a wide range of political events that might otherwise appear completely ordinary. For example, some considered the source of President Bill Clinton's problems at the time to be a grand right-wing conspiracy. The liberal media were accused of conspiratorial intrigues, which were supposed to be behind the fact that the media image of global events does not match the conservative views of the population (Arnold, 2008, p. 10).

Regardless of the personal preferences and opinions of individuals, conspiracy theories have penetrated from the periphery of interest to the mainstream of American culture and politics as a powerful source of contemporary experience, but one that can sometimes be confusing and ambiguous (Shields, 2022, Jetten, Peters & Casara, 2022; Sunstein, 2023, Cassam, 2023; Dentith, 2023; Stokes, 2023).

3. Conspiracy theories in the context of new media

The Internet has significantly changed our perception and way of communication, as well as our access to information. Based on this, the Internet has also been a great asset to the field of conspiracy theories. The modern era, associated with intermingling cultures and the development of information and communication technologies, systems and means, enables a much more effective and widespread dissemination of information and

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communication between people. These aspects increase the influence of conspiracy theories on politics and society. With the declining influence of traditional gatekeepers of information, such as book publishers or film producers, it is easier than ever to access information considered unacceptable or even absurd by the mainstream. This phenomenon does not only bring positive aspects but can also provide specific threats and the risk of abuse (Hajdúková & Šišulák, 2022).

Therefore, in the next part, we will focus on the negatives that the Internet brings and new ways of spreading information that the Internet provides.

4. The threat of conspiracy theories in the context of new media

The Internet, various social networks, and their platforms offering the possibility of so-called microblogging have changed how it can access information and shape and spread the acquired knowledge further. Especially nowadays, viral social networks, where the users themselves create the content, provide a new dimension for observing how their content leads the interest of the visitors of the given servers to specific patterns of how they create, receive, and spread further information.

Despite the enthusiastic debate about how new technologies and media have sparked interest in public discussion on political or social issues, the role of the technical system and its influence on public opinion still needs to be determined. Although social media users are becoming more wary of unverified information, false, fabricated, altered, and alarmist news remains ubiquitous on the Internet. However, a large part of active users of social networks are still willing to believe them.

The World Economic Forum, in this regard, has called the spread of unofficial theories on the Internet "one of the biggest threats the world will face in the coming years" and said it could have serious real-world consequences (Howel, 2013, p. 11). Industry officials and event risk experts said the spread of fake news on the Internet ranks alongside economic crises, environmental degradation, and the spread of disease among the biggest global threats today.

The current situation regarding the Internet and social networks and the spread of fake news and conspiracy theories is compared to that of 1938 when the massive spread of radio receivers led to the confusion and fear of thousands of Americans during the broadcast of Orson Wells' radio play The War of the Worlds. Today, radio broadcasts would not confuse anyone, but this role has now been taken over by the Internet, especially social networks.

The World Economic Forum sees the main threat: the Internet has no regulatory mechanism for spreading false information. The viral spread of various conspiracy theories, disinformation and hoaxes on social networks negatively impacts individuals and society. A possible solution to this problem is limiting Internet anonymity. However, attempts that should have led to this or a similar decision are regularly met with a great wave of resentment (Wood, 2013). But how do we deal with the situation if the originator of disinformation is an international organization or even a state? Social networks and their users and content creators will have to develop an ethos of self-responsibility and healthy scepticism towards the content presented on the Internet, just as happened with radio listeners (World Economic Forum, 2013).

Spreading conspiracy theories, disinformation, hoaxes, and alarmist messages of various kinds on the Internet and social networks is currently a major problem. And that's because of the easy availability of this information, combined with the possibility that anyone who decides to present their opinions or articles publicly can do so at will with zero or only minimal control. This shows how the subject of these messages can quickly get their disinformation into broader awareness and harm someone through them. New media provide space for the

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expression and association of people who share the same interest in conspiracies and the possibility of deliberately spreading deceptive, invented altered or unverified news.

In this context, Solon (2014), as an illustrative example, points to an event when a message appeared on the Facebook social network during the Italian elections in 2013 that Italian senators voted for a law proposed by Senator Cerenga, the purpose of which would be to provide 134 billion euros to politicians whose party fails in the elections, to find a new job (Ascione, 2013). Even though the truth of this report could be questioned based on several points, for example, there is no senator named Cerenga, the Italian senate did not discuss or approve such a law, or the number of senators who were supposed to vote for the adoption of this law was higher than the total number of senate members, this news spread quickly. More than 350,000 users on Facebook shared it in the first month after its publication, and it even ignited civil unrest in several Italian cities. These events only prove the influence that new media has on the spread and perception of conspiracy theories today and also that their users generally approach them with a minimal degree of prudence (Visentin, Tuan & Di Domenico, 2021; Cinelli et al., 2022)

The authors tried to clarify new media's influence on the spread and acceptance of conspiracy theories in the work Collective Attention in the Age of (mis) Information. As part of this work, its authors conducted a study to understand the connection between political debate and information on the web. Part of the Facebook social network was analysed, and the findings showed that this network represents a complex set of social interactions. During the study, it was found that there is a debate based on news from different information sources (alternative or conventional) and that there is a strong interaction between political debate and information sources. Most of the activities on the mentioned social network contained the belief that the conventional media and their news are manipulated by other, superior entities, making the information they provided unreliable and biased. Out of the 1279 monitored users, 56% regularly followed alternative sources of information and were thus significantly more exposed to unsubstantiated claims and fake news (Mocanu et al., 2014). This study, therefore, shows that the greater the amount of unconfirmed information in circulation on the Internet, the greater the number of users who succumb to the distortion of this misinformation when choosing the content. With the penetration of the Intenet, the issue continues to deepen (Birchall & Knight, 2022; Gagliardone et al., 2023).

5. The impact of secularization on conspiracy thinking

Geertz (2000, p. 105) defined religion as "a system of symbols which establish strong, penetrating, and long- lasting moods and motivations in men by formulating concepts of a general order of being and endowing these concepts with such an air of reality that these moods and motivations seem uniquely realistic".

According to Wilson, religion is the ideology of a traditional society. In this society, religion provided signs and symbols to individual and group identity and legitimized the way of life. The goals of human life were expressed in transcendent terms, that is, in terms of moving beyond sensory experience, and every part of the life of traditional societies was permeated with religious symbolism. People used religion to gain strength and justification for their position, well-being or, on the contrary, poverty (Mužny, 1999, p. 62).

Thus, religion established societal interactions, defined moral norms, and explained various phenomena. But over time, with the progress of industrialization and the development of modern technologies, society moved from a religious level to a rational one to a certain extent. In contemporary society, religion is no longer the apparent originator of the functions above, and a process of social secularization is taking place. Secularization is when religious practices, consciousness and institutions lose their original social meaning (Mužny, 1999, p. 62).

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One of the possible reasons why contemporary society is so permeated with conspiratorial thinking can also be the fact that the Western world is going through a process of secularization, during which the position of religion is significantly weakened (Casanova, 2006, p. 14). Halík disagrees with this and states that "faith does not disappear; it only "moves" from public life and from external forms (especially institutional church-oriented forms) to the area of the private life of individuals; religion does not disappear, but becomes less visible" (Halík, 2013). This thesis is evidenced by the rise of modern religious movements within the New Age movement. Modern society no longer clings so much to classical forms of religion but looks for alternative ways through contemporary forms of religion and philosophical directions. Believing in conspiracy theories can be one of the possible alternatives.

Heil states that, for example, the current belief in anti-Semitic conspiracy theories stems from the belief that the Jewish people are no longer under God's guidance, are uncontrollable and that everything they do is for their benefit, deliberately ignoring anyone who is not of the Jewish faith. This state is called the "desacralization process", which is more broadly the result of multifaceted social secularization. According to the author, the process of secularization changed the concept of anti-Semitic conspiracies and led to a complete reversal of their original arrangement (Heil, 2014, p. 66).

Popper, on the other hand, presents the opinion that conspiracy theories are a typical result of the secularization of religious beliefs. While earlier traditional religions attributed wars to the intrigues of the gods, in current society, conspiracy theories have replaced the gods with powerful individuals or organizations, sinister and influential groups whose sinfulness is responsible for all the evil that society suffers from (DeHaven-Smith, 2014, p. 92). Supporters of conspiracies can thus find an explanation for the evil and suffering that occurs in society through conspiracy theory, but with the difference that the originator of individual events is no longer transcendental authorities and forces in the form of various deities or demons but powerful figures from the field of politics or an influential organization.

Conspiracy theories provide an alternative way to interpret specific actions or events in contemporary society, just as these explanations were previously offered by traditional religion. Belief in conspiracies represents a belief system that replaces conventional religious orientations and fulfils a deep-rooted desire for spirituality that has been transforming in recent decades. This also proves that religion and belief in it is not a matter of social evolution but rather an "anthropological constant" (Halík, 2013). This phenomenon can be traced to the rise of the already mentioned New Age movement, which points out that the departure from the classic directions of faith does not mean that contemporary society is not interested in religion but that this interest is only moving in a different direction than the traditional one - less towards community way and more to the individual. Conspiracy theories can thus, in a certain way, represent a contemporary secularized form of religion and can be considered a modern form of a traditional religious myth, which means an analogy to religious belief (Bilewicz, Cichocka & Soral, 2015, p. 116), in the sense that these theories present an explanation of events that are perceived as threatening.

6. Belief in conspiracies as a consequence of authoritarianism in society

A prominent element of belief in conspiracy theories is the relationship between authoritarianism and society, especially right-wing authoritarianism. Therefore, some authors tried to find a causal connection between the level of authoritarianism in society and the belief in conspiracies and conspiracy theories. Adorno drew attention to this phenomenon in his work and outlined the relationship between authoritarianism and belief in conspiracy theories. Right-wing authoritarianism is defined as a covariation of three attitude sets – authoritarian obedience, authoritarian aggression, and conventionalism (Altemeyer, 1996, p. 7).

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Authoritarian obedience expresses a general acceptance of the establishment and official authorities in the society where the individual lives and a high degree of willingness to accept them. Authoritarian aggression is a state of hostility and general aggressiveness towards other members of society, for example, towards members of minority groups or towards those whom the individual considers to be ideological enemies. It is possible to include racial, ethnic, or national minorities among them. Right-wing authoritarians are the group most subject to social prejudice. Authoritarian aggression is usually accompanied by the conviction that this behaviour is approved by the authority in question or that it is a way to keep the rule in place and thus maintain its status quo. Conventionalism expresses adherence to social conventions, perceived as punishment and support from authority and society. This phenomenon is closely related to the belief that others should also have a positive attitude towards and follow social norms. It is also possible to point to a relationship between authoritarianism and religion or that religious upbringing can represent the basis for an authoritarian personality type (Bilewicz et al., 2015, p. 116).

For the first time, the thesis connecting authoritarianism and conspiracy theories, as already mentioned, was expressed by Adorno and a group of authors in the publication (Adorno et al., 2019, p. 765). Specifically, that belief in conspiracies is characteristic of individuals with a high degree of authoritarianism. The first work that looked at the influence of personality differences on belief in conspiracy theories, including authoritarianism, was a study by Abalakina-Paap and her colleagues, in which they measured authoritarianism with a twelve-item scale derived from Altmeyer's Scale of Right-Wing Authoritarianism. Based on this measure, right-wing authoritarianism was a good predictor of belief in a particular conspiracy theory. These included, for example, the theory that a Jewish conspiracy controls the banking system or that the government is deliberately covering up the landing of extra-terrestrial civilizations on Earth (Abalakina-Paap et al., 1993, p. 642). However, this study did not confirm the connection between authoritarianism and belief in the existence of conspiracies on a general scale, only their connection with specific theories.

Bruder, in his study, using Funke's twelve-part scale, demonstrated that right-wing authoritarianism has a positive effect on both acceptance of conspiracy theories as a general phenomenon and belief in specific conspiracy theories. These particular cases of conspiracies in the study included the death of Princess Diana, the landing of extra-terrestrial civilizations, or business conspiracies pointing to the influence of organized crime on the operation of the Vatican Bank (Bruder et al., 2013). Grzesiak-Feldman, for example, addressed this topic in her work on the influence of authoritarianism on the spread of anti-Semitic conspiracy theories in Poland. Her study pointed out that anti-Semitic conspiracy theories among the Polish population are also positively influenced by authoritarianism (Grzesiak-Feldman, 2009).

On the other hand, it is also necessary to mention works that reached different results. McHoskey, in his publication, concluded that the respondents he observed, who showed a greater degree of authoritarianism, were more open to arguments that supported the official, non-conspiracy explanation of the assassination of J.F. Kennedy (McHoskey, 1995). Exciting and unexpected results were achieved in Swami's research. He showed mixed results when he conducted two investigations as part of the study. The first research investigation revealed a relationship between right-wing authoritarianism and belief in a Jewish conspiracy, and the second investigation pointed to a positive correlation between right-wing authoritarianism and general belief in conspiracy theories (Swami, 2012). Imhoff and Bruder (2014) also got surprising results the following year when they used Funke's scale again during the following study but with different results. They pointed out that the relationship between authoritarianism and conspiratorial thinking was statistically insignificant.

Many contemporary conspiracy theories have a populist and anti-government focus. In these theories, authorities are blamed as the originators of evil in society - for example, that the American government is responsible for the attacks of September 11, or that the British secret service MI6 is responsible for the accident of Princess Diana.

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According to Wood (2013), it can be deduced from this those supporters of authoritarianism are significantly less prone to believe that their authorities (the government) conspired against them and, conversely, that opponents of authoritarianism find this idea even more attractive.

Although most research on the link between authoritarianism and conspiratorial thinking sounds positive in favour of their mutual correlation, some studies have yielded the opposite results. An evident connection between authoritarianism, belief and the spread of conspiracy theories has not yet been demonstrated, and it is, therefore, possible that this aspect is present only in some specific theories and cannot be considered a general characteristic that could be applied to a broader spectrum of conspiracy theories. The different characteristics of the research sample of the respondents likely caused the other research results to be different.

Swami attributes this phenomenon primarily to cultural contexts (Swami, 2012). While his study on the relationship between authoritarianism and conspiratorial thinking conducted among respondents in the Central European region showed a positive correlation, his second study, which investigated the same among a Malaysian sample of respondents, showed the opposite results. It is, therefore, evident that it is necessary to consider the extent to which regional politics, the economic situation and the cultural climate affect a given society and how these factors influence conspiracy thinking and belief in conspiracy theories in general. It is also essential to distinguish between belief in a specific conspiracy theory and belief in conspiracy theories as a widespread phenomenon that includes a subset of individual theories.

Conclusions

Taking into account the fact that in the last few years, due to the enormous progress in the spread of the Internet, in the development of information and communication technologies, systems and means, and the mass use of various social network platforms, we increasingly encounter multiple theories that respond to several socially significant events taking place around us, the aim of this the work was, with the use of relevant methods of qualitative theoretical scientific research, to investigate one of the phenomena of the current modern information society – conspiracy theories. We found that they represent a phenomenon that can be looked at from different points of view, both in terms of their scope and the size of their sphere of influence, as well as based on their originators, causes, or what roles they have in society or what their motivations are. Although conspiracy theories and tendencies towards conspiracy theorizing have been inherent in humans throughout the long historical development of human society, they only entered the wider consciousness in the 21st century after the terrorist attacks of September 11, 2001.

Based on the examination of certain selected social aspects related to the relationship between society and conspiracy theories, we can conclude that there is a connection between the increase in popularity of conspiracy thinking and socially significant events that took place under unclear circumstances or whose official explanation was not sufficiently convincing for part of the population. This relationship is mutual and is mainly visible in how the popularity of conspiracy theories has affected, for example, television and film production. Other aspects that positively affect this relationship include the degree of authoritarianism and religious secularization in a particular society. Ambivalent results were obtained on the question of how the degree of authoritarianism affects the affinity for conspiratorial thinking. It is impossible to generalize since it is necessary to consider the specifics of societies, conditions and cultures. As we indicated above, the development of the Internet and the massive use of social media platforms played a significant role in this area, which raised conspiracy theorizing to a new higher level. While conspiracy theorists had limited opportunities to spread their theories until then, with the massive development and availability of internet connections and the active use of various social networks, they have gained a powerful tool to associate and share their theories about supposed conspiracies.

Conspiracy theories represent a topic within which it is difficult or impossible to formulate clear conclusions and attitudes. Just as it is impossible to condemn every supporter of conspiracy theories as paranoid suffering from cognitive distortion, it is also impossible to label every theorist as a truth-seeking and injustice-fighting individual. While some theories are so outlandish that it is evident from the start that they are mere figments of a wild imagination, some theories not only have at least a partial basis in reality but may prove to be wholly or partially true over time. This situation further complicates the attitude towards the phenomenon of conspiracy theories. This points out that they cannot be seen as a general set to which all conspiracy theories belong but must be seen as separate and distinct entities in their context. In an individual approach to this topic, it is, therefore, necessary to focus on specific aspects of personal theories with a critical distance and try to form an opinion of a particular conspiracy based on them. This way of thinking could lead to finding out whether a specific theory is at least partially relevant and whether it tries to point out a possible problem, the detection and subsequent solution of which would be valuable and desirable for society, or whether it is just a purposeful accusation that aims harm the subject who is the target of the accusation.

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DELPHI METHOD APPLICATION FOR EVALUATION OF INNOVATIVE PRODUCT DEVELOPMENT SCENARIO

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Abstract. The authors had the idea to apply the Delphi method to evaluate innovative product development scenarios. For this purpose, questionnaires were prepared, and two rounds of the investigation were carried out, in which 30 experts participated as the respondents to evaluate factors related to innovative product development scenarios. A set of the factors and sub-factors to be assessed was selected for the research. This set was formed as the basis from the paper's authors' collected and summarised data. After analysis of obtained research results, it was found that the successful introduction of an innovative product to the market, strategic agility, and reduction of uncertainty scenario is favourable. Also, it was found that there is a significant difference in the experts' opinions on what parameters should be a priority. The options have to rely on a few experts' opinions to evaluate objectively and select the best innovative product development scenario. Then, using their average evaluation as a basis for possible options selection is good. Based on the research results, a model of innovative product development and implementation using scenarios was created. This model describes a possible scenario development path choice, scenario development, evaluation, selection, adaptation and implementation. In the article, the authors also suggest adopting the concept of green innovation in product development, as green innovation positively impacts the growth of the modern economy.

Keywords: Delphi method; innovative product; development; scenario; green innovation

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JEL Classifications: D22, D24, J28, O14, O31, O33

1. Introduction

For innovative product development in a rapidly changing environment, it is required to develop methods to generate possible scenarios and select the most appropriate set for the consumer and producer. The Delphi method can be used to assess a number of views of experts from various fields. The authors had the idea to use the Delphi method to create the background to develop and evaluate innovative product development scenarios.

Innovative product development must catch up on more predictable scenarios that enable increased go-to-market success, greater strategic agility, and reduced risk. Creating scenarios in companies is limited because this activity requires considerable resources and relevant personnel competencies. The great efforts of the companies pay back the investment, as it can prevent risks that can cause more significant losses through detailed analysis of trends. Creating scenarios allows you to determine the most likely development of the business environment and to prepare for these challenges in advance by predicting the necessary business

changes and resources to implement the changes. However, when quality scenarios are ready, the situation becomes much more manageable thanks to informed decisions.

The work aims to provide research on the Delphi method application possibilities in the field of innovative product development scenario creation and to establish a set of factors for making decisions for the best scenario selection.
The subject of research is the Delphi method application for evaluating innovative product development scenarios.

The main application area for the research results is engineering and marketing activity for innovative product development. The research involved Lithuanian experts of various fields to participate in the Delphi method for different scenarios evaluation. The results of the investigation can help create innovative product development scenarios.

2. Theoretical background

According to O'Brien and Meadows (2013), scenario planning is one of the tools consistently reported as being used by executives to support their business development.

The creation of innovative product development scenarios becomes important due to the identification and overcoming of existing barriers related to innovation development. Based on Castaneda et al. (2023), one of the most critical challenges organisations face to innovate is dealing with different types of barriers, such as demand uncertainty, product imitation, lack of employees, scarcity of government funding, and absence of internal and external financing. Anticipating future customer needs under uncertainty to elicit robust top-level design requirements is the motivation for using future scenarios (Randt, 2015).

According to Avagyan et al. (2022), firms can practically take specific actions to encourage small-range scenario presentation, often by setting expectations and/or providing resources and training.

The creation of innovative product development scenarios can be positively influenced by the application of artificial intelligence in organisational settings to enable the safety of workers as well as the ability to speed up the rate of complex global problem solving (Farrow, 2022) and the use of the digital twin method for combining systems and systems-of-systems simulations to run trade-off analysis based on different product-service systems configurations Bertonia et al. (2022).

In our study, the Delphi method is used to identify factors important for scenario evaluation. The development of future scenarios is often combined with different participatory approaches; one among many is the Delphi method, widely adopted for its systematic and interactive nature, according to Calleo and Pilla (2023).

Based on Marchais-Roubelat and Roubelat (2011), the Delphi method is important to give access to specific forms of knowledge, and this knowledge may be characterised according to the type of knowledge sought after, its status, its temporality, its field of use and the risk of bias that may affect it. According to Konu's (2015) study, customer ideas and opinions were used in new product and service development even though it has sometimes been found challenging, e.g., by criticising that customers do not necessarily know what they want. Two Delphi rounds were used in the Konu (2015) study. The first round was used to collect new ideas for different purposes in new service development. These ideas were then analysed, and thematic products/product themes were formed by using narrative analysis. During the second round, alternative forms or products were suggested.

According to Ribeiro and Quintanilla (2015), participants of the Delphi method found it challenging to assess variables and support their opinion in the absence of evidence and make judgements under briefly described scenarios; the questionnaire was considered to be long and included complex questions, making participation in the survey rather time-demanding; the design of the survey did not allow space for a debate on the positive aspects of the subject.

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The Delphi method is also important to harmonise different opinions. The Delhi study of Giménez-Medina et al. (2023) reached a consensus on requirements for an Agile Innovation Funding Framework oriented toward obtaining an improved competitive advantage for information and communication technology products or services based on trust, transparency, inspection, and adaptation principles.

3. Research course and methodology

As the first step, the aim of the research was formulated. In the second step, the Delphi method application case research took place. The third step involved the analysis and evaluation of the obtained data by using an average value method, Kendall's coefficient of concordance and after the analysis, adequate conclusions were stated.
The authors had the idea to use the Delphi method to establish the factors for innovative product development scenarios. For this purpose, questionnaires were prepared, and two rounds of investigation were carried out, in which 30 experts were the respondents:

1. During the first round of investigation, the respondents were asked about the set of factors and sub-factors for evaluation and its evaluation expediency. For this purpose, professionals from industry and science institutions were interviewed.

2. During the second round of investigation the respondents were asked to determine the weights of the factors for different categories of the scenarios. Scenarios were divided into the successful introduction of an innovative product to the market, strategic agility, and reduction of uncertainty scenarios, which are favourable. Also, the respondents were interviewed, and the priority positions of the parameters were determined, which was done according to the importance of the successful implementation of innovative product development scenarios (respondents were asked to identify an order sequence number from 1 to 12). The questionnaire was developed in order to harmonise the opinions of the experts. The results were processed using Kendall concordance coefficient.

Kendall's coefficient of concordance KW was calculated as:

$$\mathrm{KW} = \frac{12\left(\sum_{\mathrm{i}=1}^{n}\left(\sum_{\mathrm{k}=1}^{m} r_{i,k} - \frac{1}{n}\sum_{\mathrm{i}=1}^{n}\left(\sum_{\mathrm{k}=1}^{m} r_{i,k}\right)\right)^2\right)}{m^2(n^3-n)};$$

where $r_{i,k}$ is given the rank for the object *i* by the judge number k, n – the total number of the objects, and m – the total number of judges. If the KW is 1, all the survey respondents have assigned the same rank sequence to the list of concerns. If KW is 0, then there is no overall trend of agreement among the respondents.

4. Results

4.1. Preparation for the research and results of the first Delphi round

For the first stage of Delphi, a list of factors that we selected from literature sources was offered. The results of this analysis are presented in Tables 1, 2, 3. These factors became the basis for forming the questionnaire of the first Delphi round.

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Table 1. Relationship between factors (the innovativeness of company employees (1st group of factors), product (2nd group of factors), and the globality of the product (3rd group of factors)) studied in this article and factors studied by various authors

The factors investigated in the current article	The authors in whose articles similar factors were investigated
1.1. Creativity of company employees	Sivam et al. (2019)
1.2. Entrepreneurship of company employees	Sivam et al. (2019)
2.1. Newness of the product to the market	Hassan et al. (2012)
2.2. Newness of the product to the company	Hassan et al. (2012), Walheiser et al. (2021)
2.3. Improvement of the functional characteristics of the product	Hassan et al. (2012)
2.4. Improvement of product ergonomics	Hassan et al. (2012)
2.5. Improvement of the product's intended use	Hassan et al. (2012)
3.1. Large number of international markets for product distribution	Walheiser et al. (2021), Zamborský et al. (2023)
3.2. A large number of international agreements for the supply of raw materials	Brandao & Godinho-Filho (2022)
3.3. Global availability of product information	Zamborský et al. (2023)
3.4. High number of international patents used in the product	Ma et al. (2021)
3.5. Large number of foreign countries where production is planned	Dreher & Oesterle (2022)
3.6. Use of international labour	Dreher, & Oesterle (2022) Zamborský et al. (2023)
3.7. Use of international capital	Zamborský et al. (2023)
3.8. Use of international high technologies	Zamborský et al. (2023)

Table 2. Relationship between factors (the product improvement process (4th group of factors) and the adequacy of the product to the environment (5th group of factors)) studied in this article and parameters studied by various authors

The factors investigated in the current article	The authors in whose articles similar factors were investigated
4.1. Improvement that is based on creativity	Tennyson & Breuer (2002)
4.2. Improvement is based on problem-solving	Tennyson, & Breuer (2002)
4.3. Improvement is based on replication of successful cases	Tennyson, & Breuer (2002)
5.1. Compliance of the product with the overall strategy of the company	Hallstedt (2017)
5.2. Compliance of the product with the "push" strategy	Urbaniec & Żur (2021).
5.3. Compliance of the product with the "pull" strategy	Urbaniec & Żur (2021).
5.4. Compliance with the needs of the company's interest groups	Wang et al. (2021)
5.5. Compliance of quality with market needs	Wang et al. (2021)
5.6. Compliance with market competitiveness	Wang et al. (2021)
5.7. Compliance with finances and other resources	Li et al. (2022)
5.8. Compliance with technological capabilities	Li et al. (2022)
5.9. Compliance with work performance	Mazzei et al. (2016)
5.10. Compliance with energy consumption	Hassan et al. (2012)
5.11. Compliance with material costs	Hassan et al. (2012)
5.12. Compliance with planned profitability	Wang et al. (2021)
5.13. Matching the knowledge and ability base	Sivam et al. (2019)
5.14. Compliance with employee capabilities	Sivam et al. (2019)

Table 3. The relationship between factors (the sustainability of the product (6th group of factors), the determination of the preliminary price (7th group of factors), and the compliance with norms and standards (8th group of factors)) studied in this article and parameters studied by various authors

The factors investigated in the current article	The authors in whose articles similar factors were investigated
6.1. Recyclability of product elements	Hallstedt (2017), Hassan et al. (2012), Hummen & Sudheshwar (2023), Wang et al. (2021)
6.2. Absence of adverse effects on humans	Hallstedt (2017), Brandao & Godinho-Filho (2022), Hassan et al. (2012), Wang et al. (2021)
6.3. Absence of negative impact on nature	Hallstedt (2017), Brandao & Godinho-Filho (2022), Wang et al. (2021)
6.4. Production from renewable sources	Hallstedt (2017), Hassan et al. (2012), Wang et al. (2021)
6.5. Environmental friendliness of operation	Hallstedt (2017), Hassan et al. (2012), Wang et al. (2021)
6.6. Environmental friendliness of production	Hallstedt (2017), Brandao & M. Godinho-Filho (2022), Hassan et al. (2012), Wang et al. (2021)
6.7. Environmental friendliness of transportation	Hallstedt (2017), Brandao & Godinho-Filho (2022)
7.1. For the successful implementation of an innovative product, it is important to determine its preliminary price	Hassan et al. (2012)
8.1. For the successful implementation of an innovative product, it is important whether the product complies with norms and standards	Hallstedt (2017), Brandao & Godinho-Filho (2022), Wang et al. (2021)

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During the first round of Delphi, 30 respondents were interviewed. These respondents were mainly 20-29 years old (67 per cent) and 30-29 years old (14 per cent), working as engineers (37 per cent) and heads of departments or managers (23 per cent), representing industrial companies (80 per cent of respondents). Most of the respondents (80 per cent) had higher education. They were offered a list of factors that we selected from literature sources. The results of this analysis are presented in Tables 4, 5, 6.

Respondents had to assess the need for existing factors to prepare and evaluate innovative product development scenarios. Also, the respondents had to propose their factors, which are also appropriate to consider. Evaluation of the factors by points, according to the Likert scale, is presented in Tables 4, 5, 6.

Table 4. Factors (the innovativeness of company employees (1st group of factors), product (2nd group of factors), and the globality of the product (3rd group of factors)) obtained during the first round of Delphi and their importance

Factors	Average points
1.1. Creativity of company employees	4.57
1.2. Entrepreneurship of company employees	3.97
1.3. Teamwork *	4.67
1.4. Psychological climate *	4
1.5. Presentation of specific tasks *	4
1.6. Close work with customers and partners, ensuring feedback *	4.4
1.7. Motivation, initiative *	3.75
1.8. Education, knowledge, skills, professionalism *	4.8
2.1. Newness of the product to the market	4.37
2.2. Newness of the product to the company	3.9
2.3. Improvement of the functional characteristics of the product	4.23
2.4. Improvement of product ergonomics	4.07
2.5. Improvement of the product's intended use	4.03
2.6. Product design improvement *	4.5
2.7. Increasing product quality and utility *	4.5
2.8. Increasing product reliability *	4
2.9. Product cost reduction *	4.5
2.10. Increasing product competitiveness *	4
2.11. Increasing product use safety *	4
2.12. Enhancing product usability *	4
2.13. Reducing the noise level of product use *	4
2.14. Increasing product uniqueness *	5
3.1. Large number of international markets for product distribution	3.93
3.2. A large number of international agreements for the supply of raw materials	3.5
3.3. Global availability of product information	4.47
3.4. High number of international patents used in the product	3.4
3.5. Large number of foreign countries where production is planned	3.2
3.6. Use of international labour	3
3.7. Use of international capital	3.23
3.8. Use of international high technologies	4.07
3.9. Showing the product at exhibitions abroad *	4
3.10. Transport options *	5
3.11. Advertising abroad *	4
3.12. Risk created by the spread of infectious diseases *	5

* Additional factors proposed to be included by survey respondents

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Table 5. Factors (the product improvement process (4th group of factors) and the adequacy of the product to the environment (5th group of factors)) obtained during the first round of Delphi and their importance

Factors	Average points
4.1. Improvement that is based on creativity	3.77
4.2. Improvement that is based on problem-solving	4.73
4.3. Improvement that is based on replication of successful cases	3.4
4.4. Improvement based on reduction of production costs *	4
4.5. Improvement based on intuition *	3
4.6. Improvement based on competitor analysis *	5
4.7. Improvement based on the analysis of the need for new functions *	5
4.8. Improvement based on generating new ideas for future trends *	4
4.9. Improvement is based on the analysis of the economic profitability of the product *	5
4.10. Improvement based on response to user needs *	4
5.1. Compliance of the product with the overall strategy of the company	4.1
5.2. Compliance of the product with the "push" strategy	3.83
5.3. Compliance of the product with the "pull" strategy	4.03
5.4. Compliance with the needs of the company's interest groups	3.63
5.5. Compliance of quality with market needs	4.53
5.6. Compliance with market competitiveness	4.53
5.7. Compliance with finances and other resources	4.17
5.8. Compliance with technological capabilities	4.53
5.9. Compliance with work performance	4.07
5.10. Compliance with energy consumption	3.7
5.11. Compliance with material costs	3.9
5.12. Compliance with planned profitability	4.4
5.13. Matching the knowledge and ability base	4.37
5.14. Compliance with employee capabilities	3.97
5.15. Meeting the needs of social groups *	4
5.16. Compliance with the company's capabilities *	3
5.17. Compliance with consumers' needs *	5
5.18. Compliance with suppliers' capabilities *	5

* Additional factors proposed to be included by survey respondents

Table 6. Factors (the sustainability of the product (6th group of factors), the determination of the preliminary price (7th group of factors), the compliance with norms and standards (8th group of factors) and four additional groups of factors (9th-12th)) obtained during the first round of Delphi and their importance

Factors	Average points
6.1. Recyclability of product elements	3.97
6.2. Absence of adverse effects on humans	4.7
6.3. Absence of negative impact on nature	4.7
6.4. Production from renewable sources	3.7
6.5. Environmental friendliness of operation	4.07
6.6. Environmental friendliness of production	4.07
6.7. Environmental friendliness of transportation	3.9
6.8. Necessity of the product for the consumers *	5
6.9. Warranties for the product, service *	4.5
7.1. For the successful implementation of an innovative product, it is important to determine its preliminary price	4.43
8.1. For the successful implementation of an innovative product, it is important whether the product complies with norms and standards	4.37
9.1. The management policy towards the innovative product (motivation and support) **	5
10.1. Brand distribution **	5
11.1. Compliance with the situation of preparation and implementation of the innovative product project **	4.33
12.1. Possibilities to change personnel **	5

* Additional factors proposed to be included by survey respondents
** Additional groups of factors proposed to be included by survey respondents

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After the first round of the survey, the list of analysed factors was supplemented with 32 factors proposed by the respondents of the surveyed companies. Also, the following groups of factors (9th-12th) have been added to the list: the management's policy towards the innovative product, brand distribution, the situation of preparation and implementation of the innovative product project, and the possibilities to change personnel.

4.2. Results of the second Delphi round and their application for scenario development

12 respondents participated in the second round. These respondents mainly were 20-29 years old (42 per cent) and 30-29 years old (33 per cent), working as department heads and managers (33 per cent), engineers (17 per cent), directors (17 per cent), and representing industrial companies. (50 percent of respondents). Most of the respondents (92 per cent) had higher education.

Using the basis of the finer factors, the coarser factors, which were weighted in the second stage of the Delphi method, were constructed for the three main scenarios:
1. How important are each of the following factors for the successful introduction of an innovative product to the market?
2. How much attention and resources should be devoted to each factor below to ensure strategic agility during an innovative product launch?
3. How much attention and resources should be devoted to each factor below to reduce uncertainty (risk) for introducing an innovative product?

These three scenarios were selected based on the literature that emphasised the importance of the relevant factors for product innovation.

Ding and Ding (2022) stated that technological innovativeness and market innovativeness are both associated with perceived new product performance, and market innovativeness is more pertinent to new product performance than technological innovativeness for new ventures. Nathan and Rosso's (2022) paper sheds new light on the links between firm-level innovation and growth.

Walheiser et al. (2021) suggest that the translation of firm-level product innovativeness into successful commercialisation of new products is facilitated when firms' organisational structures are designed to unleash their abilities to overcome internal resistances in the innovating organisation and external resistances in the marketplace.

The results of Mata et al. (2023) study indicate that companies are more willing to acquire knowledge from external environments (customers, competitors, markets, etc.); transforming this information efficiently leads to new services and products, improving innovation and boosting the success rate of projects in return, and strategic agility can provide further information to help organisations reform and renew strategically. According to Tarba et al. (2023), strategic agility is a vital asset enabling firms to cope with an uncertain and changing world.

According to Ivory and Brooks (2018), the application of strategic agility to managing corporate sustainability with a paradoxical lens can comprise three organisational meta-capabilities: strategic sensitivity, collective commitment, and resource fluidity.

Based on Helm and Gritsch (2014), international entrepreneurship has a more significant impact on uncertainty reduction than the use of networks, and after having reduced uncertainty, a firm tends to adapt its communication and pricing strategy, whereas the adaptation of the product and distribution strategy, in general, is not significant.

After analysing the received data and applying the Kendall concordance coefficient calculation methodology, it was found that there is a significant difference in the experts' opinions on what parameters should be a priority. The concordance rate of 0.22 was obtained when the maximum value is 1.

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The obtained results are presented in Figure 1. As shown in Figure 1, for all three scenarios, the factors are evaluated quite similarly; the factors related to product innovativeness and the factors related to management policy stand out a little. There is a significant difference of several points between some factors, such as the possibility of changing employees and the innovativeness of the product.

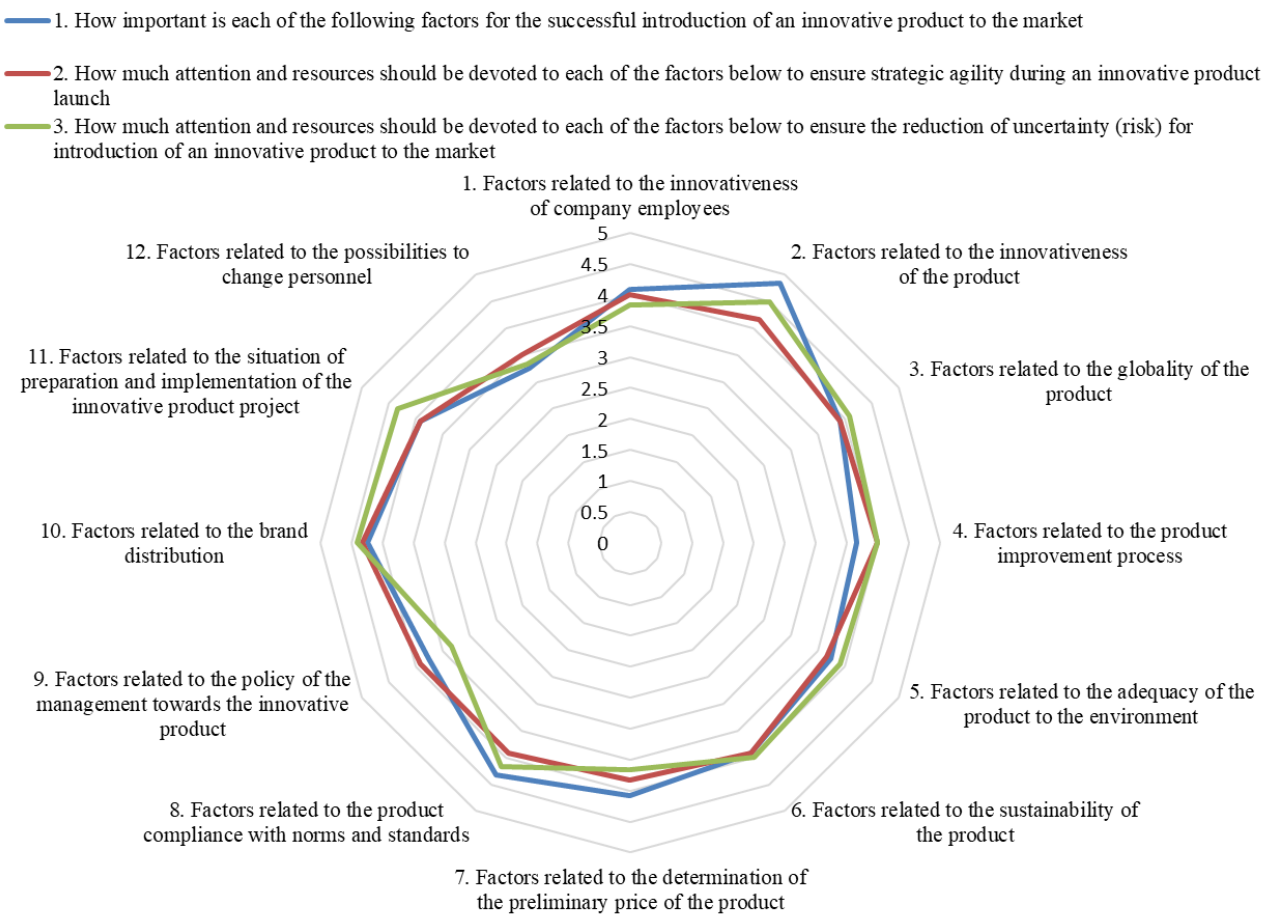

Figure 1. The results obtained during the second round of Delphi

The obtained results can be used to develop and evaluate innovative product development scenarios. This process is shown in Figure 2. Based on the literature analysis (Hassan et al., 2012; Mazzei et al., 2016; Hallstedt, 2017; Sivam et al., 2019; Rezk et al., 2019; Wang et al., 2021; Ma et al., 2021; Walheiser et al. 2021; Avagyan et al., 2022; Zamborský et al., 2023; Giménez-Medina et al., 2023; Castaneda et al., 2023), it was established that many authors agree that the development of an innovative product begins with the determination of market demand and its trends, or with the product development process initiated within the company itself. Such analysis should show which products are competitive in the market and which are not. Products that are uncompetitive in the market must be additionally evaluated to determine whether they can still be updated with the help of innovation or not. Only for products that still have a good development future an innovation process is initiated, which can be entirely dictated and implemented by the company developing innovations (Push strategy) or focusing on the dynamic environment of market demand; the innovation process can be organised and implemented taking into account specific individualised market needs (Pull strategy). For both strategies, it is sometimes possible to develop sufficiently defined scenarios for their development. If this is possible, then industrial companies can and should follow this path to detail the market development alternatives, link them with industrial product innovation alternatives, and more accurately assess the risks and their management decisions. The results of the empirical study showed that the most relevant are the scenarios of introduction to the market, Strategic agility during the introduction of the product to the market, and Uncertainty risk reduction, which best meet the expectations of industrial companies and the market situation for creation the innovative

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product and development of it. Considering the selected and approved scenarios, industrial companies implement them by purposefully creating and developing innovative products. This process must be implemented with a continuous assessment of the market situation and the innovative process itself so that, if necessary, the relevant adjustment decisions can be made.

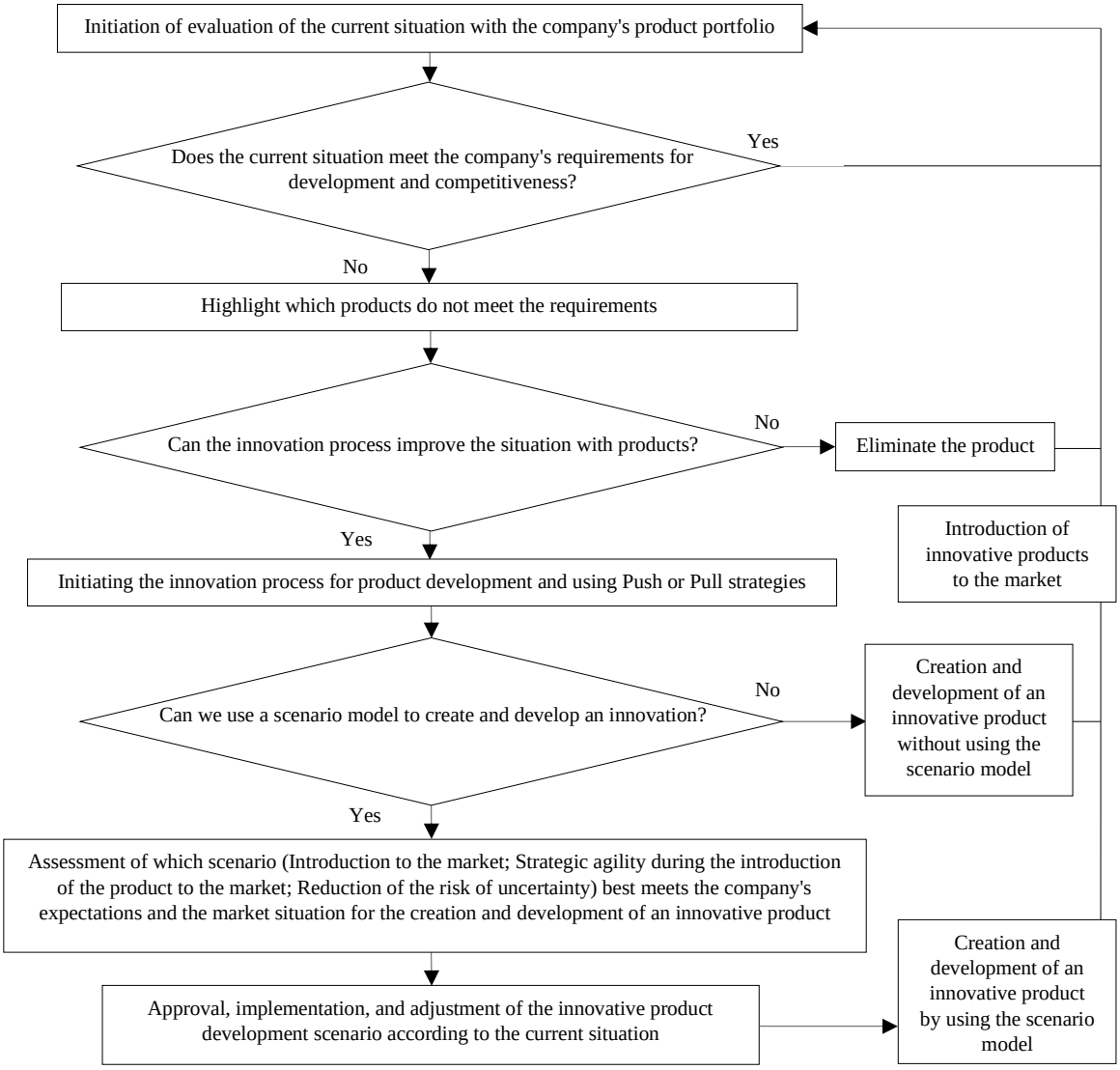

Figure 2. A model of innovative product development and implementation using scenarios

As a result, the created product, as an innovative product, is launched to the market with the most evaluated scenario of its development, maximising success and minimising risks.

5. Discussion

Creating innovative product development scenarios can be helpful for companies that want sustainable long-term development in the presence of considerable uncertainty and applying the principles of strategic agility. That the creation and implementation of innovative product development scenarios is taking place is evident from the results of our research. As shown by the survey carried out in the first round of the Delphi method, 83 per cent of the respondents of the surveyed companies indicated that their companies produced innovative products. In comparison, 17 per cent of the respondents indicated that they did not. Also, 43 per cent of the respondents stated that their company creates scenarios for the development of innovative products, 33 per cent that it does not, and 24 per cent of the respondents did not know about it. When asked who usually develops

innovative products, 60 per cent of respondents indicated that their company with customers, 13 per cent that only their company, 10 per cent with suppliers, 14 per cent together with business partners or that scenarios are developed only by business partners, 3 per cent of respondents knew nothing about it. When asked who usually implements innovative product development scenarios, 20 per cent of respondents indicated that their company with customers, 27 per cent that only their company, 20 per cent with suppliers, 13 per cent together with business partners or that scenarios are implemented only by business partners, 20 per cent of respondents did not know anything about it. As can be seen from the survey, when creating innovative products, companies cooperate strongly with consumers and other business partners. In this area, greater cooperation is possible in developing innovative products and their scenarios.

By examining the three possible priorities of the parameters of the innovative product development scenarios, it is possible to narrow down the various scenarios and select the ones with the highest scores. Differences of opinion and disagreements can be explained by the fact that the business environment is challenging to predict, and there is a lack of competencies in predicting business processes. Critical factors (driving forces) that were determined and evaluated for the creation and choosing of possible scenarios - product introduction to the market, strategic agility, or uncertainty (risk) reduction, may have a different influence on the success of innovative product development. When writing scenarios, one has to anticipate the effects of these factors and their possible reactions to them to achieve the intended results. It is also worth considering the mutual interaction of factors and their change trends during the period for which the scenario is being developed.

It is worth considering the concept of green innovation because, as the research of Banelienė and Strazdas (2023) shows, green innovations have a positive impact on economic growth in the European Union. Thao and Xie (2023) also suggest promoting the efficiency of green innovation through an open innovation strategy. Farooq et al. (2024) also state that with rising pollution emissions, it is vital to devise regulatory policies that ensure sustainable development and green innovation offers an alternative strategy, fostering economic progress and environmental sustainability. In our scenarios, green innovation can partially cover several groups of factors, such as groups of product sustainability and compliance with norms and standards.

It should also be noted that scripting is labour-intensive, and our proposed method can help reduce time costs. In addition, finding a consensus in evaluating various factors is essential because the study showed a considerable difference in the respondents' opinions.

Labour intensity can be reduced with the help of artificial intelligence (AI). Creating a scenario using AI requires formulating prompts that specify the objective, the factors, the query about their impact, and the planned response to that impact. After reviewing many factors, it is possible to summarise everything and combine the text into a coherent operational scenario, avoiding conflicting, irrelevant or illogical decisions.

6. Conclusions

After application of the Delphi method to evaluate the innovative product development scenario, the following conclusions were stated:

1. After reviewing the sources of scientific literature, it was found that creating scenarios can provide advantages in reducing business uncertainty and facilitating the innovation development process. The application of the Delphi method enables gathering information about the factors important for developing innovative product scenarios and evaluating them to select the most suitable scenarios. Based on literature sources, the factors that formed the basis for the Delphi method surveys were selected.
2. The first Delphi round helped to supplement the list of factors and their groups. Respondents indicated the importance of factors using a Likert scale (from 1 to 5 points). Most factors are deemed necessary, but only a few are rated moderately important. It was also seen that applying the Delphi method and creating scenarios is a labour-intensive process that requires sound knowledge and skills of the organisers in the field under study.
3. In the second round of Delphi, weights were determined for various factors, comparing 3 possible scenarios – innovative product introduction to the market, strategic agility, and uncertainty reduction. The conducted studies showed that when evaluating the weights of groups of factors in relation to all three possible scenarios, very similar results were obtained, which makes it possible to move from one scenario to another more easily

during their implementation. It was also found that there is a considerable difference in the opinions of the respondents who participated in the Delphi survey. After evaluating the difference of opinion, it was determined that Kendall's concordance coefficient would be 0.22, with a maximum value of 1 and a minimum value of 0. Therefore, when evaluating prepared scenarios, it is valuable to rely on the opinions of several experts by taking the averages of their evaluations.

4. Based on the research results, an innovative product development and implementation model was created using scenarios. This model describes a possible scenario development path choice, scenario development, evaluation, selection, adaptation and implementation.

5. The development and implementation of scenarios open up new possibilities for increasing the sustainability of industrial enterprises in innovative product development and introduction to the market. Having explicit scenarios allows for a more correct and effective reaction to environmental changes and acquiring a strategic advantage.

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KNOWLEDGE TRANSFER AND INNOVATION INCUBATORS: THE CONTEXT OF THE EUROPEAN UNION

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Abstract. Since Lithuania became a member of the European Union in 2004, the main course of the country's economic development has changed. Lithuanian government was forced to search for new ways to ensure the wealth and prosperity of local society. One of the chosen methods for supporting economic growth was related to knowledge transfer and the incubation of innovations in Lithuania. The article aims to formulate theoretical and practical assumptions for knowledge transfer and incubation of innovations. Based on data from the State Data Agency and the European Statistics Bureau Eurostat research results, the situation in Lithuania is evaluated in the context of the European Union. Finally, juxtaposing theoretical background and research results helps establish main guidelines for further innovation development.

Keywords: knowledge; innovation; incubation; incubators; open innovation; sustainability; ecosystem; startups; research & development

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JEL Classifications: I23, M21, M53

1. Introduction

Processes of globalisation encouraging economic growth highlighted the importance of innovation sector development. Lithuania experienced a long period of economic transition from the planned model based on traditional industries of national production and export by using favourable geographical allocation and status of a transit country; the shift towards new ways to attract foreign investment into economic development became a reality. Such a decision was geared by the changed political situation and the most recent financial priorities to achieve a high quality of life and economic competitiveness by improving significantly low levels of technologies and insufficient labour force productivity. Therefore, the Lithuanian government took an interventionist approach toward the economy, strongly emphasising science and technology. The decision was supported by an argument that traditional industry needs more competitive incentive to introduce new technology and would recommend reliance on international market forces.

Since the political changes in 1990 and the economic crisis in 1998, there was increasing determination to revitalise the Lithuanian science and technology base, and legislation reflected the pressure. For example, the Governments Act of 2003 encouraged technology transfer to the country and established the concept of science and technology park development.

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The general concept's provisions are:
- The main development policy objective is to improve the competitiveness of the Lithuanian economy.
- Major economic changes are the main reason for the Lithuanian economy's orientation to knowledge, research and innovation-oriented industries.
- Some of the most important activities to promote competitiveness are creating the environment for entrepreneurship development, investments into personnel, research and increasing technological development, the business services sector and its infrastructure.

The government, municipal authorities, private entities and the community should support science and technology parks' activities, promote scientific and technological progress, innovate-oriented changes in the economy's structure, and increase competitiveness and social activity (Lithuanian Government's Act 2003).

Lithuanian innovations and technology development priorities were recognised as the areas in which Lithuanian companies can compete on world markets and require the contribution of science: biotechnology and pharmaceuticals, information, telecommunications and laser technology, electronics, and mechatronics. These areas were approved in the programs of technology development supporting Lithuania's Progress Strategy "Lithuania 2030". The strategy defines science and technology parks as organisations that support established companies operating in applied research and development and the results of research and economic relations between scientific and academic institutions in research commercialisation, knowledge transfer and incubation of innovations.

Therefore, the paper aims to formulate theoretical and practical assumptions for knowledge transfer and incubation of innovations in Lithuania. The objectives include theoretical background analysis, revealing main directions in knowledge transfer and incubation of innovations, and economic analysis of statistical data in the context of the European Union.

2. Theoretical background of innovation and knowledge transfer

2.1. Innovation concept

The General Lithuanian Encyclopedia (2023) states that innovation (lat. "innovatio"- renewal) is a process of change when new elements (models) of material and non-material culture are created, recognised, and implemented in a particular social system, new scientific knowledge is used, new legally legalised technologies of higher quality are introduced to produce products, to provide better services. Chen and Chen (2023) argue that innovation can indicate changes to an existing product, idea, or area. In other words, there is an innovation focused on thinking using available knowledge and materials to meet social needs for improvement or create new things, methods, items, paths, and environments and get some beneficial effect.

Although Ji et al. (2022) mentioned that economic globalisation and rapidly increasing technological complexity make innovation more critical than ever, Eppinger et al. (2021) consider potential benefits gaps and harmful effects of innovation; their study proposes six different attributes of innovation provide benefits to society:

(I) appropriate information and communication channels,
(II) affordable price,
(III) appropriateness and availability,
(IV) predictability in terms of relevant and reflective risk assessment,
(V) accountability concerning the proper allocation of the costs of harmful side effects and
(VI) creating a sustainable path for the transition to societal and environmental sustainability.

Sánchez Ramírez et al. (2022) considered that ***making technological decisions*** for the development of new products and processes promotes the innovative capacity of companies, allowing them to satisfy the needs of a constantly changing market. Conversely, internally developed innovations or absorbed by companies provide an opportunity to shape or react actively to technological transitions. López and Oliver (2023) argue that the

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culture and innovation of each company experience different expectations, and technical capabilities can change the perception of product innovation. Some examples of the different ways that innovation can occur are:

(1) Product innovation when the Apple iPhone revolutionised the mobile phone industry.
(2) Process innovation, where the assembly line has changed the production process and enabled the mass production of goods.
(3) Business model innovation where Netflix disrupted traditional movie rental industry subscription streaming service.
(4) Organisational innovation where Google encourages creativity and collaboration among employees.
(5) Open innovation, where LEGO allows customers to submit ideas for new products; or
(6) Marketing innovation when Red Bull sent a man to the edge of space on a helium balloon.

Dziura and Rojek (2021) mentioned that the ***concept of novelty*** in the global sense needs to be emphasised in these models, and thus, the interpretation has weakened the meaning of innovations. Innovation in a company can be defined as an economic decision made to perform tasks related to the use of market opportunities or prevent the occurrence of threats. Such choices are often strategic. They can affect the competitive position of the company's activities and all aspects of its operation; in short, they can make a profit. Fernández-Portillo et al. (2023) stated that innovation is very important for companies. To ensure their survival, companies must constantly update their practices to keep up with market trends and evolving consumer needs. In this way, they also contribute to economic growth, employment, and the development of their respective countries. However, Maier et al. (2020) analyse that innovation has always been critical to long-term business success. Organisations that have successfully innovated have typically been rewarded with growth, profit, and access to new markets. According to Maier et al. (2020), continuous innovation has become vital to achieving competitive advantages. Innovation has been widely recognised as a critical mechanism for solving the problems of sustainable development.

Tirmizi Malik and Hussain (2020) stated that ***breakthrough innovations*** are necessary to gain and maintain a competitive advantage in the market. Similarly, Breakthrough Innovation (BI) capabilities have three fundamental building blocks: discovery, incubation, and acceleration. This means that inventions are the initial contribution to innovation, making them a viable proposition and further long-term investment in research and development organisations to ensure sustainable success and growth.

Kiseleva et al. (2022) mentioned that ***open innovation*** has proven its effectiveness and efficiency in many countries and is based on an ecosystem approach at the regional level. It provides a promising positive effect as it rapidly transfers innovations and their implementation due to the increased interest of all actors involved. Thus, it promotes high productivity of innovative activities in subjects, regions, and countries. Brodny and Tutak (2022) stated that open innovation is an excellent opportunity to develop a creative knowledge-based economy. Its practical application requires openness, willingness to share knowledge, and close stakeholder cooperation. Ryszko and Szafraniec (2022) stated that open innovation is a concept that essentially resides at the organisational level. Therefore, combining an open innovation process with the organisation's business model is necessary and perceived as an essential type of organisational change. Collaboration and co-creation in business model development are vital to sustaining open innovation. Therefore, openness is perceived as a critical factor affecting business model development. Proper business pattern matching enables co-developmental connections and increases the likelihood that external partnerships can be sustained over time.

Cao, Zhang and Qian (2019) stated that an innovation-based strategy that addresses the challenges of environmental pollution and pursues green development had gained an essential role in the economic literature in recent years. Gharbi et al. (2022) mentioned that organisations are increasingly supporting green innovation in their employee practices to promote sustainable development of the environment. Becker (2023) stated that ***green innovation*** refers to the innovation of products, processes, or organisations with a lower environmental impact. According to Becker (2023), the essential contribution of green innovation to green growth and the realisation of a sustainable economy is now well accepted. However, while the innovation economics and environmental economics literature will note that regulation, technology push, and market pull drive green innovation, its impact on firm performance is still debated. This lack of consensus in the literature is a significant

knowledge gap: the greater complexity, uncertainty, and cost of green innovation compared to other innovations that require changes in organisational goals, practices, and routines may discourage investment in green innovation if it does not increase and possibly weaken the company's performance in terms of growth, employment, and productivity.

Kurniawati et al. (2022) analyse that ***sustainability-oriented open innovation*** is an open innovation designed to meet organisational needs from an economic, environmental and social perspective. Case studies by Behnam, Cagliano and Grijalvo (2018) and Lopes et al. (2023) show the successful implementation of sustainability-oriented open innovation in large organisations. According to Kurniawati et al. (2022), sustainability is essential for large organisations and SMEs. Therefore, it is necessary to implement sustainability-oriented open innovations in SMEs. To achieve sustainability, SMEs must innovate in their activities, primarily related to the environment, employees, society, and ethics. Meglio and Di Paola (2021) considered that innovative solutions are needed to improve well-being or address sustainability challenges, including in the fashion and clothing, chemical, pharmaceutical or logistics, and transport industries, which usually create tension between increasing economic/financial value and preserving the natural environment. According to Meglio and Di Paola (2021), they need customised solutions to achieve this balance. The solution to these significant challenges is not a one-sided effort but a collective, open, and multi-stakeholder effort that requires collaboration across disciplines and institutional boundaries. Companies can actively find and develop sustainable innovations and provide viable solutions to global problems such as climate change, food security, and population ageing. Harsanto et al. (2022) stated that innovation for sustainability goes beyond profit but also for social, environmental, or both advantages. This term is a blend of two well-known words: innovation and sustainability. Innovation has been around for over five centuries, and sustainability has been around for over a century. Both share that the term is now interdisciplinary and examined from various perspectives. Combining these two concepts, innovation and sustainability, ultimately creates a new paradigm where this combination creates several concepts that are used interchangeably, e.g. sustainable innovation, sustainability-oriented innovation (SOI), environmental protection-friendly innovation, or sustainability-based innovation. Martínez-Alonso et al. (2019) mentioned that innovation has been identified as one of the most valuable sources of sustainable competitive advantages, allowing companies to grow and develop even faster, survive and endure over time in a rapidly changing environment, manage company resources more efficiently and ultimately achieve better results.

Latifah et al. (2022) considered that ***human capital*** is a set of knowledge, skills, and abilities integrated into company employees. Organisations can only create knowledge with individuals. Latifah et al. (2022) argue that knowledge creation and innovation are processes in which tacit knowledge is internalised as part of organisational knowledge. Employees with higher education will find it easier to adapt to new tasks and technologies. In addition, companies with a high level of human capital will facilitate the creation of knowledge and innovation. The literature also shows that innovative activities increase through exchanging and combining available knowledge. Thoumrungroje and Racela (2022) argue that innovation capability refers to the firm's ability to continuously ***convert knowledge resources*** and ideas into new products/services and organisational processes. According to Thoumrungroje and Racela (2022), such innovations are considered the most crucial element for companies seeking to provide the highest value proposition to the markets; therefore, these companies try to understand customers by acquiring market information so that they can anticipate changes in customer needs and behaviour.

As a result, it can be agreed with the summary provided by Visser (2020), who stated that embedded innovation is my term for scalable, breakthrough design and implementation solutions in the areas of systemic failure, so multi-level, multi-functional are improved through our interconnected economic, social, ecological, technological, and human systems. More simply put, integrated innovation means finding market-based solutions to problems for sustainable development.

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2.2. Incubation of innovations

Al Sharif et al. (2022) provide insights into an incubation program organised by one of the prominent centres in Qatar to incubate interested potential entrepreneurs who want to use ***open innovation in digital startups***. The article uses a qualitative method of data analysis obtained during interviews with the centre's instructors (employees) and entrepreneurs who have gone through the incubation process. Four hypotheses were developed to understand various aspects of open innovation, collaboration, the number of startups, and the role of the incubation centre. The results show that incubation and open innovation can contribute to digital startups. Habiburrahman et al. (2022) mentioned that factors influencing digital success from an incubator perspective, startups have eleven success factors with three different priorities. The priority levels consist of the following factors:
(1) synergy and product;
(2) process, innovation management, information technology, innovation skills, and functional skills;
(3) communication, culture, experience, and implementation skills.

Vaz et al. (2022) study extends previous research in the understudied field of ***incubation experiences*** of 16 entrepreneurs who are tenants of four technology business incubators located in the metropolitan area of Porto, Portugal. First, it illuminates several aspects these founders of technology-based startups perceive as contributing to and hindering their incubation experience. The incubation experience reported by the entrepreneur was generally positive and mainly motivated by the intangible resources provided during the incubation and the social and relational aspects experienced during the incubation process. However, it also revealed negative aspects of the incubation experience, mainly related to the irregular periodicity of mentoring sessions or shifts of mentors, training events provided by external entities, and several problems with using services provided by external incubator partners. Lin-Lian, De-Pablos-Heredero and Montes-Botella (2022) consider that the results confirm that business incubators create value in society, regardless of why entrepreneurs start their businesses. This job provides an opinion and a direct vision of how different profiles of entrepreneurs value contribution in the first stage of sustainability of business incubators. Pattanasak et al. (2022) recommend that academic researchers and BI prioritise the intangible factors that constitute the hidden value of an organisation. Thus, the review provides new findings by identifying common critical factors for BI performance and provides performance evaluation guidelines that consider BI intangible assets and trends for future studies.

Rodrigues et al. (2022) stated that ***the intellectual capital*** of the incubator company has a direct and positive relationship with innovation, satisfaction, and sustainability incubating companies. In turn, the innovative capacity of the incubated company has a direct and positive impact on sustainability. In addition, the sustainability of the incubating company and her satisfaction with the set company positively affect her competitive success. Management implications include realising that the more effort possible to improve incubated companies' human, structural, and communication capital, the better the results will be in supporting companies and helping startups develop sustainably and competitively in the market.

Bajwa et al. (2021) investigate thematic incubation for disaster risk reduction, climate change, and sustainable development with a possible approach to ***corporate sustainability***, culture innovation, entrepreneurship, science utilisation, and sustainability at the local level. Cirule and Uvarova (2022) explore the theoretical points and fundamentals of business incubation perspectives that facilitate the creation of ***sustainable value*** open innovation methods and test research tools for investigating technology-based factors in creating sustainable value in startups incubated in Latvia. Cirule et al.'s (2022) results show that climate change as a planetary boundary positively encourages the development of startup technology-based sustainable value creation. The incubator's location influences the pursuit of sustainability, affecting technology-based sustainable value creation. These results contribute to the business incubation of startups on the sustainability scale for new theoretical concepts related to integrating sustainability issues and open innovation practices in business incubation.

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3. Innovation and knowledge transfer in Lithuania: data analysis

3.1. Innovation ecosystem as knowledge transfer means in Lithuania

According to Su, Kajikawa, Tsujimoto & Chen (2018), innovation ecosystems are composed of interrelated organisations, including firms, government, intermediary agents, research institutes and universities, that are connected through a leading organisation or a technology platform to produce innovative goods or services.

De Andrade et al. (2023) considered that the knowledge-sharing process in digital startups is under development in the current debate, although its importance for sustainable economic growth is recognised. Piccinetti, Santoro and Rezk (2023) emphasised the importance of an innovation ecosystem for startups and other companies. Knowledge transfer is a way to share information, skills, and ideas across different areas of your business. This service is designed to provide the most efficient way for the knowledge transfer process. Transferred knowledge can be theoretical, practical, complex, or specific (specific procedures or processes).

Zhang, Wang and Chun (2022) found that knowledge sharing had a significant positive effect on all three elements of intellectual capital, while human capital and structural capital had a positive impact on innovations. Relational capital positively affected exploitable innovation but did not significantly impact research innovation. Zhang, Wang and Chun (2022) stated that, unexpectedly, there was no direct effect of knowledge sharing on ambiguous innovation, while the elements of intellectual capital are fully mediated. Companies should pay more attention to the role of relational capital when they embrace exploitative innovation. At the same time, we remind managers that innovation can be promoted only when knowledge sharing increases intellectual capital. Therefore, abuse management measures should be avoided, and ineffective management practices should be reduced. Furthermore, Zhang, Wang and Chun (2022) investigated the relationship between knowledge sharing and the open innovation paradigm and provided several suggestions for future research.

Wang et al. (2021) consider that knowledge is there an essential and unique resource for construction companies. According to Wang et al. (2021), an effective knowledge transfer process can enrich and update the company's knowledge base to improve the ability to solve problems and overcome challenges. Knowledge transfer can facilitate the company's innovation process. Pinto et al. (2019) analyse that usually requires the creation of networks related to sharing information and knowledge between producers, suppliers, and customers. Pinto et al. (2019) study that interactive information networks based on inter-organisational trust reflect the strength of knowledge transfer, and its potential benefits would reduce the risk of information asymmetry between partners.

Lithuania has been actively fostering innovation and technological development in recent years, aiming to strengthen its position in the global market. Here are some critical aspects of innovation development in Lithuania:

1) Government Support: The Lithuanian government has implemented several initiatives and support programs to encourage innovation. From 2014 to 2020, Lithuania has a National Innovation Strategy that outlines the country's vision, goals, and measures to enhance innovation and competitiveness (European Commission, 2023). The strategy aims to stimulate R&D activities, improve the innovation ecosystem, and increase cooperation between research institutions, businesses, and government bodies. As included in the reports from agencies like Invest Lithuania and government press releases, this includes tax incentives, grants, and funding opportunities for startups and innovative projects. Lithuania introduced a startup visa program to attract foreign startups and talents. This initiative simplifies the process for non-EU entrepreneurs to establish and develop their innovative businesses in Lithuania. The government-backed initiative *Startup Lithuania* supports startups through networking events, mentoring, access to funding, and international visibility. They organise events like *LOGIN*, *Startup Fair*, and *Startup Lithuania Roadshow* to showcase startups and connect them with investors and partners. Lithuania has established special economic zones and technological parks, such as Vilnius Tech Park and Kaunas Science and Technology Park, providing infrastructure and support services for technology-driven companies and startups. The Lithuanian government has introduced regulatory frameworks that foster innovation, particularly in the financial technology sector. The country's progressive regulatory environment has attracted many fintech companies, leading to the issuance of specialised licenses for payment and electronic money institutions.

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2) Startup Ecosystem: A sufficiently effective startup ecosystem has been created in Lithuania. As stated in *The Lithuanian Startup Ecosystem 2022 Review*, Lithuania "is one of the fastest-growing startup ecosystems in Central and Eastern Europe since 2017. The combined enterprise value of startups HQd & founded in Lithuania has grown 16.8x between 2017 and 2022, against a CEE growth average of 4.2x." The country has actively nurtured a conducive environment for startups, fostering innovation and supporting entrepreneurship. According to *Startup Lithuania*, in June 2023, there are over 850 startups active in the country. Lithuania offers a supportive infrastructure for startups, including coworking spaces, incubators, and accelerators. Organisations like Vilnius Tech Park, Startup Highway, and Startup Wise Guys provide resources, mentorship, and networking opportunities for early-stage companies. Lithuania has emerged as a leading fintech hub in the European Union. The country's proactive approach to issuing specialised licenses for payment and electronic money institutions has attracted numerous fintech startups and companies. The startup ecosystem in Lithuania benefits from investment and funding opportunities. Angel investors, venture capital firms, and government grants support the growth of startups across various industries, including technology, biotech, and green energy.

3) *Research and Development (R&D):* The universities, scientific institutes, and colleges contribute to research in various fields, driving innovation in technology, life sciences, and more. Different clusters and innovation hubs that combine companies, research institutions, and government bodies seek to foster innovation and R&D collaborations. For instance, Sunrise Valley Science and Technology Park in Vilnius encourages innovation and collaboration among tech companies. Science and Technology Park of the Institute of Physics collaborates with business companies in laser technologies. Altogether, seven science and technological parks operate in Lithuania. Numerous private companies across sectors like biotechnology, information technology, engineering, pharmaceuticals, and more invest in R&D activities. Companies like *Thermo Fisher Scientific* and *Teva Pharmaceuticals* have R&D operations in Lithuania. Lithuania has been steadily increasing its investment in R&D. According to Hollanders (2023), in 2020, Lithuania's expenditure on R&D (GERD - Gross Domestic Expenditure on Research and Development) amounted to around 1.07% of GDP. This reflects a positive trend in R&D investment, though it is still below the EU's average. Lithuanian organisations actively participate in international collaborations and EU-funded research programs. Horizon Europe, the EU's flagship R&D program, allows Lithuanian researchers and organisations to participate in collaborative research projects. Joint research projects with partners from other countries contribute to knowledge exchange and technology transfer.

4) *Funding:* In Lithuania, various sources often fund innovations. Apart from government funding through multiple channels, such as the Research Council of Lithuania and the Ministry of Education, Science, and Sport, private investments, EU structural funds and programmes, and innovation grants exist. These funds support academic research, innovation initiatives, and technology development. Venture capital, angel investors, private equity firms, and corporate investments play a significant role in funding innovations in Lithuania. These investors often invest in startups, tech companies, and innovative businesses, supporting their growth and development. Programs like Horizon Europe, the European Regional Development Fund (ERDF), and the Cohesion Fund provide grants and support for innovative projects and businesses. Various grants, awards, and competitions exist from public and private entities in Lithuania. Crowdfunding platforms and alternative financing methods, such as peer-to-peer lending, are also utilised by innovators and entrepreneurs to raise funds for their projects or products.

3.2. Lithuanian research & development data analysis in the context of the European Union

The research method is based on a comparative statistical analysis of data available from credible sources of relevant data (Eurostat, OECD). The research aims to investigate impact factors and establish trends explaining changes significant for knowledge transfer and incubation in Lithuania in the context of the European Union.

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Research and development (R&D) is often considered a driving force behind economic growth, job creation, innovation, and increasing product quality. The European Commission evaluates the expenditure on research and technological development as a primary instrument for funding European research (European Commission, 2010). R&D lies at the heart of the EU's strategy to become the most competitive and dynamic knowledge-based economy; moreover, it became one of the Lisbon strategy's goals to increase R&D expenditure to at least 3% of the European Union's Gross Domestic Product (GDP). It is believed it would help create a unified and attractive research area of the business, the scientific society, and ordinary citizens' needs to transform Europe into a vibrant knowledge economy, boost economic growth, create more and better jobs and ensure lasting prosperity in Europe (European Commission, 2010). However, progress has remained too slow since the 3% goal was set in 2002.

Table 1. Comparison of expenditure on R&D in the European Union in 2011 and 2021 (as % of GDP)

	European Union	Ireland	Austria	Belgium	Bulgaria	Czechia	Denmark	Estonia	Greece	Spain	Italy	Cyprus	Croatia	Latvia
2011	2.02	1.55	2.67	2.17	0.53	1.55	2.95	2.31	0.68	1.33	1.20	0.45	0.74	0.72
2021	2.27	1.11	3.26	3.43	0.77	2.00	2.76	1.75	1.46	1.43	1.45	0.83	1.24	0.74
Change	*0.25*	*-0.44*	*0.59*	*1.26*	*0.24*	*0.45*	*-0.19*	*-0.56*	*0.78*	*0.10*	*0.25*	*0.38*	*0.40*	*0.02*
	Lithuania	Luxembourg	Poland	Malta	Netherlands	Portugal	France	Romania	Slovakia	Slovenia	Finland	Sweden	Hungary	Germany
2011	0.90	1.43	0.75	0.67	1.88	1.46	2.19	0.48	0.65	2.41	3.62	3.19	1.18	2.81
2021	1.11	1.04	1.43	0.65	2.27	1.68	2.22	0.47	0.92	2.13	2.99	3.40	1.64	3.13
Change	*0.21*	*-0.39*	*0.68*	*-0.02*	*0.39*	*0.22*	*0.03*	*0.01*	*0.26*	*-0.28*	*-0.63*	*0.21*	*0.46*	*0.32*

Source: based on Eurostat, OECD

GDP expenditure on research and technological development in the European Union's 27 countries has risen by 0.25% on average. Seven countries experienced a negative trend (Ireland, Denmark, Estonia, Luxembourg, Malta, Slovenia, and Finland), while others showed growth in expenditure on R&D. The highest growth could be observed in Greece (0.78%), Poland (0.68%), and Austria (0.59%).

In 2021, expenditure on research and technological development in the European Union's 27 countries represented an average of 2.27% of GDP. However, the required level of 3% of expenditure of GDP on R&D is achieved in Belgium (3.43%), Sweden (3.40%), Austria (3.26%), and Germany (3.13%).

Expenditure on research and development is divided into four main areas: business enterprises, government, higher education sector and private non-profit organisations. Costs are calculated regardless of funding source and are expressed as a ratio to GDP, known as R&D intensity.

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Table 2. Gross domestic expenditure on R&D in the European Union in 2011 and 2021 (as %)

	Business enterprise sector		Government sector		Higher education sector		Private non-profit enterprises	
	2011	2021	2011	2021	2011	2021	2011	2021
EU-27	56.258	58.069	33.644	30.292	0.916	1.186	1.165	1.174
Belgium	60.151	64.418	23.417	17.264	2.870	2.558	0.601	0.524
Bulgaria	16.925	32.930	38.763	26.068	0.199	0.658	0.183	0.216
Croatia	38.186	38.438	48.210	35.939	1.707	4.758	0.249	0.086
Czech Republic	37.683	36.054	41.717	32.319	0.935	0.992	0.007	0.090
Denmark	61.164	59.564*	48.152	28.696*	-	-	3.579	6.280*
Germany	65.585	62.779	29.887	29.964	-	-	0.349	0.321
Estonia	55.006	50.946	32.751	36.982	0.286	1.369	0.098	0.193
Ireland	48.877	55.525	29.444	16.764	0.746	0.560	0.587	0.897
Greece	32.739	38.296	49.238	44.455	2.269	2.548	1.001	0.316
Spain	44.312	50.240	44.476	37.458	3.981	3.981	0.551	0.867
France	55.044	55.428	35.149	32.457	1.262	2.93	0.797	1.491
Italy	45.088	53.912	41.905	35.148	0.886	0.681	3.063	1.455
Cyprus	11.994	35.663	69.809	36.740	3.832	3.426	0.449	1.953
Latvia	24.849	33.468	22.535	33.894	1.610	2.219	-	-
Lithuania	28.235	36.055	42.219	29.761	0.994	2.592	0.154	0.264
Luxembourg	45.304	44.181	33.543	46.989	0.524	1.273	1.167	0.445
Hungary	47.462	50.574	38.098	35.079	-	0.216	0.990	0.336
Malta	50.047	61.301	29.099	31.065	2.129	0.770	0.300	0.732
Netherlands	51.117	56.524	33.940	30.765	0.315	0.108	3.305	2.326
Austria	46.167	52.960	35.757	28.464	0.666	1.043	0.474	0.305
Poland	28.116	50.971	55.803	37.394	2.440	3.054	0.250	0.408
Portugal	44.716	53.658	41.770	35.584	5.358	3.256	2.124	1.182
Romania	37.406	55.172	49.130	31.646	1.172	0.475	0.227	0.143
Slovenia	61.228	48.728	31.510	24.306	0.231	0.519	0.011	0.041
Slovakia	33.853	45.704	49.753	37.919	1.848	1.966	0.388	0.535
Finland	67.012	58.084	25.033	25.576	0.149	0.588	1.263	1.736
Sweden	57.640	60.653	27.464	23.255	0.930	0.854	2.968	3.283

* - data of 2019

Source: Eurostat, OECD

According to the data of the European Statistics Office Eurostat, the largest share of funds for scientific research and technological development in the European Union is in use in the business sector (58.069%), followed by the government sector (30.292%), the higher education sector (1.186%) and private non-profit sector (1.174%).

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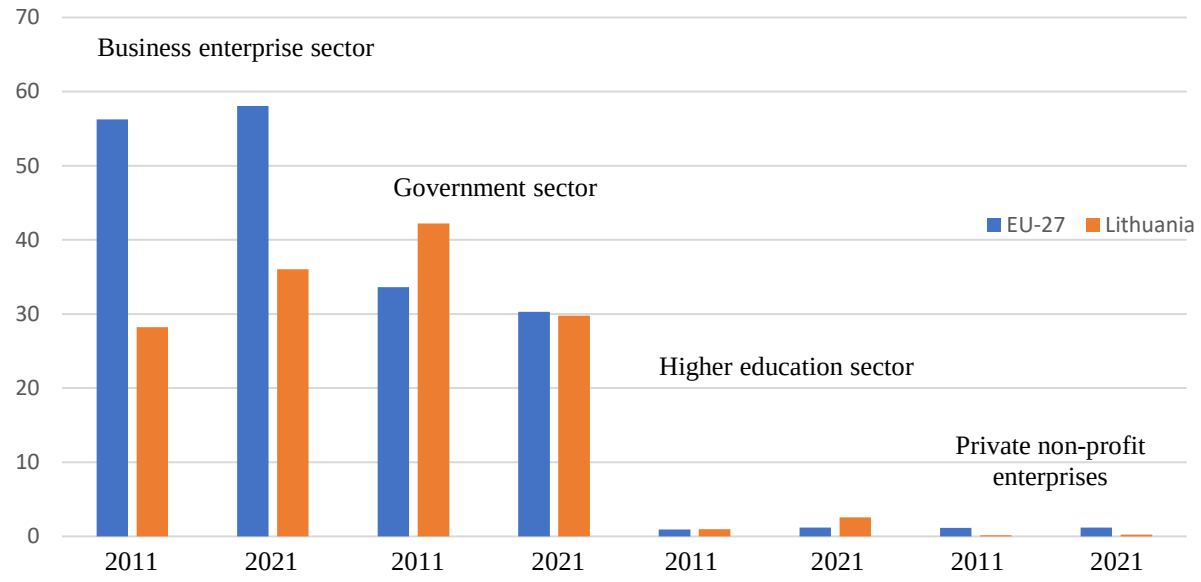

Figure 1. Comparison of gross domestic expenditure on R&D in the European Union and Lithuania in 2011 and 2021 (as %)

Source: based on Eurostat, OECD

The comparison of gross domestic expenditure on R&D has revealed the growing trend of spending on the business enterprise sector in the European Union. Interestingly, it affected Lithuanian performance, as, in the last decade, the leading position of the government sector was overtaken by the business enterprise sector, as well. The expenditure on R&D in the higher education sector has also risen in the country. However, the total amount of funding remains relatively low.

Regarding the European innovation scoreboard (2023), all European countries may be identified as a part of different innovation growth groups.

Table 3. European Innovation Scoreboard data

Innovation leaders	Denmark (137.6%), Sweden (134.5%), Finland (134.3%), Netherlands (128.7%), Belgium (125.8%)
Strong innovators	Austria (119.9%), Germany (117.8%), Luxembourg (117.2%), Ireland (115.8%), Cyprus (105.4%), France (105.3%)
Moderate innovators	Estonia (98.6%), Slovenia (95.1%), Czechia (94.7%), Italy (90.3%), Spain (89.2%), Malta (85.8%), Portugal (85.6%), Lithuania (83.8%), Greece (79.5%), Hungary (70.4%)
Emerging innovators	Croatia (69.6%), Slovakia (64.2%), Poland (62.8%), Latvia (52.5%), Bulgaria (46.7%), Romania (33.1%)

Source: European Innovation Scoreboard, 2023

Denmark is the new top innovator with the best performance in the EU, overtaking Sweden after a few years in a leading position. Other Innovation Leaders are Sweden, Finland, the Netherlands, and Belgium. Austria, Germany, Luxembourg, Ireland, Cyprus, and France are Strong innovators, performing above the EU average. Croatia, Slovakia, Poland, Latvia, Bulgaria, and Romania are Emerging Innovators. Lithuania, Estonia, Slovenia, Czechia, Italy, Spain, Malta, Portugal, Greece and Hungary are Moderate innovators.

European Innovation Scoreboard (2023), evaluating Lithuania's performance, praises the level of population with tertiary education, non-R&D innovation expenditures, collaboration of innovative SMEs, trademark

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applications; however, it suggests increasing knowledge-intensive services exports, government support for business R&D, and, R&D expenditure in the business sector.

3.3. Research results' discussion and limitations

Based on the above considerations, the European Union still struggles to implement the Lisbon Strategy of supporting innovation development by investing in R & D at least 3% of the gross domestic product. As for 2021, the level of expenditure on R&D achieved an average level of 2,27% among all 27 European Union countries. Lithuania increased the level of spending by 0,21% in the last decade. However, the overall level of the country's funding is less than half of the EU's average (1,11%).

Despite the relatively low level of R&D expenditure, the growing trend of support for the business enterprise sector, common for the European Union, in Lithuania was also indicated. Moreover, in the last decade, the leading position of R&D expenditure in the government sector was overtaken by the country's business enterprise sector. Additionally, the rising trend of expenditure of R&D in the higher education sector in the country was indicated, as well. The overall results provided by the European Innovation Scoreboard include Lithuania among Moderate innovators and suggest increasing knowledge-intensive services exports, government support for business R&D, and R&D expenditure in the business sector.

Regardless of the limitations related to the specifics of the analysed period due to the pandemic, the established impact factors suggest keeping an eye on the expenditure level on R&D in various sectors contributing to the innovation development and knowledge transfer since a speedier transition toward a more sustainable future depends on the ability of market actors to create and adopt social and technological innovations.

Conclusions

The theoretical background of innovation and knowledge transfer can be characterised by a combination of various ideas and approaches, including sustainability-oriented open innovations and knowledge resources development by keeping the importance of concepts of novelty, breakthrough innovation and the need to make technological decisions. Therefore, the current trend in knowledge transfer is focused on developing open innovations in digital startups, emphasising the role of incubation experience, intellectual capital and sustainable value of corporate sustainability.

Analysis of the innovation ecosystem in Lithuania highlighted the importance of Government support, which is deeply involved in funding R&D processes important for creating a vital startup ecosystem. Technology parks and business incubators are some of the most common and suitable ways of high technology development in countries which orientate their economy into knowledge-based industrial sectors:

- Technology parks and business incubators are the leading high technology transfer and incubation forms, which ensure high technology sector development by meeting industrial, academic and government needs.
- Technology parks and business incubators allow the development of significant sectors of high-tech industries for small and medium-sized enterprises, which, according to many scientists' opinions, is a priority for such business sectors.

Despite similarities, there is a significant difference between both forms of technology transfer and incubation: while incubators focus on new enterprise development, science and technology parks aim to establish a concentration of firms or industries in a particular area and are associated with technology transfer objectives. In Lithuania, they specialise primarily in consulting and other services rather than in research programs and technology development. This may be explained by the growing percentage of employment in the knowledge-intensive service sector and the decreasing average employment in industry in Lithuania.

Moreover, while Research and Development is often considered a driving force and the European Commission has established the limit on R&D at 3% of GDP, in Lithuania, this indicator achieves just 1,11%. Nevertheless, the growing trend in expenditure on the business enterprise sector in the European Union has accordingly affected the allocation of funding among different sectors in Lithuania. Therefore, regarding the European Innovation Scoreboard 2023, in terms of innovation growth, nowadays, the country is among a group of moderate innovator countries with a growing trend of gross domestic expenditure on R&D in the business sector. Based on the study results, it is essential to reconsider the economic policy of lagging behind countries by emphasising development factors impacting the faster development of innovations since a speedier transition toward a more sustainable future depends on the ability of market actors to create and adopt social and technological innovations.

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DIGITAL TRANSFORMATION IN FOOD RETAIL: A CASE STUDY OF LITHUANIA E-GROCERY BUYING BEHAVIOURS*

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Abstract. This study addresses the evolving landscape of food consumption in the context of digital transformation, focusing on how online platforms are reshaping grocery shopping preferences and perceptions towards local and temperature-controlled foods. Amidst the proliferation of e-grocery services and changing dietary trends, a critical need exists to understand these shifts for informed public health policy and e-commerce strategies. Our comprehensive survey investigates the growing inclination towards e-grocery shopping, including preferences for delivery times, responses to delivery delays, and the importance of perishable item shelf life. The study further assesses consumer attitudes towards local food sourcing and the role of e-groceries in promoting dietary diversity and health-conscious choices. Additionally, it probes into concerns over food safety and quality assurance in temperature-controlled foods purchased online. The findings reveal significant insights into contemporary eating behaviours and e-grocery adoption, offering crucial implications for public health interventions and the advancement of digital grocery platforms.

Keywords: E-grocery; food industry; supply chain management; buying behaviour

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1. Introduction

Understanding consumer behaviour in food consumption and e-commerce is increasingly important in today's digital age. The advent of the COVID-19 pandemic has served as a catalyst, driving a significant portion of consumers towards online grocery shopping platforms (Younes, Noland & Zhang, 2022; Gomes & Lopes, 2022). This trend is not merely a response to global health concerns; it also highlights the' convenience of e-groceries and flexibility in daily life (Hood et al., 2020). Furthermore, this shift is not uniform across all demographics. Age, gender, ethnicity, and educational attainment are just some factors that influence these behavioural changes (Younes, Noland & Zhang, 2022; Hood et al., 2020; Park, 2023). The growing interest in online grocery shopping has had several ripple effects. For instance, there has been a notable shift towards healthier food and beverage consumption behaviours during the pandemic (Gomes & Lopes, 2022). This is corroborated by research that suggests that online grocery shopping could facilitate healthier food choices by

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minimizing impulsive purchases of unhealthy items (Pitts et al., 2018; Boustani, Ferreira & Guiné, 2021). However, this potential is tempered by consumers' hesitancy to purchase fresh produce online, which could counteract some of the benefits of shopping for healthier options (Pitts et al., 2018).

Moreover, consumer expectations regarding delivery services are evolving. In the German context, the needs of an ageing population have led to a higher demand for home-delivery services, especially in rural areas (Oeser et al., 2018). In South Korea, consumer preferences for delivery services show a strong inclination towards dawn deliveries using personal iceboxes, indicating that the type of packaging can be even more influential than the delivery time in shaping consumer choices (Park, 2023). The rapid growth of the online grocery shopping sector is influenced by a complex interplay of factors such as global health crises, demographic characteristics, and evolving consumer expectations (Younes, Noland, & Zhang, 2022; Gomes & Lopes, 2022; Oeser et al., 2018; Pitts et al., 2018; Hood et al., 2020; Park, 2023).

Understanding these nuances is essential for academia and the retail industry as they navigate the opportunities and challenges of this digital transformation. While e-commerce platforms have experienced an undeniable surge in usage and popularity, academic exploration of their impact on food demand remains surprisingly underdeveloped. This oversight is particularly noticeable given the transformative effects of online shopping on other commerce sectors. The convenience, vast product selection, and often competitive pricing of e-commerce platforms have altered buying habits and reshaped entire industries. In food demand, the effects of e-commerce become even more intricate. As consumers increasingly shift to online grocery shopping, a multitude of factors come into play: regional dietary preferences, accessibility to various food items, and the logistical challenges of delivering perishable goods, to name a few (Waitz, Mild, & Fikar, 2018; Waitz, Mild, & Fikar, 2018). Yet, most research in the area tends to focus either on traditional brick-and-mortar food consumption patterns or on e-commerce trends in general without delving into the unique intersection of the two. For instance, while some studies have attempted to understand customer preferences regarding e-grocery logistics through conjoint analyses (Waitz, Mild, & Fikar, 2018), these often need to be more open to specific cities or attributes and may not capture broader trends.

Furthermore, although advanced decision support systems have been introduced to tackle the logistical challenges of last-mile distribution (Waitz, Mild, & Fikar, 2018; Merchán & Winkenbach, 2018), these solutions often focus on logistical efficiency rather than consumer preferences or behavioural patterns. While advancements have been made in understanding specific aspects of e-grocery logistics and consumer preferences, a holistic view that integrates these insights with broader demographic and e-commerce trends remains a gap in the literature. This underscores the need for comprehensive studies examining the complex landscape of e-commerce's impact on food demand, offering valuable perspectives for industry stakeholders and policymakers. This lack of focused research leaves a significant knowledge gap for businesses and policymakers aiming to optimize e-grocery operations or address food security concerns, understanding the nuances of e-commerce. Without this understanding, there's a risk of making decisions based on incomplete or outdated models, potentially leading to inefficiencies, missed opportunities, or even exacerbating existing challenges in food accessibility. In particular, the novelty of our publication focuses on empirical evidence about e-grocery buying behaviours, encompassing factors such as local producers, temperature-controlled delivery, and various e-grocery aspects. Unlike other surveys that typically concentrate on only some of these aspects, our research pays particular attention to temperature-controlled delivery. This focus is crucial as one of the critical challenges in e-grocery logistics is delivering fresh and frozen products, which requires controlled-temperature vehicles. This not only complicates the delivery process but also adds significant costs due to the specialized nature of these vehicles (Seghezzi, Mangiaracina, & Tumino, 2023).

Goal:
To assess comprehensively the impact of digital transformation on food consumption patterns, particularly focusing on the dynamics of e-grocery adoption, to inform public health policy and e-commerce strategies.
Objectives:
1. To conduct a literature review exploring the intersections of ageing populations, health-conscious consumerism, and advanced e-grocery simulations.

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2. To survey consumer behaviour and preferences in purchasing fresh food products through e-grocery platforms.
3. To derive recommendations for public health, digital grocery platforms, and e-commerce strategies based on insights from the survey findings.

2. Exploring the Evolution of Food Demand in the Digital Age: A Comprehensive Literature Review

In e-grocery, various surveys have delved into the intricacies of consumer behaviours and preferences, illuminating the multifacetedmultifaceted nature of this rapidly evolving sector. The study by Diagourtas, Kounetas and Simaki (2023) highlights the role of sociodemographic factors in organic food purchasing, revealing distinct motivations in different countries. Concurrently, Jaeger, Harker & Ares (2023) shed light on attitudes towards biodynamic agriculture, emphasizing environmental and biodiversity aspects. Vasko et al. (2023) explore household food waste in Montenegro, uncovering responsible food usage amidst the pandemic. Qaiser et al. (2023) focus on the transformative effects of COVID-19 on consumer consumption in Pakistan, identifying significant demographic influences. Wallnoefer and Riefler (2022) provide insights into Austrian consumers' perceptions of local food consumption during this global crisis. Kusz et al. (2023) offer an understanding of Polish consumers' purchasing behaviours under pandemic pressures, revealing gender and age as critical factors. Lastly, Kolondam et al. (2023) assess the impact of utilitarian, hedonic, and e-service quality on Indonesian consumer satisfaction in e-grocery shopping, pointing towards the importance of customer satisfaction in online environments. These studies underscore the dynamic and complex nature of consumer preferences and behaviours in e-grocery. They highlight the necessity for nuanced and adaptable strategies to cater to diverse consumer needs influenced by sociodemographic factors, cultural contexts, and extraordinary circumstances like the COVID-19 pandemic. This body of research forms a foundation for understanding the current landscape of e-grocery shopping and paves the way for future exploration and innovation in this sector.

The intersection of the ageing demographic with digital consumption is profoundly impacting e-commerce, particularly e-grocery. This trend reshapes older adults' interaction with technology and participation in the digital economy, presenting opportunities and challenges. While it offers convenience, it demands digital literacy and adaptation to new shopping modalities. Understanding these needs is vital for e-commerce solutions tailored to an ageing population, with market dynamics and social inclusion implications. The global demographic landscape is evolving, with the proportion of older individuals increasing. By 2050, nearly 22% of the worldwide population will be 60 or older (World Health Organization, 2015). This shift influences consumption patterns, notably in food shopping. Older adults often have specific dietary needs, impacting food demand. Studies by Younes, Noland, & Zhang (2022) and Gomes & Lopes (2022) reveal behavioural shifts in food shopping, with older individuals less likely to adopt online grocery shopping. This highlights the demographic nuances in e-commerce adoption.

Retailers and policymakers must consider these trends to cater to a diverse consumer base, balancing older individuals' needs with the growing online shopping trend. E-commerce platforms offer unique advantages in catering to an ageing global population, mainly through their ease of use and convenience. For older individuals who may face physical limitations or reduced mobility, the ability to access a vast array of products at the click of a button is not merely a convenience but often a necessity. Moreover, the personalized nature of these platforms allows for saved dietary preferences and easy repeat orders, further enhancing the shopping experience for those who may find the extensive options in physical stores overwhelming. This understanding aligns well with the comprehensive study conducted by Oeser, Aygün, Balan, et al. (2018), which delves into the implications of an ageing population on the food demand chain in Germany. Their research uses a holistic demand-chain approach to explore how older consumers' physical, psychological, and behavioural characteristics influence different facets of the food chain. From the layout of retail spaces to food packaging and logistics planning, the ageing demographic leaves its imprint on numerous aspects of the food industry. One of the study's key findings is the rising demand among older individuals for home-delivery services, especially in rural regions. This suggests a growing recognition of the logistical challenges and opportunities of catering to an older consumer base, emphasizing the role of industry 4.0 solutions in ensuring an efficient food supply.

The intersection between an ageing population and the rise of e-grocery shopping presents both opportunities and challenges.

The convenience and accessibility of online platforms offer a compelling value proposition for older individuals, especially those with limited mobility or specific dietary needs. However, it's essential to acknowledge the digital divide that may prevent older adults, who are generally less tech-savvy, from fully embracing e-commerce. This issue underscores the importance of user-friendly interfaces, robust customer support, and, potentially, the development of hybrid models that combine online and in-store shopping benefits. Understanding these dynamics is crucial for e-commerce platforms seeking to cater effectively to an ageing demographic. This nuanced landscape is further elaborated in various comprehensive studies. For instance, the research by Pitts et al. (2018) underscores the dual nature of online grocery shopping. While online platforms could encourage healthier choices by reducing impulse purchases and enabling better use of nutritional information, the study also notes a hesitancy among consumers to purchase fresh produce online, potentially leading to less healthy choices. This dichotomy becomes even more relevant for older adults, who may have specific health-related dietary needs.

Similarly, the study by Hood et al. (2020) explores the developed landscape of the UK's e-grocery industry, highlighting the various shopping channels made available due to technological advancements. Interestingly, the research points out that while younger demographics and affluent households show a significant inclination towards home delivery, the same preference is strongly noted among those over 55. This aligns well with the idea that older adults, despite potential limitations in tech-savviness, do see the value in the convenience offered by online grocery platforms. Moreover, the study by Park (2023) provides an international perspective by examining South Korean consumers' preferences in online grocery delivery. The research identifies strong consumer preferences for specific delivery times and packaging types, with a notable finding that packaging type was more influential than delivery time in consumer decisions. Given that older individuals may have particular needs or preferences, such as for eco-friendly packaging or delivery during specific times, these insights are valuable for e-grocery companies looking to tailor their services to this demographic.

While e-grocery shopping offers many advantages that could benefit an ageing population, there are also hurdles to overcome, including technological barriers and the need for specialized services. The cited studies emphasize the importance of understanding consumer behaviours, preferences, and hesitations, making it clear that a one-size-fits-all approach is unlikely to be successful. As the global population ages, e-commerce platforms have both the challenge and the opportunity to innovate and adapt, ensuring they can effectively meet the diverse needs of this growing demographic.

In recent years, a significant shift towards health-conscious consumerism has permeated various sectors, including the food industry. An increasing awareness and preference for healthier food choices, organic products, and a general inclination towards wellness-oriented lifestyles characterizes this movement. Consumers are more informed about the nutritional aspects of their food and are more concerned about the environmental and ethical implications of their consumption habits. This rise in health-conscious consumerism is particularly noticeable in e-commerce, where digital platforms have made it easier for consumers to access a broader range of healthy and specialized food options. As a result, the demand for such products is influencing the supply chains, marketing strategies, and product offerings of food retailers and e-grocery platforms. Understanding this shift is crucial for stakeholders in the food industry to align their strategy with consumer preferences and for public health advocates to leverage this trend in promoting healthier eating habits.

The transformation towards healthier and more sustainable food choices is a fleeting trend and a paradigm shift that has gained considerable momentum in recent years. This change is propelled by a heightened awareness of health benefits, scepticism of processed foods, and an increased focus on environmental sustainability. Supporting this observation, the Organic Trade Association has reported consistent growth in the organic food market, indicating that consumers are increasingly willing to invest in healthier and more eco-friendly options. Various reputable studies and surveys further corroborate this trend, offering nuanced insights. For instance, a report shows that approximately 65% of consumers aim to make spending choices that contribute to a healthier and more sustainable lifestyle (World Economic Forum, 2023). Another study found that environmental

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concerns motivate 16% of consumers to pursue healthy and sustainable eating, marking a significant increase from previous years.

Moreover, 77% of consumers are either increasing or considering increasing their fruit and vegetable consumption, reinforcing the shift towards plant-based diets (IGD, 2021). This trend toward plant-based foods is not just anecdotal. Still, it is quantified by projections from the World Resources Institute, which estimates that sustainable food will constitute a $2 trillion industry in 2022 (Acterra, 2022). The fast-food industry has also noted, with many companies introducing plant-based meat alternatives to cater to evolving consumer demands. The COVID-19 pandemic has catalyzed this transformation, pushing consumers even more decisively towards fresher and healthier food choices (Grimmelt et al., 2022). Reports from McKinsey & Company indicate that even before the pandemic, people from diverse demographic backgrounds explored conscious eating for varied health and sustainability goals. This trend has only accelerated in the wake of the pandemic. The 2022 Food & Health Survey by the International Food Information Council adds another layer to this narrative (IFIC, 2022). The survey revealed that many Americans have adopted specific diets or eating patterns, primarily motivated by long-term health benefits and weight loss.

Additionally, the study found a growing emphasis on plant-based proteins and dairy alternatives. Notably, the survey indicated a substantial increase—from 27% in 2019 to 39% in 2022—in the percentage of Americans considering environmental sustainability when making food and beverage purchases. The global shift towards healthier and more sustainable food options is multifaceted, driven by consumer awareness and environmental concerns, and even accelerated by the ongoing pandemic. It's a trend substantiated by multiple credible sources, ranging from the Organic Trade Association to the World Economic Forum, IGD, Acterra, McKinsey & Company, and the International Food Information Council. These shifts are not just influencing consumer behaviours but also reshaping industries and market offerings, making it an essential area of focus for policymakers and businesses.

E-commerce platforms have been particularly adept at capitalizing on these evolving consumer preferences. Unlike traditional brick-and-mortar stores, online grocery stores offer high transparency and ease for health-conscious consumers. They feature dedicated sections for organic and health-centric products, provide in-depth information about ingredients, and often allow consumers to trace the origins of the products. This comprehensive product information, accessible with a simple click, has made online shopping the go-to choice for many who prioritize health and sustainability in their food choices. The complex interplay of consumer behaviours and food access is not just about preferences or marketing; it also has significant social implications. Research by Buscemi et al. (2023) sheds light on how food insecurity is intricately linked with socioeconomic status and geographical location. The study found that individuals with high levels of food insecurity are often confined to areas with low median incomes, corroborating the need to consider social and economic factors in food access strategies. Although their study did not find a direct link between food insecurity and grocery store density, it revealed that individuals with higher BMIs were more likely to live in low-income areas with fewer grocery options.

Similarly, a study by Livings et al. (2023) revealed the multifaceted barriers to food access exacerbated by the COVID-19 pandemic. While living in a food desert was not necessarily correlated with food insecurity, other barriers, such as restricted grocery store hours and lack of vehicle access, were significant contributors. The study underscores the importance of addressing these geographic and logistical disparities in enhancing food security and, by extension, in the offerings of online grocery platforms. Food demand and access dynamics are evolving rapidly, influenced by a myriad of factors, from consumer preference for healthier options to socioeconomic constraints. E-commerce platforms stand at the crossroads of this change. They offer unprecedented convenience and information, instrumental in driving consumers toward more beneficial and sustainable options. However, they are also responsible for ensuring that this shift is equitable and devoid of misleading information. As online platforms grow, their role in shaping food consumption patterns becomes increasingly significant, warranting a multifaceted approach that considers both market trends and social realities.

This comprehensive analysis has underscored a significant gap in existing literature regarding e-grocery buying behaviours, particularly in temperature-controlled delivery. While previous studies have explored various facets of e-grocery dynamics, the specific focus on the complexities and logistical challenges of delivering fresh and frozen products has been markedly underexplored. This research gap is particularly noteworthy given the importance of maintaining product integrity and safety in delivering temperature-sensitive items. The current study's emphasis on empirical evidence, addressing both the consumer perspective and logistical intricacies of temperature-controlled deliveries, offers a novel contribution to the field. It illuminates the specific challenges and consumer expectations in this area. It sets the stage for future explorations and innovations in e-grocery logistics, thereby enriching the discourse on digital transformation in food consumption patterns.

3. Methodology: Assessing Digital Transformation in E-Grocery Consumer Behaviour

The survey was conducted online, successfully garnering responses from 120 participants distributed across Lithuania, thereby ensuring a geographically diverse and representative sample for the study. This study employed a structured survey methodology to investigate the interplay between digital transformation and evolving food consumption patterns. The survey was methodically segmented into distinct sections to capture a comprehensive understanding of dietary behaviours and e-grocery adoption dynamics among varied demographic groups.

1. Demographic Profiling: Initial questions were designed to gather essential demographic data, such as age, gender, occupation, education, geographical location, income, and Body Mass Index (BMI), offering a foundation for contextual analysis.
2. E-Grocery Shopping Preferences (AlTarrah et al., 2021; Qaiser et al., 2023; Kolondam et al., 2023): Focused on elucidating preferences and behaviours in online grocery shopping, this part addressed delivery time preferences, reactions to delays, expectations regarding perishable goods, purchase frequency, and handling of missed deliveries.
3. Local Food Sourcing Perceptions (Diagourtas et al., 2022; Wallnoefer & Riefler, 2022; Jaeger, Harker & Ares, 2023; Kusz et al., 2023): Here, the survey probed attitudes towards locally-sourced food, encompassing aspects like importance assigned to local produce, purchase frequency, and willingness to pay a premium for local products, alongside assessing respondents' awareness of local food producers.

4. Temperature-Controlled Food Concerns (Navickas et al., 2015; Vasko et al., 2022; Park, 2023; Seghezzi et al., 2023): Dedicated to understanding perceptions and concerns related to temperature-controlled foods purchased online, this section explored purchase frequencies, types of foods bought, safety and nutritional concerns, trust in grocery store temperature control mechanisms, and confidence in the quality of these foods when bought online.

The methodology employed multiple-choice questions, ranking scales, and Likert scale responses, enabling a nuanced capture of data that reflects current trends and perceptions in dietary habits and digital grocery shopping. This comprehensive approach aims to provide robust insights for public health policy formulation and e-commerce strategy development in food consumption.

4. Results: Analysing E-Grocery Consumer Trends and Preferences

This chapter delineates the findings from the survey, detailing the adoption and perception trends of e-grocery consumers. It dissects the collected data to clearly understand consumer behaviours, exploring the digital transformation in grocery shopping. This assessment aims to identify critical factors influencing consumer preferences and discern patterns within the e-grocery market. The analysis in this chapter informs e-commerce strategies and offers a critical understanding of the current state and potential future directions of digital food retail.

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Table 1. Demographic statistics

Question	Label	Frequency	Percentage
Gender	Woman	88	73
	Man	32	26
Age group	15 to 19	27	22
	20 to 24	42	35
	25 to 29	6	5
	30 to 34	21	17
	35 to 39	9	7
	40 to 44	5	4
	45 to 49	2	1
	50 to 54	3	2
	55 to 59	4	3
	60 to 64	1	0
	Basic education	1	0
	Primary education	4	3
Education	Secondary education	58	48
	Higher education	45	37
	Post-secondary education	12	10
Employment	Student	59	49
	Employed person	53	44
	Other, not in the labour force	5	4
	Unemployed person	3	2
Monthly Income (NET)	Less than 300 euros per month	36	30
	300 - 500 euros per month	16	13
	500 - 800 euros per month	13	10
	800 - 1000 euros per month	11	9
	1000 - 1500 euros per month	21	17
	1500 - 2000 euros per month	10	8
	More than 2000 euros per month	13	10

In the survey, we gathered data on various demographic aspects of e-grocery consumers. The results, as detailed in Table 1, reveal exciting insights into the gender distribution, age groups of the respondents, education, profession and income.

Regarding gender, most of the survey participants were women, accounting for 73% (88 respondents) of the total. Men represented 26% (32 respondents) of the sample. This skew towards female participants suggests a potentially greater engagement or interest of women in e-grocery services, a point that may warrant further investigation.

The age group data shows a diverse range of participants. The most represented age group was '20 to 24 years', comprising 35% (42 respondents) of the participants, indicating a strong inclination towards e-grocery services among younger adults. This was closely followed by the '15 to 19 years' age group, which accounted for 22% (27 respondents) of the sample. The '30 to 34 years' age group comprised 17% (21 respondents), while other age groups had lower representation. These findings suggest a significant trend of e-grocery adoption among younger demographics, possibly reflecting their comfort with digital platforms and online shopping.

A significant portion, 48% (58 respondents), reported having completed secondary education. Those with higher education, such as a university degree, comprised 37% (45 respondents) of the participants. Additionally, 10% (12 respondents) reported post-secondary education, indicating a considerable level of educational attainment among the survey participants. Only a small number had primary education or basic education, with 3% (4 respondents) and 1 respondent respectively. This distribution suggests that a majority of e-grocery consumers in the survey have at least secondary education, highlighting a potentially literate and informed customer base. Moving on to employment status, the data shows a diverse range of occupations among e-grocery consumers. The largest group was students, making up nearly half of the respondents at 49% (59 individuals). Close behind were employed persons, who accounted for 44% (53 respondents). A smaller segment, 4% (5 respondents), included individuals who were neither studying nor employed, falling under the category 'Other, not in the labour force'. Unemployed persons were the least represented in the survey, with just 2% (3 respondents). This

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variation in employment status reflects the broad appeal of e-grocery services across different occupational backgrounds.

The monthly income section of the survey provides insight into the financial demographics of the e-grocery shopping population. The data indicates a diverse range of income levels among the respondents. A significant portion of the survey participants, 30% (36 individuals), reported a monthly income of less than 300 euros, which suggests that individuals from lower-income brackets are utilizing e-grocery services. This could have implications for e-commerce platforms regarding pricing strategies and the affordability of delivery services. The next substantial income category is those earning between 1000 and 1500 euros per month, representing 17% (21 individuals) of respondents. This indicates that e-grocery shopping also appeals to middle-income earners who may prioritize the convenience that e-grocery platforms provide. Respondents in the 300 - 500 euros and 500 - 800 euros per month brackets each comprise a similar proportion of the population, at 13% (16 individuals) and 10% (13 individuals), respectively. This further supports the notion that e-grocery shopping is not exclusive to any single economic demographic. Those earning between 800 - 1000 euros and 1500 - 2000 euros per month each account for a smaller yet significant share, at 9% (11 individuals) and 8% (10 individuals), respectively. This illustrates that e-grocery platforms are servicing a broad economic spectrum of consumers.
Interestingly, the survey also indicates that e-grocery platforms are utilized by individuals in the higher income brackets, with 10% (13 individuals) reporting a monthly income of more than 2000 euros. This suggests that the convenience of e-grocery shopping is recognized across different income levels, including those with greater financial resources. Overall, the monthly income data from the survey suggests that e-grocery services cater to a wide range of economic backgrounds, highlighting the need for e-commerce platforms to consider diverse pricing and service options to meet the needs of their varied customer base.

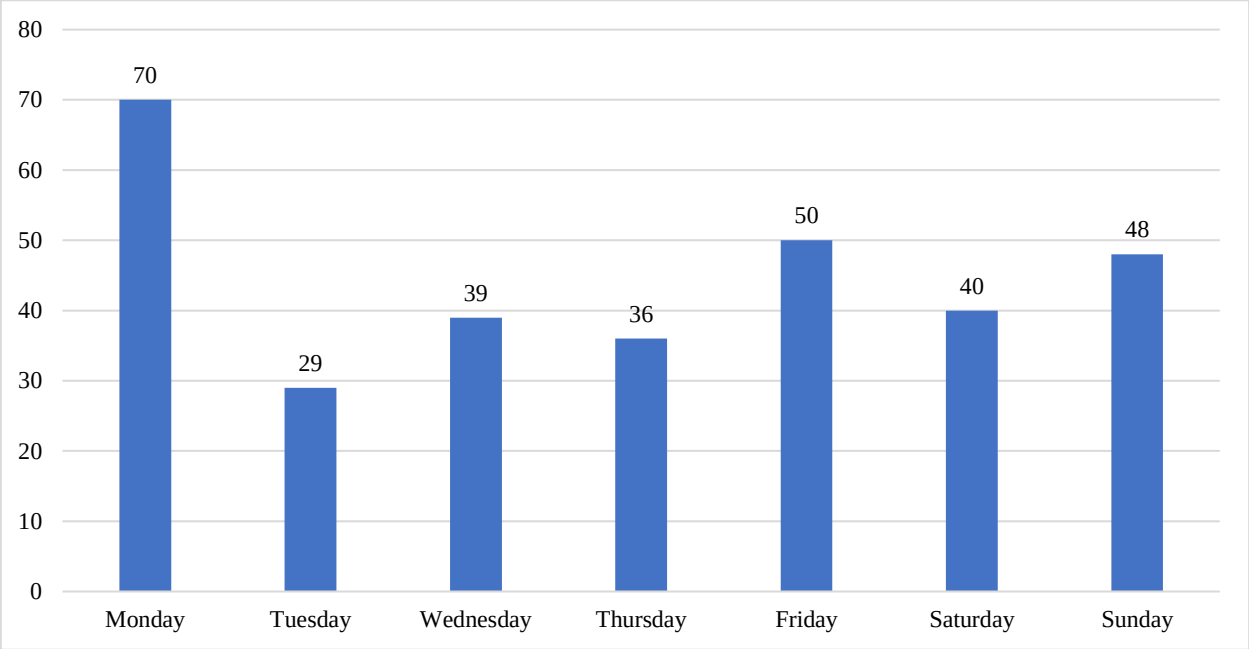

Figure 1. Preferences for day order

Figure 1 illustrates consumer preferences for the day of the week to place e-grocery orders. Monday stands out as the most popular day, with a clear peak at 70 orders, suggesting that many consumers prefer to start their week by organizing their food purchases. In contrast, Tuesday sees a significant drop to 29 orders, making it the least preferred day for placing e-grocery orders within this sample. Midweek days like Wednesday and Thursday show a moderate preference, with 39 and 36 orders, respectively. As the week progresses towards the weekend, there's an upward trend in preference. Friday marks the beginning of this increase with 50 orders, indicating that many consumers may be planning for the weekend. Saturday experienced a slight decrease to 40 orders, which could be attributed to consumers engaging in other weekend activities. However, there's a resurgence in preference on Sunday with 48 orders, possibly as consumers prepare for the upcoming week. The

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distribution of preferences throughout the week could reflect varying consumer routines and the desire to ensure fresh food availability for specific days. It's also noteworthy that the preferences for Monday and Sunday are high, framing the week with the most significant activity in e-grocery orders, which might be aligned with typical workweek patterns and preparation for weekdays. These trends offer valuable insights for e-grocery service providers, indicating potential peak and off-peak days for order fulfilment and could inform the optimization of delivery logistics and inventory management.

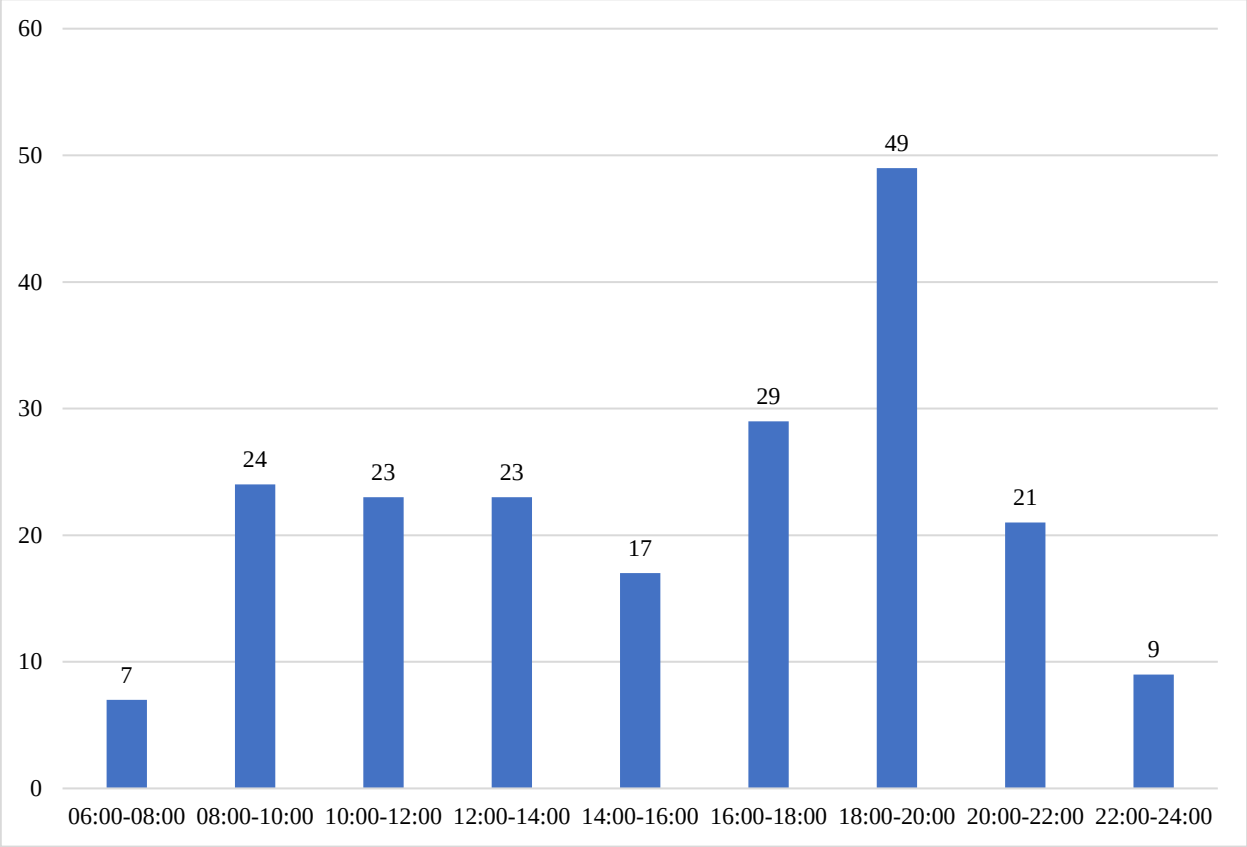

Figure 2. Consumer Preferences for E-Grocery Order Timing

From Figure 2, we can discern that the early hours of 6:00-8:00 AM are the least preferred for placing orders, with only 7 individuals choosing this time frame, suggesting that few consumers engage in e-grocery shopping first thing in the morning. The hours of 8:00-10:00 AM, 10:00-12:00 PM, and 12:00-14:00 PM show a consistent level of preference, with each time slot garnering 24, 23, and 23 orders, respectively, indicating a moderate and steady engagement throughout the late morning to early afternoon period. Consumer activity shows a dip during the mid-afternoon hours of 14:00-16:00 PM, with only 17 orders, possibly reflecting a lull in shopping activity as people might be occupied with work or other day-to-day tasks. However, there is a noticeable increase in the late afternoon and early evening, with the 16:00-18:00 PM slot attracting 29 orders. This could be attributed to individuals wrapping up their work or daily activities and finding the time to place their grocery orders. A significant spike is observed in the 18:00-20:00 PM slot, which records the highest preference at 49 orders, suggesting that this is the prime time for consumers to engage in e-grocery shopping, potentially due to the conclusion of the typical workday. Following this peak, there's a decline in the later evening hours with 21 orders during 20:00-22:00 PM and a further decrease to 9 orders in the late-night slot of 22:00-24:00 PM, as people are likely preparing to end their day. The data indicate that evening hours, particularly after work, are the most favoured for placing e-grocery orders, with a notable peak in early evening. These insights are essential for e-grocery businesses to optimize their staffing and logistics for order processing, ensuring they are best equipped to handle higher orders during these peak times.

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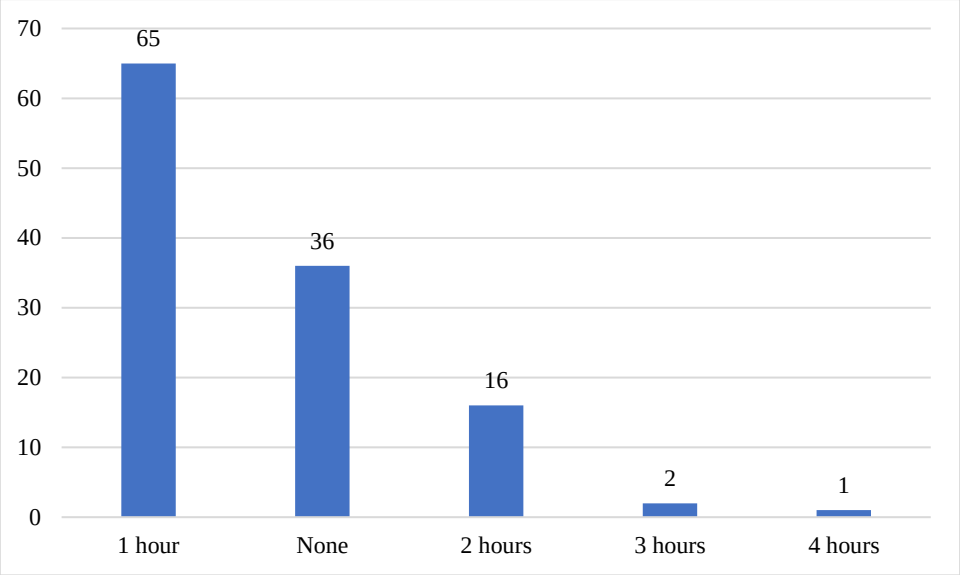

Figure 3. Delivery delay tolerance

Figure 3 illustrates consumer tolerance for delivery delays when ordering from e-grocery services. From the chart, it's clear that most consumers (65 individuals) are willing to tolerate a delay of up to 1 hour, indicating a reasonable level of patience and understanding towards minor deviations from the scheduled delivery time. Conversely, a substantial number of consumers (36 individuals) indicated no tolerance for delivery delays, highlighting a market segment with strict expectations for on-time delivery. As the potential delay increases, consumer tolerance sharply decreases. Only 16 individuals are willing to accept a 2-hour delay, suggesting that as wait times grow, customer satisfaction likely diminishes. For longer delays of 3 and 4 hours, the tolerance levels drop significantly further, with just 2 and 1 individuals respectively open to such extended wait times. This steep tolerance decline underscores timely deliveries' importance in maintaining customer satisfaction and loyalty.

Table 2. Preferences when delivery is late

Preference	Frequency	Percentage
I only accept deliveries when I am home	59	49
At the door	43	36
In the yard (private house)	9	8
At a nearby pickup location / store	5	4
At the neighbour's	4	3

Table 2 presents the preferences of e-grocery consumers when faced with a late delivery scenario. The most preferred option, chosen by approximately 49.17% of respondents (59 individuals), is only accepting deliveries when they are home. This preference indicates a significant portion of consumers prioritize being present to receive their groceries, which may be due to concerns over food safety, theft, or personal convenience. The second most popular option, with 35.83% (43 respondents), is to have the groceries left at the door. This choice suggests a level of trust in the delivery process and a preference for the convenience of not needing to be home to receive the items. A smaller segment of the sample, 7.5% (9 respondents), prefers having items left in the yard if they reside in a private house. This option might be favoured due to its security and privacy, especially in areas where leaving items at the door may not be safe or practical. Another alternative, preferred by 4.17% (5 individuals), is to collect the late delivery from a nearby pickup location or store. This preference could be driven by the consumer's desire for flexibility and control over the retrieval of their groceries. Lastly, having groceries left at the neighbour's is the least favoured option, with only 3.33% (4 respondents) selecting this. This low percentage could reflect concerns about imposing on neighbours or uncertainty about the neighbour's availability to receive the delivery. Overall, Table 2 reveals a clear preference for personal receipt of deliveries, with a majority of consumers opting for direct delivery to their home or at the door, signifying the importance of flexible and reliable delivery services in the e-grocery sector.

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Table 3. Preference for failed delivery

Preference	Frequency	Percentage
Cancel the order and get a refund	43	34
Pickup from a nearby location	40	33
Reschedule for another day	37	28

Table 3 outlines consumers' preferences in the event of a failed e-grocery delivery. The most common preference, selected by approximately 34.17% of respondents (43 individuals), is to cancel the order and receive a refund. This choice may reflect a consumer's desire for immediate resolution and financial reimbursement when service expectations are not met. Nearly as many respondents, about 33.33% (40 individuals), prefer picking up their groceries from a nearby location following a failed delivery. This alternative suggests a segment of the market values convenience. It may be willing to take additional steps to retrieve their items rather than wait for another delivery attempt or process a refund. Rescheduling the delivery for another day is a slightly less popular option, chosen by 28.33% (37 respondents). This preference indicates that many consumers are flexible and willing to accommodate another delivery time, possibly due to their importance on receiving their specific grocery items. Overall, Table 3 highlights a split in consumer preferences regarding failed deliveries, with no single option overwhelmingly favoured.

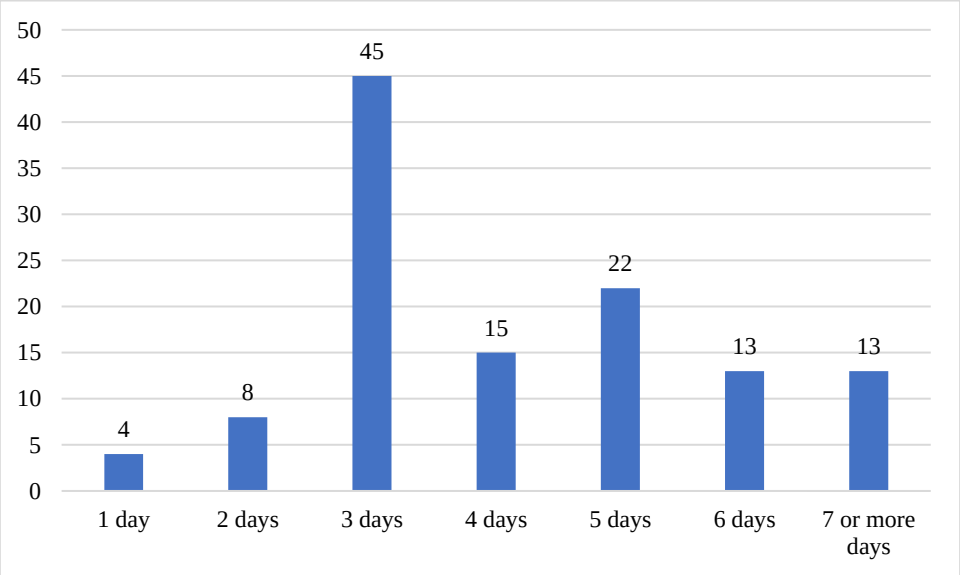

Figure 4. Preferred shelf life when buying fresh products

Figure 4 displays the preferred shelf life for fresh products as indicated by e-grocery shoppers. The chart shows a strong preference for a shelf life of 3 days, with 45 individuals choosing this option, suggesting that consumers seek a balance between freshness and practicality in their perishable goods. A shelf life of 1 day is the least preferred, with only 4 respondents opting for it, which may reflect concerns about the immediate need for consumption or potential waste. Preferences gradually decrease as the shelf life extends to 4 and 5 days, chosen by 15 and 22 individuals, respectively, indicating that while there is still a demand for relatively long-lasting freshness, there is less desire for products that may sit for an extended period before use. The preference levels out for shelf lives of 6 days and 7 or more days, with each category chosen by 13 respondents. These choices may reflect a smaller consumer segment that plans their shopping less frequently or requires longer-lasting freshness due to lifestyle or scheduling constraints. Overall, this data suggests that e-grocery retailers should prioritize stocking fresh products with an optimal shelf life of around 3 days to meet the majority's preference while catering to varied needs for shorter and longer shelf-life expectations.

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Table 4. Preferences for locally sourced products

Criteria	Category	Frequency	Percentage
Importance of locally sourced products	Very unimportant	7	6
	Unimportant	14	12
	No difference	47	39
	Important	39	33
	Very important	13	11
Frequency of purchased local products	Never	2	2
	Rarely	26	22
	Sometimes	54	45
	Often	34	28
	Always	4	3
Would buy online if products were from local producers	No opinion	53	44
	Yes	41	34
	No	26	22

From Table 4, it is observed that the largest group of respondents, representing 39.17% (47 individuals), perceives no difference in whether the products are locally sourced or not. This suggests that for a significant portion of consumers, the local aspect of produce is neither a deterrent nor an incentive when making purchasing decisions. Meanwhile, a substantial number of consumers place value on local sourcing, with 32.5% (39 individuals) considering it important and a further 10.83% (13 individuals) viewing it as very important. These consumers likely appreciate the benefits associated with local sourcing, such as supporting local farmers, ensuring fresher goods, and contributing to sustainability efforts. Conversely, a smaller percentage of the sample deem locally sourced products as unimportant (11.67% or 14 individuals) or very insignificant (5.83% or 7 individuals), indicating that factors other than the origin may play a more significant role in their purchasing decisions, such as price, convenience, or brand preference.

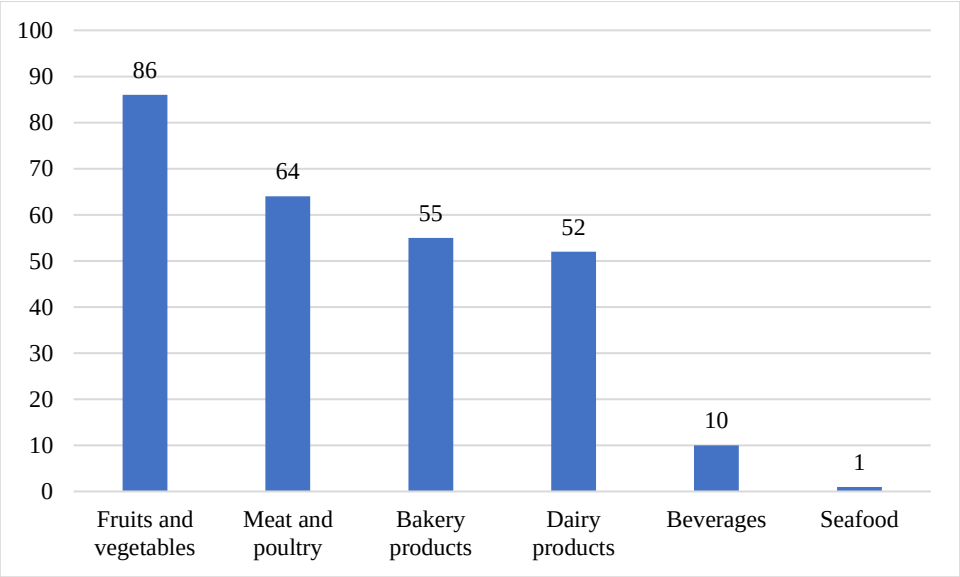

Figure 5. Purchased food categories from local producers

Figure 5 depicts consumer purchasing patterns from local producers across various food categories. Fruits and vegetables emerged as the most frequently purchased category from local producers, with a striking 86 mentions. This preference underscores a widespread consumer desire for fresh, locally grown produce, often associated with better taste and nutritional value. Meat and poultry hold the second spot with 64 mentions, indicating a strong preference for locally sourced options in these categories. Consumers might prefer local sources for reasons such as supporting local economies, perceived freshness, or ethical considerations related to the treatment of animals. Bakery products are the third most common choice, with 55 mentions suggesting a significant appreciation for local bakeries and the artisanal quality of their products. Dairy products closely follow with 52 mentions, showing a preference for local dairy, possibly due to the perception of higher quality

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and freshness or the desire to avoid processed alternatives. Beverages and seafood have markedly fewer mentions, with 10 and 1, respectively, suggesting these categories are less frequently associated with local sourcing by consumers. The low number of seafood could be due to geographic limitations, as consumers in landlocked areas have limited access to locally sourced seafood. The data indicates a clear consumer inclination towards purchasing fresh and perishable items like fruits, vegetables, and meats from local producers, with a notable drop in preference for either shelf-stable items or less commonly sourced locally.

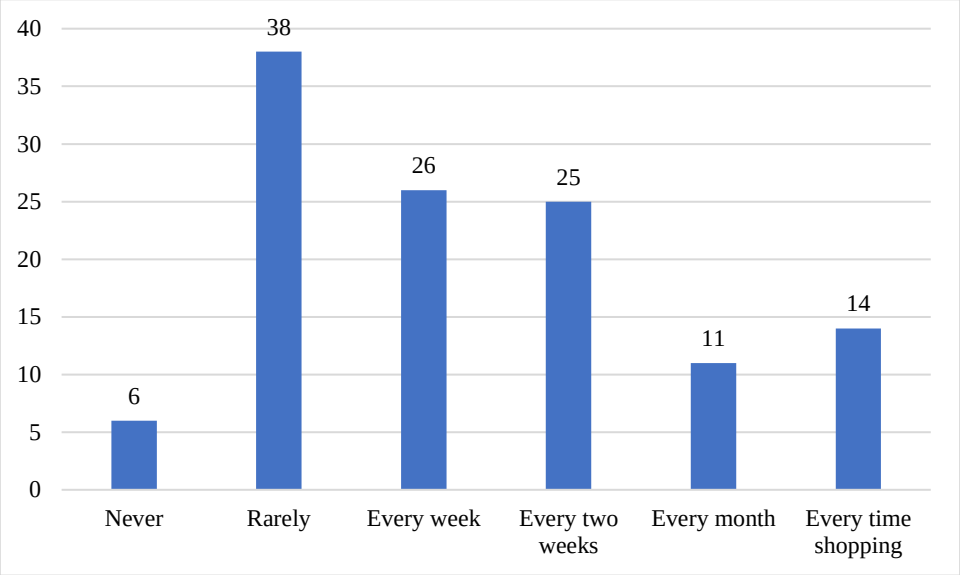

Figure 6. Frequency of temperature-controlled product purchase

Figure 6 presents the frequency with which consumers purchase temperature-controlled products from e-grocery platforms. The category "Rarely" stands out as the most selected option, with 38 individuals indicating that they seldom buy temperature-controlled items online. This could suggest a degree of consumer apprehension towards purchasing such products without physical inspection or concerns about the ability of e-grocery services to maintain proper temperature control during delivery. The next most common frequency is purchasing temperature-controlled products weekly, chosen by 26 respondents. This group likely consists of consumers who trust the delivery process and have incorporated e-grocery shopping into their routine. The option of buying these products every two weeks is nearly as prevalent, with 25 respondents selecting it, indicating a bi-weekly grocery shopping habit that includes temperature-sensitive items. A smaller number of consumers, 11 respondents, reported making such purchases every month. This could reflect a market segment planning their grocery shopping extensively or purchasing temperature-controlled products in person. Interestingly, 14 respondents indicated they purchase temperature-controlled products every time they shop online, demonstrating a segment of consumers who are possibly very comfortable with the reliability of temperature control in e-grocery logistics. Only 6 respondents stated they never purchase temperature-controlled products online, possibly due to a lack of need or significant concerns over product quality and safety during transit.

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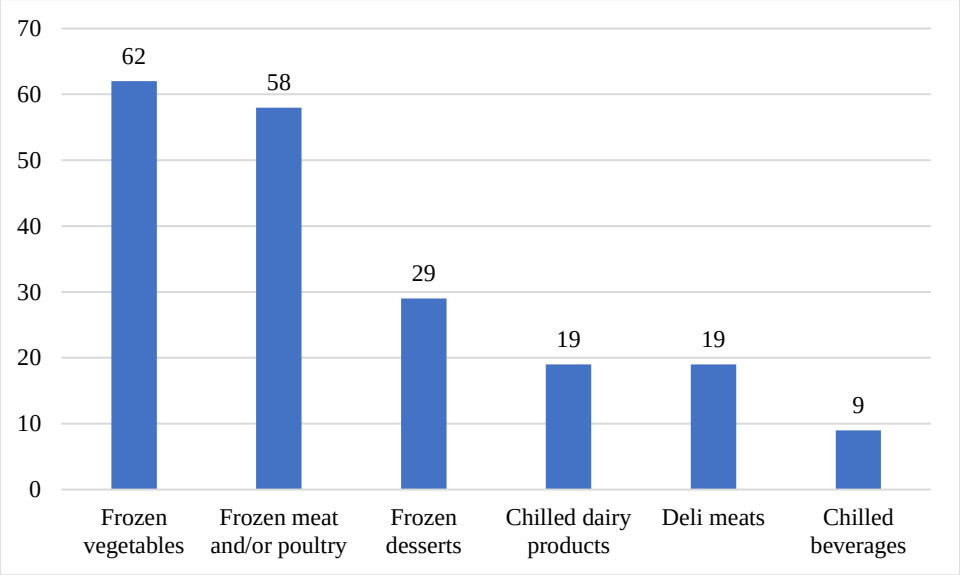

Figure 7. Purchased temperature-controlled food categories

Figure 7 illustrates consumers' preferences when purchasing various temperature-controlled food categories from e-grocery stores. Frozen vegetables are the most commonly purchased category, with 62 instances. This high number indicates a significant consumer preference for purchasing these products online, which could be due to their longer shelf life and convenience. Frozen meat and/or poultry is another highly purchased category, with 58 mentions. The popularity of frozen proteins suggests that consumers trust the e-grocery delivery system to maintain the integrity of these products during transit. Frozen desserts follow with 29 mentions, indicating a moderate preference for buying these items online. This could be because frozen desserts are seen as non-essential items compared to the staples of vegetables and meat. Chilled dairy products and deli meats are equally purchased, each receiving 19 mentions. The equal preference may suggest that consumers are generally comfortable purchasing refrigerated items but may have less need to buy these products as frequently as frozen goods. Lastly, chilled beverages are the least purchased category, with only 9 mentions. This could be due to the availability of these items in other, more immediate retail settings or a lesser need for these products to be temperature-controlled during delivery. Overall, the data from Figure 7 indicates that consumers are most inclined to purchase staple food items such as vegetables and meat from e-grocery services, with a lesser emphasis on chilled items like beverages, which could be more commonly purchased during regular shopping trips.

Table 5. Consumer Attitudes Toward Temperature-Controlled Food Delivery

Question	Answer	Frequency	Percentage
Do you think that temperature-controlled food products maintain their nutritional value?	Strongly disagree	4	3
	Disagree	26	22
	Unimportant	15	13
	Agree	70	58
	Strongly agree	5	4
Are you concerned about the safety of temperature-controlled food products (e.g., spoilage or freezer burn)?	Do not care at all	6	5
	Do not care	8	7
	Unimportant	23	19
	Care	70	58
	Care a lot	13	11
What is the longest time you think would be safe if temperature-controlled food products are not properly stored during delivery?	15 minutes	21	18
	30 minutes	31	26
	1 hour	43	36
	2 hours	10	8
	I do not think it is safe at any time	15	13
Would you buy temperature-controlled food products online?	Definitely not	16	13
	No	21	18
	I do not know	54	45
	Yes	22	18
	Definitely yes	7	6

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The survey investigated four different aspects of consumer attitudes and concerns regarding temperature-controlled food delivery. Table 5 provides a comprehensive insight into consumer preferences in this area. Regarding the importance of temperature control in food delivery, a majority of respondents, 58.33% (70 individuals), agreed with its significance, indicating a substantial consumer emphasis on maintaining the correct temperature to ensure food safety and quality. Only a minority, 3.33% (4 individuals), strongly disagreed, suggesting that this feature is not a priority for all consumers. Concerns about the safety of temperature-controlled foods during delivery were also prominent, with 58.33% (70 individuals) of participants expressing that they care about this aspect, and an additional 10.83% (13 individuals) indicating they care a lot. This concern is understandable, given the potential risk of spoilage and foodborne illnesses if temperature control fails during transit. When asked about the longest safe time for temperature-controlled food to remain unrefrigerated, the most common threshold was 1 hour, with 35.83% (43 individuals) considering it acceptable. A notable 12.5% (15 individuals) did not believe it is safe for these foods to be unrefrigerated at any time, highlighting a significant group that places strict limits on delivery times to ensure food safety. Lastly, when it comes to purchasing temperature-controlled food products from an e-grocery platform, 45% (54 individuals) were uncertain, indicating potential doubts about the ability of such platforms to handle these products adequately. Meanwhile, 18.33% (22 individuals) responded affirmatively, suggesting a level of trust in the current capabilities of e-grocery services.

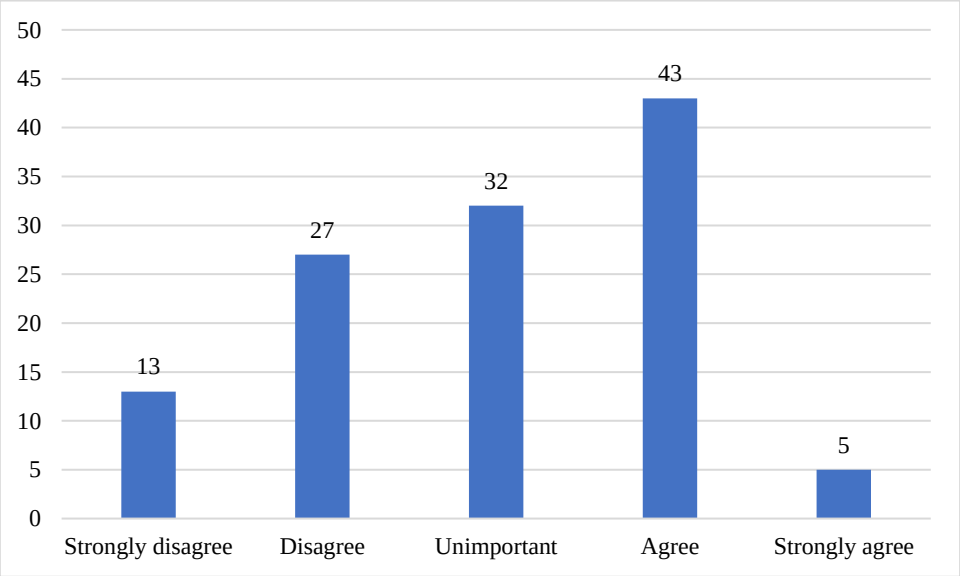

Figure 8. E-grocery helps to maintain a better diet

Figure 8 represents consumer opinions on whether e-grocery shopping contributes to maintaining a better diet. The largest group of respondents, 43 individuals, agree that e-grocery shopping helps maintain a better diet, suggesting that many consumers find the convenience and variety offered by online grocery shopping conducive to healthier eating habits. A significant portion, 32 respondents, remains neutral, indicating that they do not see a notable difference in their diet due to e-grocery shopping. This group may not perceive an impact or may not utilize e-grocery services in a way that affects their dietary choices. On the other side, 27 individuals disagree, and a smaller contingent of 13 respondents strongly disagree with the statement, making up a considerable section of the sample that does not associate e-grocery shopping with improving their diet. These consumers may be concerned about the healthy options available online or prefer to select fresh products in person. Lastly, a minority of 5 respondents strongly agree, implying a high confidence level in e-grocery shopping as a tool for enhancing dietary habits, possibly due to the ease of accessing nutritional information and making deliberate, healthy choices online. These insights into consumer perceptions reveal that while there is a trend towards believing in the positive impact of e-grocery on diet, there remains a diversity of opinions, indicating the need for e-grocery platforms to enhance features that promote healthy choices and educate consumers about the benefits of their offerings.

This chapter has consolidated the diverse strands of data into a coherent narrative that sheds light on the preferences and behaviours of e-grocery consumers. The insights garnered lay a foundation for e-commerce platforms to tailor their services more effectively, addressing the intricacies of consumer demand. As the digital grocery landscape continues to evolve, the findings underscore the need for ongoing research to navigate the shifting dynamics of consumer engagement and to ensure that e-commerce growth is both consumer-centric and sustainable.

Conclusion & Discussion

Our research focused on the behaviours and preferences of e-grocery consumers in Lithuania. The main findings included strong engagement with e-grocery services, particularly among young adults and women, indicating a trend for targeted marketing and service enhancements. Respondents' diverse educational and occupational backgrounds highlight an informed and varied customer base for e-groceries. The study also explored preferences for order timing, reactions to delivery delays, and attitudes towards perishable goods and local sourcing. These insights contribute to understanding evolving consumer behaviours in the digital grocery landscape and inform strategies for e-commerce platforms. We notice several overlaps and contrasts when discussing these findings with other research. For example, Diagourtas et al. (2023) and Wallnoefer and Riefler (2022) also highlighted the influence of sociodemographic factors on consumer behaviours, though in the context of organic food and local food consumption, respectively. Both studies and the Lithuanian case emphasize the importance of understanding consumer motivations and preferences in different cultural and situational contexts. Jaeger, Harker & Ares (2023) and Vasko et al. (2023) focused on consumer attitudes towards specific food categories (biodynamic agriculture and food waste management), much like the Lithuanian study's exploration of local food sourcing and perishable goods. Collectively, these studies illustrate the diverse factors that influence consumer decisions in different regions. The findings of Qaiser et al. (2023) and Kusz et al. (2023) about the effects of COVID-19 on consumer behaviours in Pakistan and Poland, respectively, provide a broader context to understand the Lithuanian consumers' preferences during a pandemic. The impact of the pandemic on consumer behaviours across these studies underscores the need for adaptability and innovation in e-grocery services. Kolondam et al. (2023) and Park (2023) explored factors influencing e-grocery consumer satisfaction in Indonesia and South Korea, aligning with the Lithuanian study's focus on delivery preferences and service quality. These studies suggest a global trend towards prioritizing convenience, service quality, and tailored offerings in e-grocery shopping. Lastly, the study by AlTarrah et al. (2021) on the impact of COVID-19 in Kuwait offers a comparative perspective on how global events can uniformly influence consumer behaviours, echoing some of the trends observed in the Lithuanian study. Our survey distinctively hones in on the complexities of temperature-controlled delivery, a critical aspect of e-grocery that profoundly influences consumer trust and satisfaction, especially for perishable and frozen products. This focus is integral to understanding the logistics challenges and consumer preferences in maintaining product integrity during transit, a key area that sets our research apart.

The comprehensive analysis of survey data has revealed key insights into consumer behaviours and preferences in e-grocery shopping. It was observed that young adults, particularly women, are significantly engaged with e-grocery services, highlighting the potential for developing targeted marketing strategies and tailored services for this demographic. Additionally, the respondents displayed diverse educational backgrounds, with a predominance of at least secondary education, indicating an informed customer base. This diversity extended to their employment status, with students and employed individuals represented most, reflecting the broad appeal of e-grocery services across different occupational backgrounds. A distinct preference emerged for placing e-grocery orders at the start and end of the week, particularly in the evenings. This pattern suggests that e-grocery platforms should optimize their delivery logistics to accommodate these peak periods better. In terms of delivery expectations, while most consumers are willing to tolerate up to a one-hour delay, a significant portion expects punctual delivery, highlighting the importance of reliable and timely service. When faced with late deliveries, most consumers prefer personal receipts at home, valuing food safety and convenience. However, for failed deliveries, preferences were split, suggesting that e-grocery platforms should offer various solutions to cater to varying customer needs. The survey also revealed a preference for a three-day shelf life for fresh products, balancing freshness with practicality, which e-grocery retailers should consider in inventory management.

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Regarding product sourcing, while a substantial number of consumers valued locally sourced products, a significant portion was indifferent, indicating the need for diverse product offerings by e-grocery retailers. A cautious approach was noted towards purchasing temperature-controlled items online, with consumers tending to buy these items less frequently. This suggests a need for e-grocery platforms to build trust in their delivery processes for temperature-sensitive products. Finally, many consumers agreed that e-grocery shopping aids in maintaining a better diet, yet a notable segment perceived online grocery shopping as neutral or ineffective in improving their diet, suggesting varied influences of e-grocery on dietary choices.

The survey results have significant implications for various stakeholders, including policymakers, e-commerce platforms, and other entities involved in the food supply chain. Understanding the nuances of these implications is crucial for strategizing and making informed decisions.

Policymakers:
Policymakers are crucial in shaping the e-grocery sector. Their role involves creating policies for equitable access to healthy online food options and promoting digital literacy for older adults. This is pivotal in enhancing consumer well-being and market expansion, and includes setting standards for reliable delivery services to protect consumer interests.

E-Commerce Platforms:
E-commerce platforms can leverage consumer insights to optimize delivery schedules and logistics, particularly during peak orders. Adapting to consumer preferences for delivery handling and offering a range of fresh, high-quality food options, including temperature-controlled products, can boost customer loyalty and trust, which is essential for the sector's growth.

Local Producers and Suppliers:
Local producers have an opportunity to enhance their presence on e-grocery platforms. They should focus on marketing the benefits of locally sourced products and educating consumers about their value. This approach can attract and convert customers, expanding the market presence for local products in the e-grocery sector.

Logistics and Supply Chain Managers:
Logistics and supply chain managers must focus on improving cold chain logistics for temperature-sensitive products. Innovations in packaging and real-time tracking can increase consumer trust and reduce apprehension, potentially increasing sales in this category. Enhancing cold chain logistics is vital to setting new standards in online grocery delivery and boosting overall consumer confidence.

While providing valuable insights into consumer behaviours and preferences in e-grocery shopping, the study has limitations. One notable limitation is the relatively small sample size, which restricts the generalizability of the findings. The sample predominantly comprised younger demographics, which may not accurately reflect the views and behaviours of older consumers or those from diverse backgrounds. While valuable for understanding a key segment of the e-grocery market, this focus on youth means that the findings might only partially represent the broader consumer base's perspectives and needs. Furthermore, the nature of this study as a pilot survey implies that it was exploratory and intended to provide preliminary insights rather than definitive conclusions. The scope of the survey was somewhat limited in terms of the breadth of topics covered and the depth of the questions asked. Given these limitations, future research should expand the sample size and include a more diverse range of participants to ensure a more comprehensive understanding of consumer behaviours across different demographics. Future surveys could also delve deeper into specific areas of interest that emerged from this pilot study, such as the role of e-grocery platforms in promoting healthier eating habits or the effectiveness of different delivery logistics strategies.

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SUSTAINABLE ENTREPRENEURSHIP IN THE KINGDOM OF SAUDI ARABIA: A SYSTEMATIC EVALUATION OF EXTANT RESEARCH

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Abstract. Sustainable entrepreneurship is crucial as it represents a proactive approach to business that seeks financial success and addresses pressing environmental and societal challenges, contributing to a more resilient and responsible global economy. Comparably, the importance of sustainable entrepreneurship in the Kingdom of Saudi Arabia (KSA) lies in its capacity to foster economic resilience, environmental stewardship, and social development, aligning with the nation's 2030 vision for a diversified and sustainable future. Despite the growing number of publications assessing sustainable entrepreneurship in recent years, there remains a need for further advancement in this field. In the context of KSA, despite notable efforts in existing studies, there is a compelling need to delve into the factors driving sustainable entrepreneurship. This exploration is crucial as it represents a departure from traditional norms in entrepreneurial practices. It is vital for comprehending the elements that can initiate and foster sustainable entrepreneurial behaviour, among other research agendas. Therefore, this systematic review focuses on identifying and analyzing publications that explore sustainable entrepreneurship in KSA to highlight current contributions to the field and suggest future research directions.

Keywords: Sustainable entrepreneurship; Saudi Arabia; women entrepreneurship; entrepreneurship ecosystems; entrepreneurial resilience; innovation

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1. Introduction

Entrepreneurship is a multifaceted concept encompassing behaviours focused on identifying and developing economic opportunities. These opportunities are owned and managed by individuals who bear the risk of establishing a business (Hoogendoorn et al., 2019). Specifically, entrepreneurship can be academically assessed regarding the methods, means, and parties involved in recognizing, evaluating, and exploiting opportunities to initiate products and services (Shane and Venkataraman, 2000). Consistent with these definitions, sustainable entrepreneurship is "the discovery, creation, and exploitation of entrepreneurial opportunities that contribute to sustainability by generating social and environmental gains for others in society" (Pinkse and Groot, 2015, p. 634). Traditionally, entrepreneurship was viewed as a tool for generating economic benefits; however, the growing importance of sustainability and its relevance to the global system have been pivotal in reshaping the purpose of entrepreneurship (Terán-Yépez et al., 2020). Sustainable entrepreneurship is closely aligned with the United Nations' Sustainable Development Goals (SDGs) (Pacheco et al., 2010).

Despite the increase in publications that evaluate sustainable entrepreneurship in the past few years, it still requires further development (Terán-Yépez et al., 2020; Volkmann et al., 2021). The broader academic literature often focuses on theoretical contributions, as a comprehensive theory of sustainable entrepreneurship has not yet been established (Terán-Yépez et al., 2020). In the context of KSA, despite the significant efforts observed in extant research (Abed, 2021; Alhothali and Al-Dajani, 2022), the examination of the drivers of sustainable entrepreneurs has become imperative, given that it signifies a departure from conventional norms observed in entrepreneurship practice. This scrutiny is essential for understanding the factors that can instigate and nurture sustainable entrepreneurial behaviour (Abed, 2021; Cardella et al., 2020; Mohamed et al., 2023). Furthermore, while several studies have assessed the primary predictors among individual factors contributing to success in sustainable entrepreneurship (Al-Tit et al., 2019), environmental and social concerns have not been adequately addressed. The studies did not explicitly investigate the lack of sustainable entrepreneurship research concerning communities, non-profit organizations, and establishments beyond the private sector. Despite scholarly efforts over the past decade to address these gaps, organizations of this nature are currently confronting escalating expectations to demonstrate entrepreneurial behaviours and explore new avenues for self-funding (Wagner et al., 2021).

Furthermore, the research on sustainable entrepreneurship in KSA is identified as fragmented and lacking cohesion. Specifically, twenty publications addressed sustainable entrepreneurship (Table 1). These studies were selected after employing rigorous criteria and a specific timeframe (2019-2023). The analysis of the studies identifies eight overarching themes—women entrepreneurship, education's role, governance and policy implications, SMEs and family-owned businesses, region-specific sustainable entrepreneurship, entrepreneurship ecosystems, innovation, and entrepreneurial resilience. Still, several notable findings emerged from the analysis. Geographical comparisons were evident, particularly in women's entrepreneurship and entrepreneurial ecosystems studies. The government's role, emphasizing top-down policy initiatives and knowledge dissemination, is featured in many studies. Economic diversification, especially in the Riyadh province, was identified as crucial for promoting sustainable entrepreneurship. Gender-based evaluations revealed limitations in existing studies, particularly in understanding gender differences in factors influencing entrepreneurial resilience and women entrepreneurs' sustainable behaviour. Theory utilization varied, with a few papers employing specific theories, which warrants more exploration of underutilized theories in the context of sustainable entrepreneurship in KSA.

Consequently, this systematic review primarily aims to identify and analyze publications investigating sustainable entrepreneurship within the Kingdom of Saudi Arabia. The objective is to underline existing contributions to the field and propose future research recommendations. To achieve this objective, the paper begins by presenting the systematic review's criteria and scope. Subsequently, the selected studies are subjected to further evaluation to discern common themes and emphasize their contributions to sustainable entrepreneurship. Each identified theme is comprehensively discussed, and inherent limitations are explicitly specified. A comprehensive discussion is presented to provide an overview of the noteworthy outcomes derived from the evaluation. The review's conclusion includes a depiction of the future research agenda tailored to the identified gaps and areas warranting further exploration.

2. Systematic review criteria and scope

To conduct a systematic review of existing literature, several measures were implemented to select and refine the chosen papers. First, Google Scholar was employed as the research engine, and the search query "sustainable entrepreneurship in Saudi Arabia" was utilized. Second, the timeframe was restricted to papers published between 2019 and 2023. Third, the relevance and context of the identified papers were carefully assessed, and only journals listed in the Web of Science master journal list were chosen for further analysis. This selection criterion is attributed to the stringent standards employed by the Web of Science master journal list, which includes journals demonstrating high levels of editorial diligence and best review practices. Additionally, the publications were retrieved in December 2023; hence, this paper does not consider any publications beyond the date of extraction.

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After applying the aforementioned criteria, 20 papers were selected (Table 1). Notably, research on sustainable entrepreneurship in Saudi Arabia is limited and exhibits disparities in volume and perspective. Despite gaining momentum since 2019, the existing body of research, particularly those published in high-quality journals, is considered to be in its early stages. Consequently, this study aims to supplement the current literature by incorporating additional research that evaluates sustainable entrepreneurship in general. It is crucial to highlight that only studies listed in the Web of Science master journal list will be included in this evaluation.

Table 1. Publications that evaluate sustainable entrepreneurship in Saudi Arabia

#	Title	Year	Journal	Author/s
1	Critical Success Factors of Small and Medium-Sized Enterprises in Saudi Arabia: Insights from Sustainability Perspective	2019	Administrative Sciences	Al-Tit et al. (2019)
2	Cultural Antecedents of Green Entrepreneurship in Saudi Arabia: An Institutional Approach	2020	Sustainability	Alwakid et al. (2020)
3	Role of Education and Economic Growth on the CO2 Emissions in Saudi Arabia	2020	Entrepreneurship and Sustainability Issues	Alkhateeb et al. (2020)
4	Internal and External Barriers to Entrepreneurship in Saudi Arabia	2021	Digest of Middle East Studies	Abdulghaffar and Akkad (2021)
5	Entrepreneurial Ecosystem, Entrepreneurial Self-Efficacy, and Entrepreneurial Intention in Higher Education: Evidence from Saudi Arabia	2021	The International Journal of Management Education	Elnadi and Gheith (2021)
6	Women Entrepreneurs' Adoption of Mobile Applications for Business Sustainability	2021	Sustainability	Abed (2021)
7	Role of Education, Training, and E-Learning in Sustainable Employment Generation and Social Empowerment in Saudi Arabia	2022	Sustainability	Singh et al. (2022)
8	Entrepreneurial Competency, Financial Literacy, and Sustainable Performance—Examining the Mediating Role of Entrepreneurial Resilience among Saudi Entrepreneurs	2022	Sustainability	Seraj et al. (2022)
9	Green Economy Performance and Sustainable Development Achievement: Empirical Evidence from Saudi Arabia	2022	Environment Development and Sustainability	Chaaben et al. (2022)
10	An Evaluation of the Effectiveness of Innovation Ecosystems in Facilitating the Adoption of Sustainable Entrepreneurship	2022	Journal of Small Business Management	Bakry et al. (2022)
11	Emotions and Resilience in Saudi Women's Digital Entrepreneurship during the COVID-19 Pandemic	2022	Sustainability	Alhothali and Al-Dajani (2022)
12	The Role of Sustainable Entrepreneurship and Corporate Social Performance on Social Innovation: The Case of the Private Industrial Sector in Saudi Arabia	2022	Journal of the Knowledge Economy	Alfalih (2022)
13	Developing Entrepreneurial Sustainability among Saudi Arabia's University Students	2022	Sustainability	Abdelwahed (2022)
14	Women, Entrepreneurship, and Sustainability: The Case of Saudi Arabia	2022	Sustainability	Abdelwahed et al., (2022)
15	Redefining Resilience: The Case of Small Entrepreneurs in Saudi Arabia	2023	Frontiers in Environmental Science	Alshebami (2023a)
16	Green Innovation, Self-Efficacy, Entrepreneurial Orientation and Economic Performance: Interactions among Saudi Small Enterprises	2023	Sustainability	Alshebami (2023b)
17	Using the PLS-SEM Model to Measure the Impact of the Knowledge Economy on Sustainable Development in the Al-Jouf Region of Saudi Arabia	2023	Sustainability	Fahad S. Almawishir and Benlaria (2023)
18	Riyadh: Evolving to Become as One of the MENA Region's Key Entrepreneurial Ecosystems	2023	Sustainability	Roomi et al. (2023)
19	The Role of Governance in Achieving Sustainability in Family-Owned Business: Do Responsible Innovation and Entrepreneurial Culture Matter	2023	Sustainability	Al Rawaf and Alfalih (2023)
20	Born Not Made: The Impact of Six Entrepreneurial Personality Dimensions on Entrepreneurial Intention: Evidence from Healthcare Higher Education Students	2023	Sustainability	Mohamed et al. (2023)

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3. Key themes of extant publications

The publications listed in Tables 1 and 3 were comprehensively examined to identify key themes. A significant number of studies focused on women entrepreneurship (Abdelwahed et al., 2022; Abed, 2021; Alhothali and Al-Dajani, 2022), the role of education (Alkhateeb et al., 2020; Elnadi and Gheith, 2021; Singh et al., 2022), governance and policy implications (Al Rawaf and Alfalih, 2023; Abdelwahed et al., 2022; Chaaben et al., 2022), SMEs and family-owned businesses (Al-Tit et al., 2019; Al Rawaf and Alfalih, 2023; Alshebami 2023a; Alshebami 2023b; Seraj et al., 2022), region/city specific sustainable entrepreneurship (Abdulghaffar and Akkad, 2021; Abdelwahed et al., 2022; Abdelwahed, 2022; Alhothali and Al-Dajani, 2022; Elnadi and Gheith, 2021; Fahad S. Almawishir and Benlaria 2023; Mohamed et al., 2023; Roomi et al., 2023; Singh et al., 2022), entrepreneurial ecosystem (Bakry et al., 2022; Elnadi and Gheith, 2021; Roomi et al., 2023), innovation (Al Rawaf and Alfalih, 2023; Alfalih, 2022; Alshebami 2023b; Bakry et al., 2022; Fahad S. Almawishir and Benlaria, 2023) and entrepreneurial resilience (Alhothali and Al-Dajani, 2022; Alshebami, 2023a; Seraj et al., 2022). Once the themes are examined, an overview of the methodological aspects is provided.

Women entrepreneurship

The exploration of women's entrepreneurship has been significant among scholars as women are a rapidly expanding category of entrepreneurs (Cardella et al., 2020). According to the literature, women play a crucial role in entrepreneurial activity (Noguera et al., 2013) and economic development (Hechavarria et al., 2019) by creating employment opportunities and increasing the gross domestic product (GDP) (Bahmani-Oskooee et al., 2013), which leads to poverty reduction and social inclusion (Cardella et al., 2020). Despite these significant contributions, women entrepreneurs are lower in number than men, especially as the country's level of development increases (Cardella et al., 2020).

In the context of KSA, women entrepreneurship has gained adequate attention from scholars (Abdelwahed et al., 2022; Abed, 2021; Alhothali and Al-Dajani, 2022). This can be attributed to the kingdom's substantial efforts to align its practices with the United Nation's SDG, specifically, gender equality, and to enhance the role that Saudi women play in the kingdom's social, political, and economic development (Alhothali and Al-Dajani, 2022). Based on the extant literature, three studies examined women entrepreneurship in the context of KSA (Abdelwahed et al., 2022; Abed, 2021; Alhothali and Al-Dajani, 2022); specifically, these studies examine Saudi women's awareness and adoption of sustainability practices and behaviours (Abdelwahed et al., 2022), the resilience of women that own micro-businesses in times of economic and social struggle (Alhothali and Al-Dajani, 2022), and their adoption of mobile applications (Abed, 2021).

The findings indicate that despite the level of education of the selected sample, women entrepreneurs needed to be more knowledgeable about sustainability, emphasizing that they were not pressured by their target market, society, and government to partake in sustainable practices (Abdelwahed et al., 2022). As a result, women did not perceive sustainable practices as an opportunity in relation to their business operations and business models. Therefore, policymakers should embed sustainability into the country's education system and promote sustainable practices among entrepreneurs (Abdelwahed et al., 2022). However, regarding business sustainability, women entrepreneurs showcased positive intentions to use mobile applications, which is motivated by social influence and effort expectancy (Abed, 2021). Thus, it can be deduced that once women entrepreneurs realize the benefit of sustainability, they will be more willing to adopt sustainable business practices such as digital entrepreneurship (Alhothali and Al-Dajani, 2022).

Due to the scarcity of research on women entrepreneurship in Saudi Arabia and the limited generalizability of existing studies (as indicated in Table 3), it is important to highlight the overall shortage of studies on women entrepreneurs in a broader context, as noted by Cardella et al. (2020). Most of the extant research called for studies that examine women entrepreneurship in different geographical areas (Abdelwahed et al., 2022; Abed, 2021; Alhothali and Al-Dajani, 2022), specifically in developing countries (Cardella et al., 2020). Furthermore, future research should examine the factors influencing women entrepreneurs' sustainable behaviour, as behavioural intentions have already been discussed (Abed, 2021; Cardella et al., 2020). Moreover, investigating the facilitating conditions and barriers women entrepreneurs encounter is paramount (Abed, 2021; Cardella et

al., 2020). With respect to the use of theories and research methods, current research that examines women entrepreneurship did not utilize well-founded entrepreneurship theories such as the theory of entrepreneurship (value creation), as it provides a novel and all-encompassing framework that paves the way for broader theoretical perspectives and more rigorous empirical inquiries (Mishra et al., 2015). Moreover, future research should consider using mixed methods in evaluating future research recommendations (Table 3).

The role of education

The imparting of education, training, and skill development holds substantial sway over creating employment opportunities, economic advancement, and societal empowerment (Singh et al., 2022). In the context of KSA, several studies evaluated the role of education in association with sustainable entrepreneurship (Alkhateeb et al., 2020; Elnadi and Gheith, 2021; Singh et al., 2022). Education can substantially foster social responsibility within a community (Alkhateeb et al., 2020) and entrepreneurship intentions (Elnadi and Gheith, 2021). Still, additional efforts are required to reinforce sustainability-focused education in the region and its influence on the environment and economy (Alkhateeb et al., 2020), suggesting that education, government programs and support are key factors in developing students' entrepreneurial intentions and relevant skills (Elnadi and Gheith, 2021). Furthermore, there is a notable and direct correlation between education, training, e-learning, and the sustainable generation of employment, as well as social empowerment in KSA (Singh et al., 2022).

The studies were conducted in the Eastern province (Elnadi and Gheith, 2021) and Hial province (Singh et al., 2022), emphasizing the limitation of the sample size and the lack of generalizability. Furthermore, the research papers utilized the theory of constructivism (Singh et al., 2022), the theory of planned behaviour, the entrepreneurial event model (Elnadi and Gheith, 2021) and the Environmental Kuznets Curve (EKC) (Alkhateeb et al. 2020), using quantitative research methods. Extant research emphasizes the need to refer to the human capital and entrepreneurial self-efficacy theories as they support the correlation between entrepreneurship education and entrepreneurial intentions (Boldureanu et al., 2020). In addition, current research emphasizes the need for tailored programs for business and non-business students, as the impact of studying successful entrepreneurial stories differs between the two groups (Boldureanu et al., 2020). Of note, the studies that exclusively focus on education and sustainable entrepreneurship echo other studies in the KSA context that call for embedding sustainable entrepreneurship in the country's education system (Abdelwahed et al., 2022).

Governance and policy implications

Researchers examined governance and policy implications in relation to sustainable entrepreneurship in the context of KSA (Al Rawaf and Alfalih, 2023; Abdelwahed et al., 2022; Chaaben et al., 2022). These studies identified a positive and significant impact of organizational governance and responsible innovation on business sustainability in family-owned businesses in the country (Al Rawaf and Alfalih, 2023). The entrepreneurial culture has also been identified as a significant and positive moderator, influencing the relationships between organizational governance, responsible innovation, and business sustainability in these family-owned enterprises (Al Rawaf and Alfalih, 2023). Moreover, the studies highlight a significant improvement in Saudi Arabia's green economy, and results emphasize that the country's performance in the green economy has been influenced by the consequences of the COVID-19 crisis and the new infrastructure that was governed by the 2030 vision (Chaaben et al., 2022).

Notably, the studies emphasize the need to promote sustainable entrepreneurship through policy initiatives starting from the top-down level (Chaaben et al., 2022), as lack of knowledge was a key finding of extant research (Abdelwahed et al., 2022). Furthermore, it was noted that these studies lacked the utilization of established theories relevant to sustainable entrepreneurship, explanatory variables used in research, and reliance on quantitative research methods and analysis techniques (Al Rawaf and Alfalih, 2023). Especially as sustainable entrepreneurs initiate their enterprises and encounter challenges in the initial stages needs to be fully comprehended, they require government support such as subsidies and incentives (Hoogendoorn et al., 2019).

SMEs and family-owned businesses

The management of family-owned businesses differs notably from non-family-owned counterparts, characterized by family involvement in decision-making, overlapping business and family activities, and transgenerational business succession (Singh et al., 2021). In addition, small and medium-sized enterprises

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(SMEs) significantly impact the contemporary economy (Alshebami 2023b). The factors influencing the success of SMEs are the subject of extensive academic discussion (Alshebami 2023a). Scholars across different disciplines agree on the crucial role of SMEs' success in contributing to employment, wealth, and social and economic development (Nguyen et al., 2023). In the context of KSA, several factors to sustainable entrepreneurship that contributed to SMEs' success were identified: specifically, individual factors, business characteristics, management factors, business support, capital availability, and business environment. Business support is the most significant factor influencing SMEs' success (Al-Tit et al., 2019). This support entails financial, government, and family support (Al-Tit et al., 2019; Seraj et al., 2022).

The studies highlighted the importance of financial and government support and clarified the need to diversify the research methodology and sampling techniques (Al-Tit et al., 2019; Seraj et al., 2022; Alshebami, 2023a; Alshebami, 2023b; Al Rawaf and Alfalih, 2023). Of note, research examining SMEs and family-owned businesses in KSA, utilized a variety of theories as a foundation for their studies. For instance, the positive self-concepts of internal locus of control and self-efficacy theories (Alshebami 2023b); the resource-based view theory (Alshebami, 2023a); and the socio-emotional wealth, stewardship, and stakeholder theories (Al Rawaf and Alfalih, 2023). Despite the importance of evaluating business succession (Ahmad et al., 2020; Wang et al., 2019), extant research did not examine the issue of business succession in the family-owned businesses in KSA and how successor knowledge and willingness to succeed impact corporate sustainable innovation and successful business succession. Moreover, researchers should focus on evaluating the adoption of competitive strategies centred around stakeholders, emphasizing socially responsible behaviour (Ahmad et al., 2020).

Region-specific sustainable entrepreneurship

When examining the geographic locations in extant research, several studies explicitly stated the sample's location (Table 2). Specifically, Abdulghaffar and Akkad (2021) and Alhothali and Al-Dajani (2022) focused on the Western province of Saudi Arabia; Elnadi and Gheith (2021), Abdelwahed et al. (2022), Abdelwahed (2022), and Mohamed et al. (2023) studied the Eastern province; Singh et al. (2022) conducted research in Hail province; Fahad S. Almawishir and Benlaria (2023) explored Al Jouf province; and Roomi et al. (2023) centred their study on Riyadh province. The majority of the authors called for more diversification in terms of geographical location (Table 3). Still, a noteworthy limitation concerns the studies conducted in the Riyadh province. Even though it's crucial to examine sustainable entrepreneurship in all the regions in KSA, the entrepreneurial ecosystem in Riyadh serves as a significant catalyst for entrepreneurship and innovation within the MENA region. This is particularly crucial for Saudi Arabia's goal of achieving economic diversification within its industries and reducing reliance on oil (Roomi et al., 2023).

Table 2. Geographical location of extant research

	Author/s	Region
1	Abdulghaffar and Akkad (2021)	Western Province
2	Elnadi and Gheith (2021)	Eastern province
3	Singh et al. (2022)	Hail Province
4	Alhothali and Al-Dajani (2022)	Western Province
5	Abdelwahed (2022)	Eastern province
6	Abdelwahed et al. (2022)	Eastern province
7	Fahad S. Almawishir and Benlaria (2023)	Al-Jouf
8	Roomi et al. (2023)	Riyadh province
9	Mohamed et al. (2023)	Eastern province

Entrepreneurial ecosystem

Scholars define an entrepreneurial ecosystem as a multidimensional set of interacting factors that moderate the effects of entrepreneurial activity on economic growth (Bruns et al., 2017).

The concept of entrepreneurial ecosystems has become a prominent topic in entrepreneurship research. However, more attention needs to be paid to how these ecosystems promote sustainable entrepreneurship and contribute to the SDGs set by the United Nations (Volkmann et al., 2021). In the context of KSA, these factors are considered essential in fostering entrepreneurial intentions, namely, availability of funding, governmental policies and regulations supporting the establishment and expansion of businesses, government initiatives and

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assistance for emerging companies, availability of physical infrastructure, cultural elements, social considerations, and educational and training aspects (Elnadi and Gheith, 2021). Other factors were examined in the capital city of KSA; the results indicate that notable improvements were observed in factors such as connectivity, talent, physical infrastructure, and formal institutions, whereas other factors did not exhibit comparable development, which is leadership, funding, and knowledge (Roomi et al., 2023). Furthermore, Bakry et al. (2022) provided a comprehensive assessment framework for entrepreneurship and innovation ecosystems. Specifically, the framework aims to enhance the integration of innovation in sustainable entrepreneurship. The research concentrates on policies and strategies that foster various forms of innovation, presenting a model encompassing a comprehensive set of measures to guide the development of effective policies and strategies.

Of note, in alignment with other studies in KSA, the authors emphasized the need to evaluate the entrepreneurial ecosystem in different geographical locations (Elnadi and Gheith, 2021), and enhance the generalizability of the findings by improving the sample size (Bakry et al., 2022; Roomi et al., 2023). Furthermore, future research should consider shifting from a narrow economic focus to encompass larger societal and ecological contexts as extant research highlights the role of entrepreneurs in fostering non-economic benefits to society and catalyzing larger-scale socioeconomic transformations towards sustainability (Volkmann et al., 2021).

Innovation

Innovation is a crucial element in entrepreneurship. It simultaneously influences an organization's ability to uphold its competitive advantages, enabling it to effectively respond to swift and unexpected changes in the market and economy in which it operates (Ionescu et al., 2020). Sustainable innovation is viewed as a solution to foster sustainable development, and it is an integral part of sustainable entrepreneurship (Anand et al., 2021). Companies aware of these obligations and practising responsible innovation across various business functions (including inventory, production, sales, and risk management) can enhance their social and environmental performance and profitability. This, in turn, will positively affect their business's sustainability (Al Rawaf and Alfalih, 2023; Silva et al., 2018). However, the potential integration of innovation and sustainability in entrepreneurship faces various challenges related to sustainability innovation, social justice, and environmental issues. These challenges encompass funding, economic downturns, intellectual property laws, social awareness, and educational levels (Alfalih, 2022; Bakry et al., 2022). In KSA, Fahad S. Almawishir and Benlaria (2023) specified that innovation was not deemed as a crucial dimension in public and private institutions, as it was placed last with research and development. Therefore, evaluating the barriers to innovation adoption across institutions in KSA is instrumental, emphasizing the need for knowledge and government incentives.

Entrepreneurial resilience

Resilience refers to a business's capacity to sustain operational continuity and recover despite disruptions (Iyengar et al., 2021). In the context of entrepreneurship, research indicates that resilience stems from three dimensions, namely, hardiness, resourcefulness, and optimism. These dimensions predict entrepreneurial success, with resourcefulness emerging as the pivotal factor (Ayala et al., 2014). With respect to sustainable entrepreneurship in KSA, several studies examined entrepreneurial resilience (Alhothali and Al-Dajani, 2022; Alshebami, 2023a; Seraj et al., 2022). These studies examined factors such as entrepreneurial competency (Seraj et al., 2022), passion (Alhothali and Al-Dajani, 2022) and self-efficacy (Alshebami, 2023a). Specifically, the examined research indicated that entrepreneurial competency is crucial in enhancing SMEs' entrepreneurial resilience and sustainable performance in Saudi Arabia. Notably, entrepreneurial resilience is a significant mediator, influencing sustainable performance and mediating the impacts of financial literacy and competency on sustainable performance within Saudi SMEs (Seraj et al., 2022). Furthermore, entrepreneurs motivated by passion tend to experience positive emotions and thoughts, contributing to increased resilience in the face of difficulties (Alhothali and Al-Dajani, 2022). Moreover, the findings indicated that the ability to believe in one's entrepreneurial capabilities could mediate how an internal locus of control influences entrepreneurial resilience (Alshebami, 2023a). Still, the studies reported several limitations, such as limitations in relation to sample size, sampling method, and lack of generalizability (Alhothali and Al-Dajani, 2022; Alshebami, 2023a; Seraj et al., 2022).

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Table 3. Summary of the theoretical foundation, sample size, region/city, contributions and limitations of the examined studies

#	Author/s	Theoretical Foundation	Method/ analysis	Sample size	Region/ city	Contributions	Limitations
1	Al-Tit et al. (2019)	Not specified	Quantitative CFA-SEM	347	Not specified	Business support is the most significant factor that influences the success of SMEs	The sample was a cross-sectional sampling design from SMEs that benefit from funding sources
2	Alwakid et al., (2020)	Not specified	Quantitative Fixed Effect Models	84	21 cities	Environmental actions, environmental consciousness, and temporal orientation positively influence the extent of green entrepreneurial activity in various cities in Saudi Arabia	Incorporate city-specific variables Secondary data was used for the analysis Lack of cross-country comparisons Lack of data sources
3	Alkhateeb et al., (2020)	Environmental Kuznets Curve (EKC)	Quantitative ARDL equation	Sample period of 1971- 2014	Not specified	Increased level of education has a positive influence on the reduction of CO2 emissions	More initiatives are needed to support sustainability-related education in the kingdom and its impact on the environment
4	Abdulghaffar and Akkad (2021)	Theory of planned behaviour Institutional economic theory	Quantitative SEM	235	Jeddah	Personal characteristics and the business environment are crucial in shaping an entrepreneurial mindset.	Limited sample size in the city of Jeddah Utilize qualitative research design Lack of gender-specific assessment
5	Elnadi and Gheith, (2021)	The authors mentioned several theories in the theoretical background section, such as the theory of planned behaviour and the entrepreneurial event model.	Quantitative SEM	259 undergraduate students	Eastern province	Students with a favourable outlook on the factors within the entrepreneurial ecosystem also exhibit elevated levels of entrepreneurial intention. The pivotal factor influencing students' entrepreneurial intention is their self-efficacy. Significant differences were observed across genders	Limited sample from one university in one region Lack of cross-cultural perspective
6	Abed (2021)	The unified theory of acceptance and use of technology	Quantitative CFA-SEM	330 women entrepreneurs	Not specified	Social influence and effort expectancy exerts the most substantial impact on the intention to use mobile applications. Conversely, facilitating conditions were identified as an insignificant predictor of intention among female entrepreneurs.	The study focused on observing behavioural intention rather than actual usage behaviour. The study concentrated on entrepreneurs' intentions to use mobile applications rather than exploring the intentions of their consumers. The study's population was confined to respondents in Saudi Arabia, limiting the generalizability of the findings to other populations. The study did not explore the potential moderating effects of age, gender, experience, and voluntariness.
7	Singh et al. (2022)	Constructivism theory	Quantitative SEM	396 students	Hail	The results reveal a significant direct relationship between education, training, e-learning, sustainable employment generation, and social empowerment. Government policies are found to have a significant moderating effect, while national culture directly relates to social empowerment rather than sustainable employment generation.	Limited sample size scope to students that attend the University of Hail Examining moderation effects is limited to only two factors, namely government policies and national culture.
8	Seraj et al. (2022)	Not specified	Quantitative SEM	220 small business entrepreneurs	Not specified	The findings indicate a positive and significant relationship between financial literacy and entrepreneurial competency, where financial literacy positively influences entrepreneurial competency and resilience. Entrepreneurial competency significantly impacts the entrepreneurial resilience and sustainable performance of small and medium-sized enterprises (SMEs) in Saudi Arabia. Entrepreneurial resilience emerges as a significant mediator, simultaneously influencing sustainable performance and mediating the effects of financial literacy and competency on sustainable performance within Saudi SMEs	Limited factors that reflect SME performance Lack of cross-country examination Sample size and demographic diversity
9	Chaaben et al., (2022)	Green Economy Index Quintuple Helix Innovation Model	Quantitative Z-score/T-score	Secondary data was used	Not specified	The observed data indicates substantial advancement in the Green Economy index score for Saudi Arabia Moreover, the results affirm that the kingdom's performance in the realm of the green economy has been impacted by the aftermath of the COVID-19 crisis	The study does not explicitly state its limitations; still, recommendations are provided to policymakers to increase the score of the kingdom
10	Bakry et al. (2022)	Hierarchical decision	Qualitative Conceptual construction	11 experts	Not specified	The methodology illustrates a model that can be applied universally for evaluating innovation ecosystems.	Limited sample size

#	Author/s	Theoretical Foundation	Method/ analysis	Sample size	Region/ city	Contributions	Limitations
		model (HDM)	of a model validated by pairwise comparisons				
11	Alhothali and Al-Dajani, (2022)	The broaden-and-build theory	Qualitative longitudinal approach	8 women	Western region	The results indicate that digital entrepreneurship played a role in supporting micro businesses during challenging times. Entrepreneurs driven by passion also experience positive emotions and thoughts, fostering resilience in the face of hardship	The study is gender-specific and located in one region Lack of generalizability due to qualitative outcomes
12	Alfalih, (2022)	The authors mentioned several studies in the hypothesis section	Quantitative SEM	180 Employees in the industrial private sector	Not specified	The findings specify that corporate social performance serves as a mediator between extrinsic motivation in sustainable entrepreneurship and its outcomes, particularly social innovation.	Limited sample size The measurement tool can be improved Lack of control variables
13	Abdelwahed (2022)	Theory of planned behaviour Shapero-Krueger model	Quantitative SEM	292 Students	Al-Ahsaa	Favourable and noteworthy impact of attitudes toward sustainability, perceived desirability, and perceived feasibility on both sustainable entrepreneurial intentions and opportunity recognition	Limited sample size Use of cross-sectional data
14	Abdelwahed et al., (2022)	Not specified	Qualitative	20 Saudi women and entrepreneurs	Eastern province	A lack of knowledge about sustainability was observed among the sample The importance of top-down policy to foster sustainable entrepreneurship	The study is gender-specific and located in one region
15	Alshebami (2023b)	The positive self-concepts of internal locus of control and self-efficacy	Quantitative SEM	284 small business entrepreneurs	Various regions	There is a positive correlation between both green entrepreneurial self-efficacy and green entrepreneurial orientation with green innovation The findings indicated that green innovation serves as a mediator in the connection between green entrepreneurial self-efficacy, green entrepreneurial orientation, and economic performance	Limited sample size Lack of control variables Under-represented female participants
16	Alshebami (2023a)	The resource-based view theory	Quantitative SEM	284 small business entrepreneurs	Various regions of Saudi Arabia	The findings illustrated that entrepreneurial self-efficacy has the potential to act as a mediator in the connection between internal locus of control and entrepreneurial resilience	Limited sample size Sampling method Lack of generalizability
17	Fahad S. Almawishir and Benlaria (2023)	The authors mentioned several studies in the hypothesis section	Quantitative SEM	162 employees	Al-Jouf	The findings suggest that information and communication technology stands out as the most crucial dimension in both public and private institutions, whereas the dimension of innovation, research, and development is positioned last.	Limited sample size Unavailability of data relevant to the knowledge economy Need for more qualitative research
18	Roomi et al. (2023)	The Stam Model	Quantitative Chi-square tests ANOVA	Secondary data was used from the Global Entrepreneur ship Monitor project, which included a significant number of entrepreneurs in the region.	Riyadh	Four pillars exhibited the most improvement in the entrepreneurial ecosystem of Riyadh. These include two systemic pillars (networks and talent) and two environmental pillars (physical infrastructure and formal institutions). The systemic pillars, specifically leadership, demonstrated noteworthy enhancements	Lack of generalizability
19	Al Rawaf and Alfalih (2023)	The socio-emotional wealth, stewardship and stakeholder theories	Quantitative SEM	87 family enterprises	Different regions in Saudi Arabia	The findings indicate that business sustainability in family-owned businesses in Saudi Arabia is positively and significantly influenced by organizational governance and responsible innovation. Entrepreneurial culture significantly and positively moderates the relationships between organizational governance, responsible innovation, and business sustainability in these family-owned businesses.	Analysis technique The utilization of limited explanatory variables
20	Mohamed et al. (2023)	The theory of planned behaviour	Quantitative SEM	329 students at King Faisal University	Al-Ahsaa	The internal locus of control positively influences entrepreneurial intention. Innovativeness, proactiveness, and problem-solving personality dimensions showed positive impacts on entrepreneurial intention, However, risk-taking propensity did not exhibit a significant effect on entrepreneurial intention.	More personality dimensions can be examined Lack of generalizability Lack of examination of moderating and mediating variables Need for more qualitative research

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Examination of methodological facets
Table 3 outlines the research methodologies, sample sizes, and analysis techniques employed in the studies. Notably, a majority of the studies utilize quantitative research methods and apply diverse analytical techniques such as Confirmatory Factor Analysis-Structural Equation Modelling (CFA-SEM), Fixed Effect Models, Environmental Kuznets Curve (EKC) analysis, ARDL equation, and Z-score/T-score analysis. Sample sizes vary across studies, ranging from 8 individuals in a qualitative longitudinal approach to 396 students in a quantitative SEM study. The samples encompass diverse groups, including undergraduate students, women entrepreneurs, small business entrepreneurs, industrial private sector employees, family enterprises, and experts. In one study, secondary data from the Global Entrepreneurship Monitor project is utilized, incorporating many entrepreneurs in the region.

Consequently, the studies exhibit various theoretical perspectives, emphasizing the diverse theoretical foundations in entrepreneurship research. The prevalence of quantitative methods such as SEM and regression analysis indicates a concentration on statistical modelling. Therefore, considering additional qualitative approaches could enhance comprehension of the context and dynamics surrounding sustainable entrepreneurship.

4. General Discussion

This study evaluates twenty publications addressing sustainable entrepreneurship within the Kingdom of Saudi Arabia. The selection of these papers adheres to rigorous systematic criteria and a well-defined timeframe. The analysis reveals the existence of eight overarching themes, encompassing women entrepreneurship, the role of education, governance and policy implications, SMEs and family-owned businesses, region-specific sustainable entrepreneurship, entrepreneurship ecosystems, innovation, and entrepreneurial resilience. The examination extends to relevant studies associated with each identified theme, incorporating additional publications that met the established evaluation criteria.

The commonalities across these themes highlight a general approach to sustainable entrepreneurship in Saudi Arabia. Emphasis on cross-geographical comparisons, top-down policy initiatives, economic diversification, knowledge dissemination, gender-specific evaluations, theory utilization, and consideration of societal and ecological contexts reflects a comprehensive and interconnected research agenda for promoting sustainable entrepreneurship in the region. These shared elements highlight the importance of addressing multiple dimensions for a well-rounded understanding and advancement of sustainable entrepreneurship.

Specifically, it was noted that geographical comparison was evident in multiple studies, specifically studies that focus on women entrepreneurship (Abdelwahed et al., 2022; Abed, 2021; Alhothali and Al-Dajani, 2022) and entrepreneurial ecosystems (Bakry et al., 2022). Comparably, the role of the government is considered a focal point in a significant number of studies in KSA, where the promotion of sustainable entrepreneurship is needed through top-down policy initiatives and government incentives. Of note, the role of the government in encouraging the dissemination of knowledge pertinent to sustainable entrepreneurship has been emphasized in most of the studies. Moreover, economic diversification is important to promote sustainable entrepreneurship in KSA, especially in the Riyadh province (Roomi et al., 2023).

Gender-based evaluation was a prominent area, as it was considered a limitation of many studies. Specifically, it aims to assess gender differences in the factors that influence entrepreneurial resilience and the factors that influence women entrepreneurs' sustainable behaviour. With respect to theory utilization, a limited number of papers utilized the theory of planned behaviour and the institutional economic theory; however, the rest of the studies used various theories to test their research hypotheses and answer their research questions (Table 3). Therefore, it was noted that significant theories were not examined, such as the theory of market failure (Dean and McMullen, 2007), game theory (Pacheco et al., 2010), transition management theory (ONeill et al., 2014), human capital and self-efficacy theories (Boldureanu et al., 2020). Most prominently, since the first studies examining sustainable entrepreneurship were published, there is still a need for a meta-theory of purposeful entrepreneurship (Muñoz and Cohen, 2018).

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Moreover, it has been observed that research on sustainable entrepreneurship in KSA is fragmented and lacks cohesion. Often in the broader literature, studies focus on theoretical contributions as an all-encompassing theory of sustainable entrepreneurship is yet to be established (Terán-Yépez et al., 2020). Despite the efforts of extant researchers (Abed, 2021; Alhothali and Al-Dajani, 2022), examining the drivers of sustainable entrepreneurs has become essential as they represent a departure from the conventional norms observed in entrepreneurship practice. This analysis is crucial for comprehending the factors that can initiate and cultivate sustainable entrepreneurial behaviour (Abed, 2021; Cardella et al., 2020; Mohamed et al., 2023). Moreover, several studies have evaluated the primary predictors among individual factors for achieving success in sustainable entrepreneurship (Al-Tit et al., 2019); environmental and social concerns were not present. The studies did not explicitly examine the lack of sustainable entrepreneurship research concerning communities, non-profit organizations, and other organizations outside the private sector. Over the past decade, scholars have made efforts to fill these gaps. Yet, organizations of this nature now face growing expectations to exhibit entrepreneurial behaviours and discover new avenues for self-funding (Wagner et al., 2021).

Concluding remarks and future research agenda

The shared characteristics among these themes highlight the commendable research endeavours dedicated to sustainable entrepreneurship in KSA. Emphasis on cross-geographical comparisons, top-down policy initiatives, economic diversification, knowledge dissemination, gender-specific evaluations, theory utilization, and consideration of societal and ecological contexts reflects a comprehensive and interconnected research agenda for promoting sustainable entrepreneurship in the region. These shared elements emphasize the importance of addressing multiple dimensions for a well-rounded understanding and advancement of sustainable entrepreneurship. Accordingly, Table 4 summarizes the recommendations for each key theme identified in the review to facilitate future research progress in this area.

Table 4. Future research agenda

#	Key theme	Research Recommendations
1	Women entrepreneurship	▪ Compare sustainable practices relevant to women entrepreneurs in different geographical locations with an emphasis on developing countries. ▪ Examine the factors that influence women entrepreneurs' sustainable behaviour. ▪ Investigate the facilitating conditions and barriers that women entrepreneurs come across. ▪ Utilize well-grounded entrepreneurship theories, such as the theory of entrepreneurship, using mixed research methods.
2	The role of education	▪ Evaluate how policymakers and government officials can embed sustainability in KSA's education system. ▪ Utilize qualitative research to tailor relevant programs for business and non-business students. ▪ Investigate the association between education and entrepreneurship intentions using the human capital and entrepreneurial self-efficacy theories.
3	Governance and policy implications	▪ Establish a governance model for sustainable entrepreneurship in the context of KSA. ▪ Encourage sustainable entrepreneurship by implementing policy initiatives, beginning with top-down approaches. ▪ Encourage the dissemination of knowledge pertinent to sustainable entrepreneurship through governmental efforts. ▪ Identify the barriers to sustainable entrepreneurship.
4	SMEs and family-owned businesses	▪ Promote sustainable entrepreneurship through the adoption of top-down policy initiatives. ▪ Identify the predictors and barriers of sustainable entrepreneurship in SMEs and family-owned businesses. ▪ Explore the business succession in family-owned businesses in Saudi Arabia and its connection to the influence of the successor's knowledge and willingness to succeed in corporate sustainable innovation and successful business succession. ▪ Evaluate successful competitive strategies for stakeholders.
5	Region-specific sustainable entrepreneurship	▪ Explore the evolving entrepreneurial ecosystem in Riyadh as a critical driver for entrepreneurship and innovation in the MENA region.

6	Entrepreneurial ecosystems	▪ Evaluating the entrepreneurial ecosystem in different geographical locations in alignment with studies in KSA. ▪ Improving the generalizability of findings by increasing the sample size. ▪ Future research should consider moving beyond a narrow economic focus and include larger societal and ecological contexts, aligning with existing research that underlines the role of entrepreneurs in generating non-economic benefits for society and driving broader socioeconomic transformations towards sustainability.
7	Innovation	▪ Future research should assess barriers to innovation adoption across institutions in KSA and stress the necessity for knowledge and government incentives. ▪ Future research should consider using the business models for sustainability innovation (BMfSI) framework (Lüdeke-Freund, 2020).
8	Entrepreneurial resilience	▪ Evaluate gender differences in the factors that influence entrepreneurial resilience in the context of KSA.

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IMPACT OF COVID-19 ON CORPORATE CULTURE*

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Abstract. The crisis associated with the global COVID-19 pandemic has had an impact on the economies of all countries in the world. The stoppage of production lines, insufficient demand, and layoffs were just some of the negative effects that Slovak enterprises also experienced as a result of the dynamically changing business environment. The aim of the research is to determine whether the perception of corporate culture in Slovakia was affected by the COVID-19 pandemic. It is achieved by identifying the type of corporate culture that dominated at the beginning and after the crisis caused by the COVID-19 pandemic. The methodology of Cameron and Quinn, based on the Organizational Culture Assessment Instrument, was chosen. Corporate culture was analyzed based on the opinions of employees working in the private sector in Slovakia during the period from 2020 to 2023. The significance of differences was tested using the Tukey HSD test. The novelty of the research is that the research results confirmed that changes existed in the perception of partial areas of corporate culture, as well as in the perception of the corporate culture type, over time in Slovakia. Furthermore, based on the results obtained, it can be concluded that clan corporate culture dominated in the private sector in Slovakia in 2020; however, hierarchy corporate culture dominated in 2023. The research results are valuable from the point of view of the development of knowledge in the area of corporate culture in Slovakia, understanding its development, and the impact of global trends on corporate culture.

Keywords: corporate culture; The Organizational Culture Assessment Instrument; COVID-19; private sector; Tukey HSD test

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1. Introduction

Previous crises had a particular impact on society. Some had a significant microeconomic impact, while others had a macroeconomic impact. Not only production but also industries, trade, finance, and other sectors were affected. There was a decrease in consumption, the gross domestic product of individual economies, and an increase in unemployment or a decrease in wages and pensions. The crises were characterized by varying intensity, duration, and the extent of their impact on the functioning of individuals, the business sector, and society as a whole. The aim of the research is to determine whether the perception of corporate culture was affected by the COVID-19 pandemic.

2. Theoretical background

The first global economic crisis caused by the collapse of the New York Stock Exchange can be considered the Great Depression (1929-1933). The crisis itself was caused by a price bubble in the stock market, which, due to an optimistic mood, drove share prices to higher levels, while buyers had a lasting vision of profit from these shares in the form of dividends. However, the share prices did not reflect the actual state of the economy. Banks became illiquid and began to go bankrupt (Alcidi, Gros, 2011). The Great Depression affected almost every country in the world (Siegler, Van Gaasbeck, 2005). The most significant impact was on countries like the United States, Canada, Germany, Poland, Czechoslovakia, and the Netherlands. The United Kingdom, France, and Japan were also severely affected. All sectors of the economy were impacted, particularly mining, metallurgy, and lumbering. Production and demand declined. Other crises such as the Mexican Crisis, Asian Crisis, Russian Crisis, Brazilian Crisis, and Argentine Crisis were triggered by either a recurring cycle of rising and falling dollar exchange rates or a loss of foreign exchange reserves or currency devaluation (Frolov, 2020). The result of these crises was not only a halt in economic growth but also a decline in gross domestic product and rising unemployment.

The modern financial crisis can be considered a milestone among previous crises. Although it began in 2008 in the United States, it escalated into an economic crisis, gained momentum, and became a global economic crisis (Mateo, 2016). The crisis was caused not only by the failure of banks but also by the failure of the economic system itself and, above all, by the reaction of the economic system to this crisis. The crisis has resulted in rising unemployment, an exacerbation of poverty, and a decline in gross domestic product in almost every country in the world (Hagiwara, 2019).

Perhaps the most significant global recession since the Great Depression was caused by the COVID-19 pandemic, also known as the coronavirus pandemic, when the virus spread from China to several countries around the world in early 2020 (Olivia et al., 2020). The pandemic has led to the postponement or cancellation of most sporting, religious, political, and cultural events, as well as widespread food shortages caused by panic shopping. Consumer spending, industrial production, investment, trade, capital flows, and supply chains were significantly disrupted (Khan et al., 2021). The pandemic has become a global health threat with a direct impact on the global economy as well as society as a whole (Aktar et al., 2021). Governments around the world have used various tools to mitigate its effects. They have postponed the payment of taxes and levies, overpaid wages, guaranteed loans, and implemented similar measures (Tisdell, 2020). Restrictive measures have also affected the business sector in Slovakia, with some sectors being more affected than others. Businesses have faced a drop in demand and delays in payments from customers. There has been a decline in business income, and many enterprises have been under pressure to cut costs, which has resulted in redundancies.

The COVID-19 pandemic has been studied from various perspectives, including health and ecological aspects (Jankelová et al., 2021; Chen et al., 2021; Anderson et al., 2023; Dale et al., 2023; Khunti et al., 2023; Xu et al.,

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2023). The economic impact of COVID-19 was examined in the research conducted by Mungmunpuntipantip and Wiwanitkit (2023). Meyer et al. (2022) documented and evaluated how businesses are responding to the COVID-19 crisis. The aim of our research is to determine whether the perception of corporate culture was affected by the COVID-19 pandemic.

According to previous research (Ogbonna, Harris, 2000; Škerlavaj et al., 2011, Rezaei et al., 2016, Mullakhmetov et al., 2019; Vlaicu et al., 2019; Zhang et al., 2023), corporate culture is an important element of corporate management and serves as a tool that influences its functionality and viability of the enterprise. This area has been extensively studied due to its significant role in workplace behavior and business performance (Heritage et al., 2014). Corporate culture is defined as a system of values (Heinen, 1987) and informal rules (Deal, Kennedy, 1982) that guide people's behavior in most situations. It can vary. According to employees in the construction industry in Finland, these enterprises applied a clan and adhocratic corporate culture (Teräväinen et al., 2018). In the Persian Gulf countries, a hierarchy corporate culture was typical for the construction industry (Jaeger, Adair, 2013). Turkish workplaces were perceived to have a hierarchy corporate culture (Caliskan, Zhu, 2019). Similarly, in Polish public universities, a hierarchy corporate culture was applied (Debski et al., 2020). In the health sector in Vietnam, a clan corporate culture was typical (Van Huy et al., 2020), while hotel enterprises in Mexico (Ibarra-Michel et al., 2019) and Greek banks (Belias et al., 2015) also dominated a clan corporate culture. Market corporate culture prevailed in universities in Kazakhstan (Dostiyarova, 2016). The presented research demonstrates that differences in corporate culture existed not only geographically but also in terms of the sectoral structure of enterprises. The aim of our research is to identify the type of corporate culture that dominated at the begining and after the crisis caused by the COVID-19 pandemic, and to determine whether the perception of corporate culture was affected by the COVID-19 pandemic.

3. Research objective and methodology

In the context of effective management, it is important for the manager to understand the work values that their employees adhere to in terms of corporate culture. This is because work values can vary for various reasons. The aim of the research is to determine whether the perception of corporate culture was affected by the COVID-19 pandemic. It is achieved by identifying the type of corporate culture that dominated at the begining and after the crisis caused by the COVID-19 pandemic. To define the corporate culture type, the Organizational Culture Assessment Instrument (Cameron, Quinn, 1999) was used. The methodology is widely used. The questionnaire consisted of six partial areas (dominant characteristics, organizational leadership, management of employees, organization glue, strategic emphases, and criteria of success) with four subareas (alternative A, alternative B, alternative C, and alternative D). Based on the chosen methodology, respondents expressed their opinions about each of the six areas by dividing 100 points to each area based on which one they believed reflected the state-of-the-art most accurately. In the area of dominant characteristics, respondents expressed their opinions about the characteristic features of the environment and atmosphere prevailing in the enterprise. In the following analyzed area, organizational leadership, respondents expressed their opinions about what leadership entails, followed by the characteristics of managerial style and management methods applied. In the subsequent areas, respondents expressed how the enterprise consolidates itself, what is emphasized within the enterprise, and how success is defined. Each of the six partial areas was divided into four subareas (Alternative A, Alternative B, Alternative C, and Alternative D). Each of these alternatives corresponds to one of the corporate cultures (clan, adhocracy, market, hierarchy). Alternative A corresponds to the clan corporate culture. The clan corporate culture is based on similarities with family-type businesses. Teamwork, participation, and consensus are considered to be of primary importance in the enterprise (Cameron, Quinn, 1999; Demski et al., 2016; Jaeger et al., 2017; Teräväinen et al., 2018). Alternative B corresponds to the adhocracy corporate culture. It represents a very dynamic, entrepreneurial, and creative environment where employees are willing to take risks (Cameron, Quinn, 1999; Lau, Ngo, 2004, Jaskyte, 2014). Alternative C corresponds to the market corporate culture. Among the primary interests of the market corporate culture is the realization of transactions (exchanges, sales, and contractual

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obligations) with other actors in order to create competitive advantages (Cameron, Quinn, 1999). Emphasis is placed on overtaking the competition and achieving a leading position in the market (Cameron, Quinn, 1999). Alternative D corresponds to the hierarchy corporate culture characterized by its formalized and structured work environment emphasizing procedures and regulations, in which the binding element is formal rules (Heritage et al., 2014).

In the initial step, the partial aspects of corporate culture were analyzed both before and after the crisis caused by the COVID-19 pandemic. Subsequently, the type of corporate culture was analyzed before and after the crisis. The analysis of corporate culture was based on the opinions of employees working in the private sector in Slovakia. The research sample consisted of over 3,800 respondents who participated in the research from 2020 to 2023. The detailed structure is presented in Table 1.

Table 1. Composition of the research sample

Indicator		Absolute frequency	Relative frequency
Year	2020	950	24.98%
	2021	1,165	30.63%
	2022	966	25.40%
	2023	722	18.99%
Total		3.803	100.00%

Source: Own research

The following hypotheses were tested:
- WH1: the type of corporate culture that dominated at the begining and after the crisis caused by the COVID-19 pandemic changes in terms of time.
- WH2: there exist changes in the perception of partial areas of corporate culture in terms of time.

To verify the hypotheses, the Tukey HSD test was used. The test was used to determine the significance of differences. A significance level of 5% was utilized.

4. Results and discussion

The initial area of study focused on the dominant characteristics. Respondents provided their opinions on the characteristic features of the environment and atmosphere that dominated within the enterprise. The results reached are presented in Figure 1. The results obtained in the initial step of the investigation were further subjected to statistical analyses using the Tukey HSD Test. The results of the statistical analyses are presented in Table 2, with statistically significant differences being highlighted.

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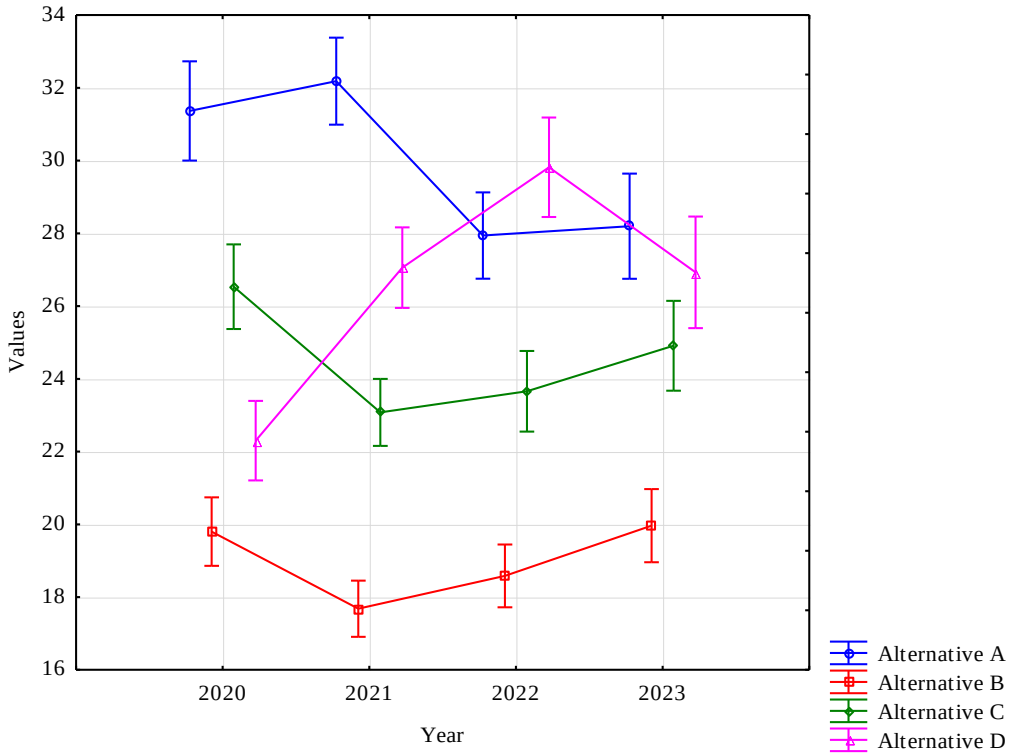

Figure 1. The development of dominant characteristics
Source: Own research

Based on the results obtained in the area of dominant characteristics, it was found that alternative A dominated in private sector in Slovakia in 2023. According to the findings, respondents attributed the highest level of importance to this alternative. Respondents perceived the enterprise as a very personal place, similar to an extended family. In 2022, there was a rapid decrease in the importance of alternative A. A statistically significant difference was observed when comparing 2021 and 2022 (Table 2). Table 2 presents additional statistically significant differences. Based on the obtained results, it can be concluded that the importance of alternative A grew from 2022 onwards. However, it did not reach the level observed at the beginning of the crisis.

From the perspective of alternative D, it was identified as the second most important alternative in 2023. A decline was observed when comparing 2022 and 2023. Respondents attributed lower importance to this alternative. According to the employees working in the private sector, the enterprises were perceived as less controlled and structured places. Formal procedures generally governed the actions and behaviors of individuals.

When analyzing the results of alternative B and alternative C, it is evident that the importance of these alternatives gradually increased from 2021. However, it should be noted that the average rating from 2021 did not reach the level observed at the beginning of the crisis. Respondents perceived the enterprises as highly dynamic and results-oriented entrepreneurial place, which are typical characteristics of alternative B and alternative C.

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Table 2. Statistical analysis in the area of dominant characteristics

Indicator	Alternative A				Alternative B				Alternative C				Alternative D			
	2020	2021	2022	2023	2020	2021	2022	2023	2020	2021	2022	2023	2020	2021	2022	2023
2020		0.792	0.001	0.008		0.003	0.223	0.995		0.000	0.001	0.221		0.000	0.000	0.000
2021	0.792		0.000	0.000	0.003		0.442	0.003	0.000		0.864	0.109	0.000		0.007	0.999
2022	0.001	0.000		0.994	0.223	0.442		0.182	0.001	0.864		0.448	0.000	0.007		0.016
2023	0.008	0.000	0.994		0.995	0.003	0.182		0.221	0.109	0.448		0.000	0.999	0.016	

Source: Own research

Based on the analysis of the Tukey HSD test in the area of dominant characteristics presented in Table 2, it can be concluded that there existed statistically significant differences in perception of partial alternatives of corporate culture. This indicates that respondents perceived alternatives differently. In 2023, there were statistically significant differences in perception of alternative A and alternative D compared to 2020. However, it is important to note that alternative A, alternative B, and alternative C did not reach the level observed at the beginning of the crisis.

The organizational leadership was the second area studied using the methodology of Cameron and Quinn (1999). The results obtained are presented in Figure 2. The statistical analysis results can be found in Table 3.

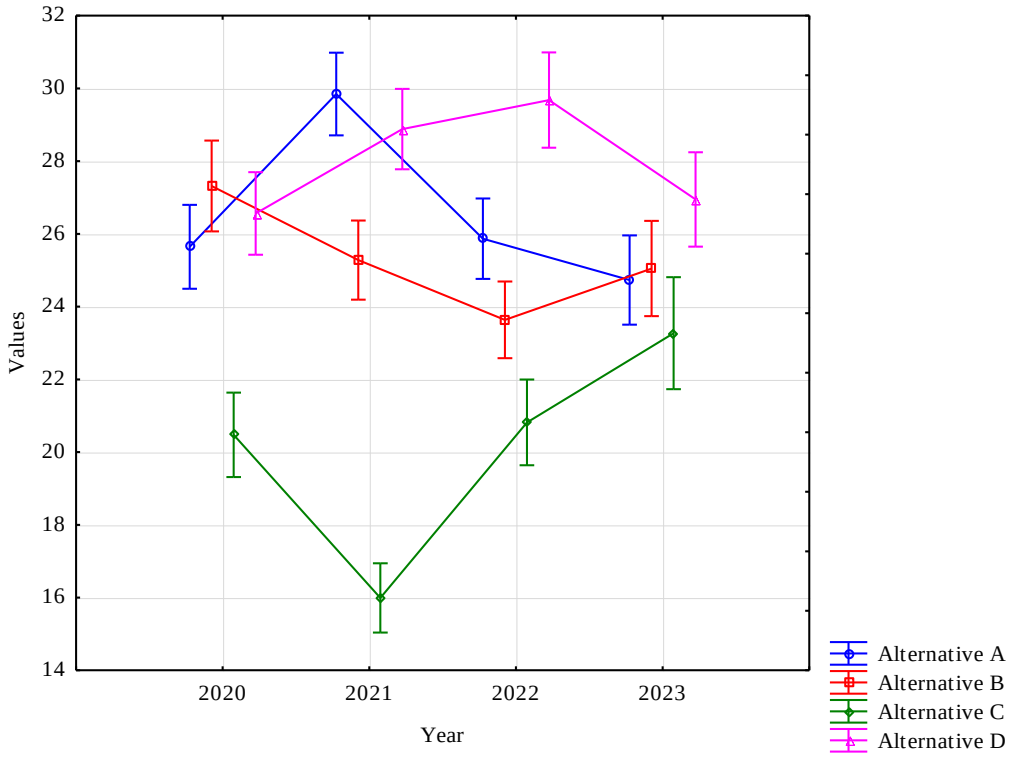

Figure 2. The development of the organizational leadership
Source: Own research

In the area of organizational leadership, alternative D received the highest rating in 2023. According to the employees working in the private sector in Slovakia, the leadership in the enterprises was generally perceived as exemplifying coordinating, organizing, or smooth-running efficiency. The Tukey HSD test confirmed statistically

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significant differences in alternative D when comparing 2022 and 2023. Additional statistically significant differences are highlighted in Table 3.

Based on the results obtained, it can be concluded that there was a decrease in the perceived importance of alternative A. Starting from 2021, respondents gradually attributed lower importance to alternative A. According to their opinion, leadership in the enterprises was generally seen as less exemplifying mentoring, facilitating, or nurturing.

On the other hand, there was an increase in the importance of alternative B in 2023 compared to 2022. Respondents attributed more significance to it. Based on the obtained results, it can be concluded that leadership in the enterprises was generally perceived as exemplifying entrepreneurship, innovation, or risk taking.

Based on the results obtained, it can be concluded that the importance of alternative C gradually increased every year from 2021. Respondents perceived the leadership as exemplifying a no-nonsense, aggressive, and results-oriented focus.

Table 3. Statistical analysis in the area of organizational leadership

Indicator	Alternative A				Alternative B				Alternative C				Alternative D			
	2020	2021	2022	2023	2020	2021	2022	2023	2020	2021	2022	2023	2020	2021	2022	2023
2020		0.000	0.993	0.742		0.055	0.000	0.060		0.000	0.978	0.011		0.027	0.002	0.977
2021	0.000		0.000	0.000	0.055		0.168	0.993	0.000		0.000	0.000	0.027		0.770	0.139
2022	0.993	0.000		0.586	0.000	0.168		0.401	0.978	0.000		0.034	0.002	0.770		0.018
2023	0.742	0.000	0.586		0.060	0.993	0.401		0.011	0.000	0.034		0.977	0.139	0.018	

Source: Own research

The Tukey HSD test confirmed the existence of the highest number of statistically significant differences in the perception of alternative C. Respondents had different perceptions of this alternative in 2020 and 2023. Further, based on the results obtained, it can be concluded that there has been an increase in the importance of alternative C compared to 2020. Alternative A, and alternative B did not reach the level at the beginning of the crisis.
Figure 3 presents the obtained results in the area of the management of employees.

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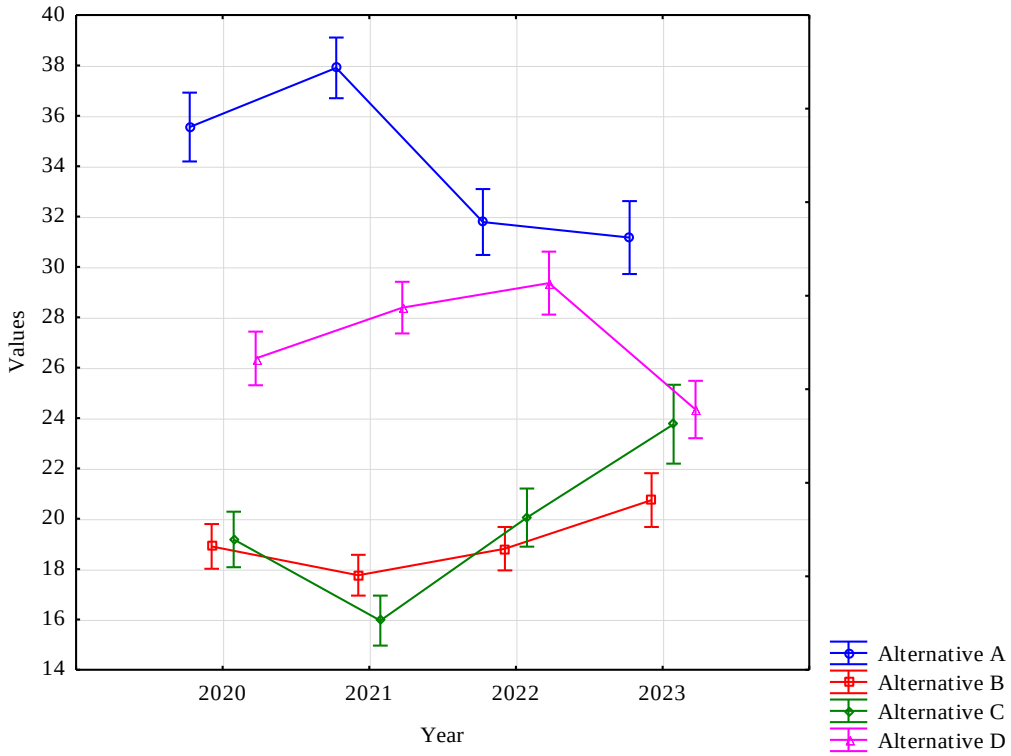

Figure 3. The development of the management of employees
Source: Own research

Following the results presented in Figure 3, it can be stated that alternative A consistently achieved the highest average rating each year. Despite the confirmation of statistically significant differences when comparing 2020 and 2023 (Table 4), the respondents still maintained the opinion that management of employees focused on teamwork, consensus, and participation.

Alternative D was the second most dominant alternative in the private sector in Slovakia at the begining the period analyzed. Based on the methodology of Cameron and Quinn (1999) and the definition of alternative D, respondents perceived that the management style in the enterprises was characterized by security of employment, conformity, predictability, and stability in relationships. Similar to alternative A, alternative D experienced a decrease in importance in 2023 compared to the beginning of the crisis caused by the COVID-19 pandemic.

Further analyzing the results, it can be stated that the importance of alternative B and alternative C gradually increased from 2021. Respondents attached more importance to the management style characterized by individual risk taking, innovation, freedom, and uniqueness (alternative B), as well as to the management style characterized by hard-driving competitiveness, high demands, and achievement (alternative C).

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Table 4. Statistical analysis in the area of management of employees

Indicator	Alternative A				Alternative B				Alternative C				Alternative D			
	2020	2021	2022	2023	2020	2021	2022	2023	2020	2021	2022	2023	2020	2021	2022	2023
2020		0.048	0.000	0.000		0.245	0.999	0.040		0.000	0.730	0.000		0.045	0.001	0.093
2021	0.048		0.000	0.000	0.245		0.313	0.000	0.000		0.000	0.000	0.045		0.586	0.000
2022	0.000	0.000		0.931	0.999	0.313		0.027	0.730	0.000		0.000	0.001	0.586		0.000
2023	0.000	0.000	0.931		0.040	0.000	0.027		0.000	0.000	0.000		0.093	0.000	0.000	

Source: Own research

Statistical analysis using the Tukey HSD test confirmed that there existed changes in the area of the management of employees in terms of time. The differences were observed in the perception of alternative A, alternative B, and alternative C when comparing 2023 and 2020. This indicates that respondents had different perceptions of these alternatives in 2023 compared to the beginning of the crisis caused by the COVID-19 pandemic. The results reached in the area of organization glue are presented in Figure 4. The results of the statistical analyses are presented in Table 5, with statistically significant differences being highlighted.

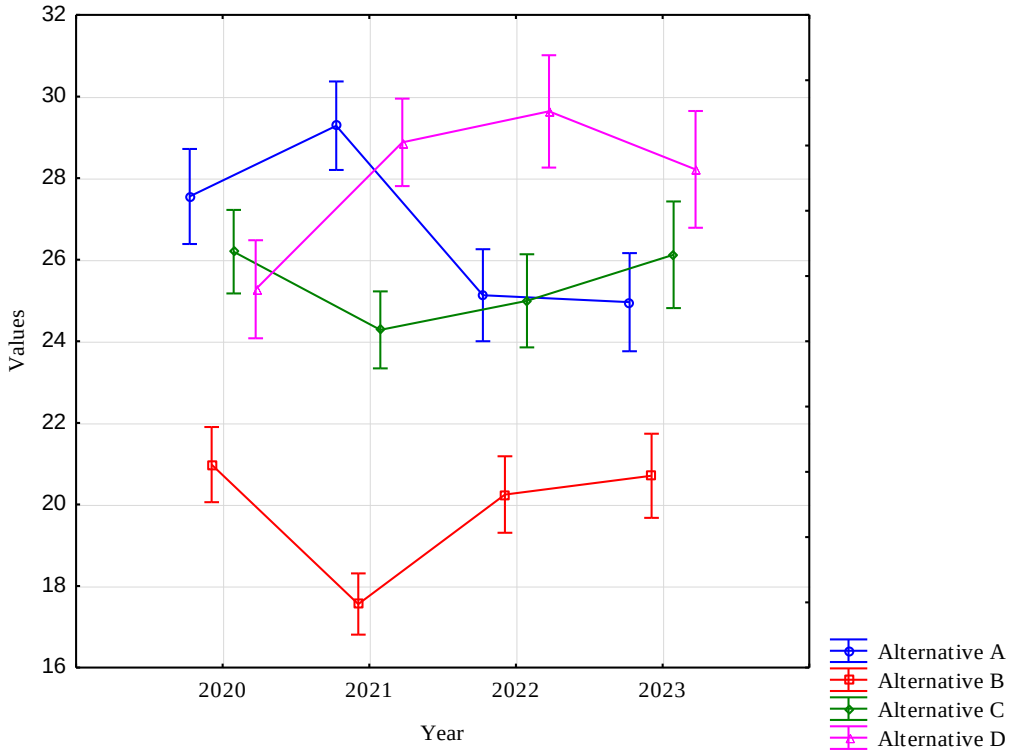

Figure 4. The development of the organization glue
Source: Own research

In the area of organization glue, respondents perceived that the glue that held the enterprises together was formal rules and policies. Maintaining smooth-running enterprises was important. Alternative D domintated in 2022 and 2023. The importance of alternative D gradually increased from 2020.

Based on the results obtained, it can be concluded that the importance of alternative C and alternative B has gradually increased. The factor that kept the enterprises united was their focus on achievement and goal

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accomplishment (alternative C). Greater emphasis was given to the commitment to innovation and development (alternative B.

However, according to the results obtained, alternative A was given less importance. Loyalty and mutual trust (Alternative A) were not considered as important as formal rules and policies (alternative D).

Table 5. Statistical analysis in the area of organization glue

Indicator	Alternative A				Alternative B				Alternative C				Alternative D			
	2020	2021	2022	2023	2020	2021	2022	2023	2020	2021	2022	2023	2020	2021	2022	2023
2020		0.123	0.017	0.019		0.000	0.664	0.979		0.050	0.410	1.000		0.000	0.000	0.014
2021	0.123		0.000	0.000	0.000		0.000	0.000	0.050		0.772	0.102	0.000		0.813	0.893
2022	0.017	0.000		0.998	0.664	0.000		0.911	0.410	0.772		0.533	0.000	0.813		0.458
2023	0.019	0.000	0.998		0.979	0.000	0.911		1.000	0.102	0.533		0.014	0.893	0.458	

Source: Own research

According to the results obtained using the Tukey HSD test in the area of organization glue, it can be concluded that in 2023 there were statistically significant differences in perception of alternative A (p=0.019) and alternative D (p=0.014) compared to 2020. This indicates that respondents perceived alternatives differently in terms of time. The opinions of the respondents regarding the strategic emphases are presented in Figure 5. The results of additional statistical testing using the Tukey HSD test are presented in Table 6.

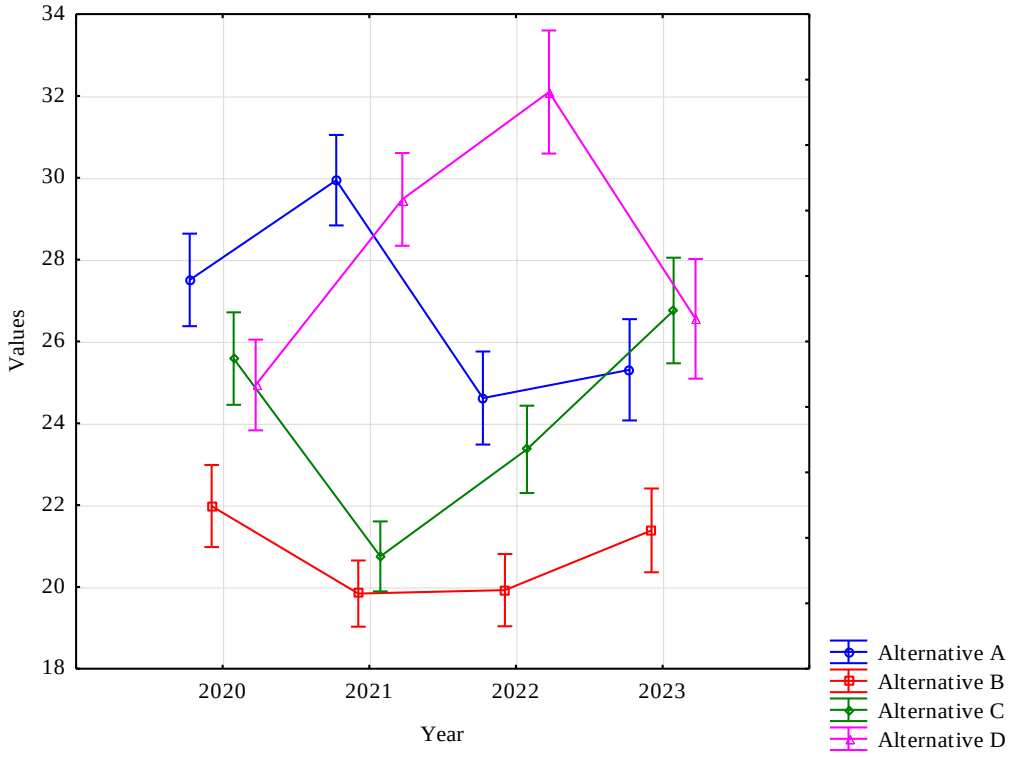

Figure 5. The development of the strategic emphases
Source: Own research

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Alternative C achieved the highest rating in 2023. Its importance gradually increased from 2021. According to the respondents the enterprises emphasized competitive actions and achievement. Hitting stretch targets and winning in the marketplace were dominant.

Based on the research results, it is evident that alternative D received the highest rating in 2022. Enterprises placed emphasis on permanence and stability, prioritizing efficiency, control, and smooth operations.

A statistically significant difference was confirmed when comparing alternative A in 2021 and 2022, indicating a significant decrease. However, the research results also indicate an increase in the importance of alternative A when comparing 2022 and 2023. Further, it should be noted that alternative A did not reach the same high rating as at the beginning of the COVID-19 pandemic crisis in 2020.

Based on the research results, it can be concluded that the importance of human development, high trust, openness, and participation (alternative A) was not as high as that of competitive actions and achievement (alternative C)
Alternative B achieved the lowest overall rating. The enterprises did not emphasize acquiring new resources and creating new challenges.

Table 6. Statistical analysis in the area of strategic emphases

Indicator	Alternative A				Alternative B				Alternative C				Alternative D			
	2020	2021	2022	2023	2020	2021	2022	2023	2020	2021	2022	2023	2020	2021	2022	2023
2020		0.011	0.003	0.067		0.004	0.010	0.840		0.000	0.019	0.483		0.000	0.000	0.375
2021	0.011		0.000	0.000	0.004		0.999	0.109	0.000		0.002	0.000	0.000		0.016	0.013
2022	0.003	0.000		0.867	0.010	0.999		0.170	0.019	0.002		0.000	0.000	0.016		0.000
2023	0.067	0.000	0.867		0.840	0.109	0.170		0.483	0.000	0.000		0.375	0.013	0.000	

Source: Own research

According to the research results presented in Table 6, there were no statistically significant differences confirmed when comparing 2020 and 2023. This suggests that in 2023, respondents perceived the alternatives similarly to the beginning of the COVID-19 pandemic crisis.

The results obtained in the area of the criteria of success are presented in Figure 6. The results of the statistical analyses are presented in Table 7, with statistically significant differences being highlighted.

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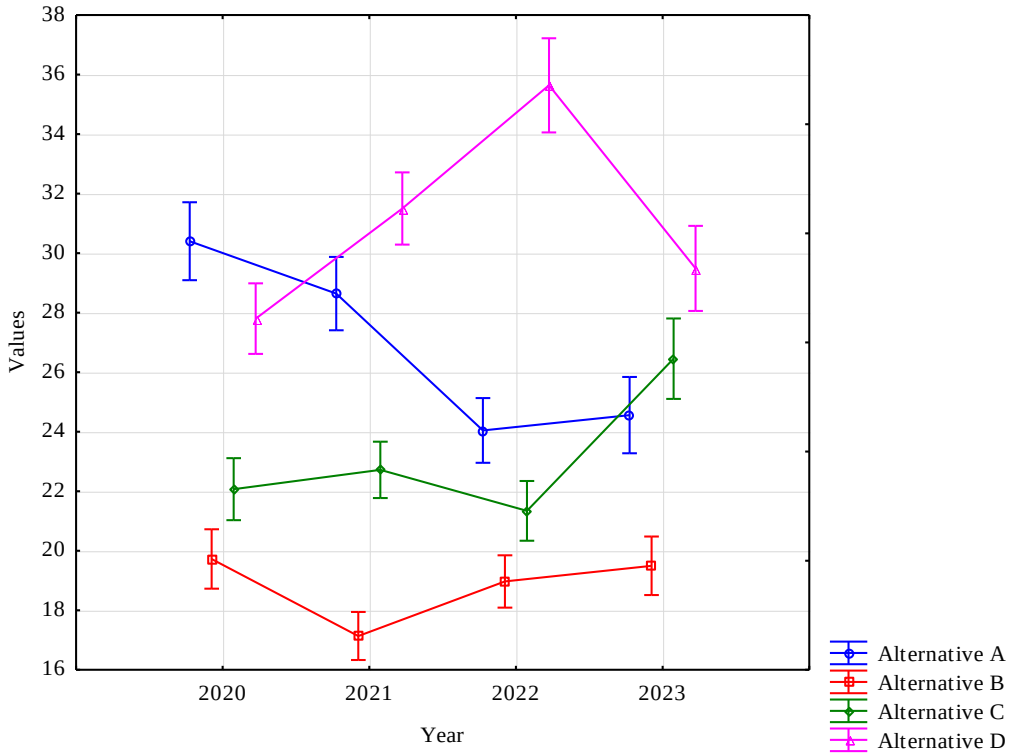

Figure 6. The development of the criteria of success
Source: Own research

In the area of criteria of success, alternative D was identified as the most significant alternative starting from 2021. According to the respondents, enterprises defined success based on efficiency, dependable delivery, smooth scheduling, and low-cost production, which were considered critical. Alternative C emerged as the second most dominant alternative in 2023. Based on the research results, it can be concluded that the importance of alternative C has increased since 2022. Enterprises defined success based on winning in the marketplace and outpacing the competition, with competitive market leadership being a key factor. However, the importance of alternative A has gradually decreased. Factors such as the development of human resources, teamwork, employee commitment, and concern for people were not considered as important as efficiency, dependable delivery, smooth scheduling, or low-cost production. Alternative B consistently received the lowest rating throughout the entire analyzed period. The enterprises assigned the lowest importance to success defined by having the most unique or newest products.

Table 7. Statistical analysis in the area of criteria of success

Indicator	Alternative A				Alternative B				Alternative C				Alternative D			
	2020	2021	2022	2023	2020	2021	2022	2023	2020	2021	2022	2023	2020	2021	2022	2023
2020		0.165	0.000	0.000		0.000	0.658	0.988		0.812	0.775	0.000		0.000	0.000	0.377
2021	0.165		0.000	0.000	0.000		0.017	0.003	0.812		0.231	0.000	0.000		0.000	0.192
2022	0.000	0.000		0.950	0.658	0.017		0.879	0.775	0.231		0.000	0.000	0.000		0.000
2023	0.000	0.000	0.950		0.988	0.003	0.879		0.000	0.000	0.000		0.377	0.192	0.000	

Source: Own research

Based on the analysis of the Tukey HSD test in the criteria of success, as presented in Table 7, it can be concluded that there were statistically significant differences in the perception of alternative A and alternative C. However, it

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is important to note that the average rating of alternative A in 2023 did not reach the level observed at the beginning of the crisis.

Based on the achieved results, it can be concluded that assumption WH2, which assumes that changes in the perception of partila areas of corporate culture occur in terms of time, was confirmed by the Tukey HSD test at a significance level of 5%.

According to the methodology of Cameron and Quinn (1999), the type of corporate culture was analyzed in the final stage. The results obtained are presented in Figure 7. The results of the statistical analyses are presented in Table 8.

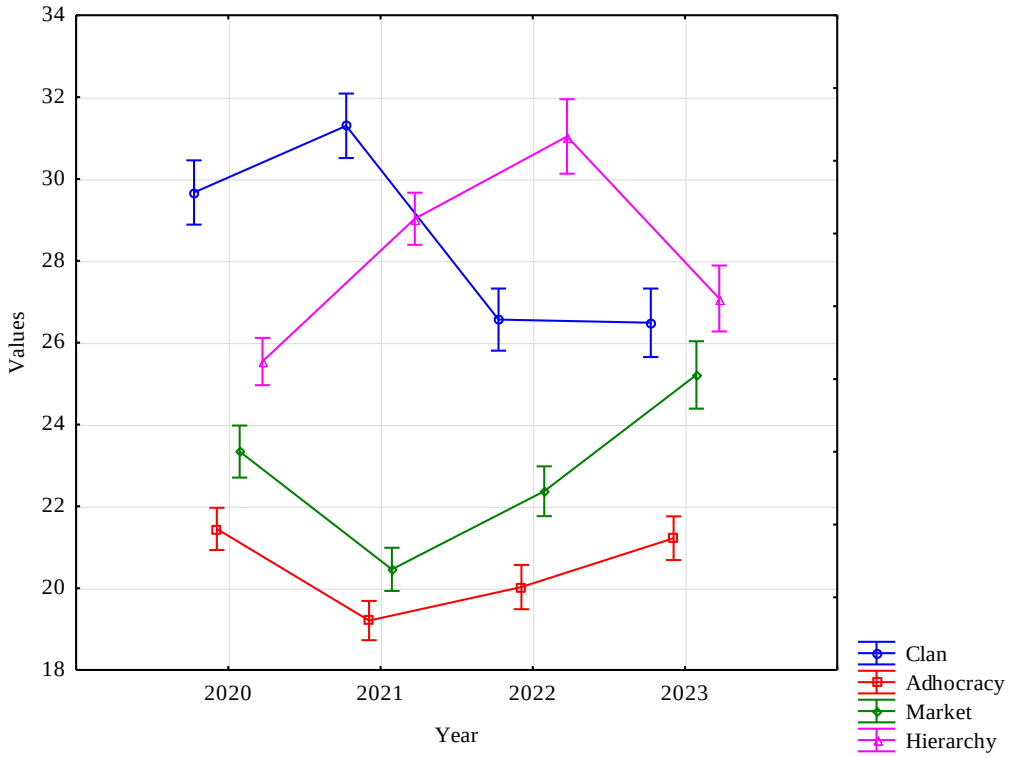

Figure 7. The development of the corporate culture
Source: Own research

Based on the results obtained, it can be concluded that there has been an increase in the importance of hierarchy corporate culture during the period from 2020 to 2022. Statistically significant differences were observed when comparing the entire period analyzed. Hierarchy corporate culture dominated in private sector in 2023. Based on the results obtained and the methodology of Cameron and Quinn (1999), it can be stated that effective leaders were characterized as good coordinators and organizers who prioritized maintaining the smooth functioning, stability, and efficiency of the organization. Success was defined by the reliability of deliveries, smooth fulfillment of schedules and low costs. Management of employees was primarily focused on ensuring employment security.

According to Figure 7, it can be observed that the importance of clan corporate culture gradually decreased over the period analyzed. In 2023, the average rating for clan corporate culture was lower compared to 2020. There was a decrease in emphasis on creating a friendly workplace where employees shared the same values. In

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comparison to 2020, enterprises have shown a decreased emphasis on cementing loyalty and traditions. There was a decrease in devotion to the organization. Teamwork, participation, and consensus were not considered to be of primary importance in the organization.

As follows from the results, there was an increase in the importance of market and adhocracy corporate culture from 2021 to 2023. Competitiveness, and productivity dominated enterprises with market corporate culture. There was a higher emphasis placed on final results, market power, ambitious goals, and reliable clients. The enterprises were cemented by the orientation to the first place.

Throughout the entire analyzed period, adhocracy corporate culture received the lowest average rating. Enterprises with an adhocracy corporate culture were characterized by a highly dynamic, entrepreneurial, and creative environment. Employees were willing to take risks. There was a higher emphasis placed on the production of unique and original products, and services.

Table 8. Statistical analysis in the area of corporate culture

Indicator	Clan corporate culture				Adhocracy corporate culture				Market corporate culture				Hierarchy corporate culture			
	2020	2021	2022	2023	2020	2021	2022	2023	2020	2021	2022	2023	2020	2021	2022	2023
2020		0.016	0.000	0.000		0.000	0.001	0.943		0.000	0.141	0.001		0.000	0.000	0.036
2021	0.016		0.000	0.000	0.000		0.097	0.000	0.000		0.000	0.000	0.000		0.000	0.002
2022	0.000	0.000		0.999	0.001	0.097		0.016	0.141	0.000		0.000	0.000	0.000		0.000
2023	0.000	0.000	0.999		0.943	0.000	0.016		0.001	0.000	0.000		0.036	0.002	0.000	

Source: Own research

The Tukey HSD test confirmed the existence of statistically significant differences in the perception of clan, market, and hierarchy corporate culture over time (Table 8). This suggests that respondents had different perceptions of these cultures in 2023 compared to the beginning of the crisis caused by the COVID-19 pandemic. Upon further analyses of the results, it can be concluded that clan corporate culture dominated in the private sector in 2020, whereas hierarchy corporate culture dominated in 2023.

The COVID-19 pandemic has affected social and economic life in all countries of the world. Measures taken by the governments of individual countries aimed at protecting the health of the population and slowing down the spread of the virus caused restrictions on the movement of the population, closure of establishments, restrictions on production, ban on international transport, etc. The COVID-19 pandemic quickly took on the dimensions of a global pandemic with a significant impact on the economic and financial spheres as well. For this reason, most of the previous research so far has focused primarily on examining its impact on the financial performance of enterprises. For example, Zheng et al. (2023) conducted research analyzing the impacts of the COVID-19 outbreak on the financial performance of 126 Chinese listed firms across 16 industries using quarterly data. Additionally, Sun and Li (2021) described the effects of the COVID-19 outbreak on the financial performance of Chinese listed firms, incorporating evidence related to corporate culture and corporate social responsibility.

Research that has been conducted abroad in the field of corporate culture has focused, for example, on investigating corporate culture during the COVID-19 lockdown in two different countries (Kazakhstan and Spain). This period presented a stressful social and work context that required entire working populations to telecommute from home (Diáz-Soloaga, Díaz-Soloaga, 2022). The research conducted by Zulfikar et al. (2021) in South Kalimantan, Indonesia, described the level of effectiveness of the contribution and ability of competitive advantage factors and corporate culture in improving the sustainable behavior of SMEs. Park et al. (2023) aimed

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to investigate both management strategies and organizational culture, which may affect the performance of enterprises, and analyzed the influence of education and training investment.

Previous research that has been carried out in the area of corporate culture in Slovakia examined whether corporate culture has an impact on the work performance of employees through the mediators of leadership and work engagement (Michulek et al., 2023). Kosiciarová et al. (2021) pointed out that leadership and motivation can be perceived as important aspects of the corporate culture in international enterprise.

Our research is motivated by the lack of existing research studies on the impact of COVID-19 on corporate culture in Slovakia. The research was carried out between 2020 and 2023. It was carried out on a sample of 3,803 respondents. The opinions of employees working in the private sector in Slovakia were examined. Based on the results achieved it can be concluded that the type of corporate culture that dominated at the begining and after the crisis caused by the COVID-19 pandemic changed in terms of time. At the beginning of the pandemic, employees perceived that elements typical of clan corporate culture were being applied in the private sector (Übius, Alas, 2009; Jones, Madey, 2014; Demski et al., 2016; Jaeger et al., 2017). Employees shared common views. They saw themselves as part of one big family that was active and engaged. The work environment resembled an extended family, where equal opportunities were created for every employee, while also promoting diversity in the workplace. Individuals' goals were aligned with corporate goals, based on their trust in the business. Leadership took the form of mentoring, with leaders playing the role of teachers, advisors, or parents. Loyalty and traditions were integral to the company's culture, and devotion to the company was high. Emphasis was placed on the long-term development of each individual. Great importance was attached to cohesion, morale, and the working environment. Success was understood in connection with the internal environment and the care of employees. Core values were rooted in teamwork, participation, communication, and consensus.

The research results also show that in 2023, a hierarchy corporate culture prevailed, characterized by the following features (Wallach, 1983; Cameron, Quinn, 1999; Heritage et al., 2014; Demski et al., 2016, Jaeger et al., 2017). Businesses were characterized by a formalized and structured work environment that emphasized procedures and regulations. Internal sustainability was emphasized, along with the need for stability and control. Regulations and order became the basic values of the company. Management was based on organized coordination and monitoring. Emphasis was placed on the efficiency of smooth operations, predictability, efficiency, and accuracy of management procedures. Values included consistency and uniformity. Top-down communication prevailed, and standardization was typical. The binding element was the formal rules. Effective leaders were good coordinators and organizers, for whom it was important to maintain the smooth running of the enterprise, its stability, and efficiency. Success was defined by the reliability of deliveries, the smooth fulfillment of schedules, and low costs. The management of employees primarily focused on ensuring job security.

Enterprises should create an appropriate corporate culture because, according to the research of Park et al. (2023), corporate culture can increase business performance. Additionally, according to Khan et al. (2023), it is a key aspect of sustainability. Foreign research confirms that despite the large negative impact of COVID-19 on the operations of enterprises, those with a strong corporate culture outperform those without (Li et al., 2021). Furthermore, Li et al. (2021) concluded that corporate culture is an intangible asset designed to meet unforeseen contingencies as they arise. Zulfikar et al. (2021) added that corporate culture has a substantial impact on the sustainable behavior of SMEs. Samad et al. (2018) stated that the better the company's performance, the more the corporate culture is shared by employees. Additionally, businesses that embrace and share a strong corporate culture encourage employee participation and adaptability, leading to greater employee commitment and motivation, which in turn leads to higher business performance. Moreover, if the values, norms, and patterns of behavior resulting from the corporate culture are shared to a high degree within the company, the corporate culture becomes strong and significantly impacts the company's functioning (Kotter, Heskett, 2011), success or

failure (Owoyemi, Ekwoaba 2014), competitiveness, social responsibility, innovation, and performance (Jafari et al., 2013, Kraśnicka et al., 2018).

Conclusions

The COVID-19 pandemic has gradually evolved into a global crisis. The Slovak Republic was not an exception and was also affected by the pandemic, with some areas of business being more heavily impacted than others. Measures such as the ban on international transport and the closing of borders, implemented by individual governments to protect public health and slow down the virus spread, resulted in a decrease in consumer demand, reduced production, increased unemployment, and the closure of some businesses. Other effects of the pandemic are being studied by various researchers. The aim of the research was to determine whether the perception of corporate culture was affected by the COVID-19 pandemic. It was achieved by identifying the type of corporate culture that dominated at the beginning and after the crisis caused by the COVID-19 pandemic. The research findings indicate that the pandemic has indeed influenced the perception of corporate culture in Slovakia. While teamwork, participation, and consensus were considered crucial in enterprises at the beginning of the pandemic, there is now an increased emphasis on procedures and regulations, where adherence to formal rules is important for businesses post-pandemic.

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APPROACHES TOWARDS PERFORMANCE MEASUREMENT AND MANAGEMENT

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Abstract. In today's dynamic and highly competitive business environment, performance measurement and management systems play a crucial role. They help companies to be competitive. However, companies must properly set up approaches towards performance measurement, management, and all associated activities to take full advantage of these systems and ensure their sustainability. This can be a challenging task. Only some researchers discuss approaches toward comprehensive performance measurement and management. The authors have identified issues related to understanding, implementing, and using these systems. This article aims to fill this gap by providing a comprehensive view of performance measurement and management. It describes the performance measurement system, components, steps, measures, measurement areas, users, and information transfer. The performance management system has to consider the context of the entire organisation and embrace external and internal factors that influence its implementation, development and quality, as well as tools that make it more efficient and ensure its sustainability. The suggested framework is graphically illustrated. Finally, the meaningfulness, reality and possible usability in practice are verified through semi-structured interviews with managers of selected companies.

Keywords: performance; management; approaches; measurement; system; factors; tools

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1. Introduction

In today's dynamic and highly competitive business environment, managers need a reliable performance management system based on performance measurement results for their decision-making. At the same time, they need to understand the management of performance measurement systems. This is possible by answering two key questions (Kennerly, Neely 2003): "What factors affect the ability of performance measurement systems to transform over time?" and "How will companies help manage their performance measurement systems to continue to fulfil their purpose? " It is therefore necessary to deal not only with the implementation and proper setup of these systems but also their development over time and sustainability. Companies focus more on what should be measured today but must address what should be measured in the future and how (Yadav et al., 2013). Likewise, only some researchers still focus on performance measurement rather than performance management in a broader context (Kennerly, Neely, 2003). They also state that only some companies have a systematic process to manage the development of their performance measurement systems to reflect the organisational context. The concept of dynamism emphasises the need to create such a system that continuously monitors the internal and external environment and, following this, sets and evaluates goals and priorities (Bititchi, Turner 2002). The performance management system should be understood in the company as a tool for connecting, improving, and learning (Atkinson, 2012). Successful performance measurement and management systems designs often need a comprehensive approach to performance management, neglecting

various dimensions. This article addresses this gap by proposing a detailed performance measurement and management approach. The primary aim is to formulate an approach toward comprehensive performance measurement and management through a literature review, achieved by designing individual components such as performance management and performance measurement systems and identifying influencing factors and tools for efficiency. The proposal is further refined through discussions with industry representatives to gather insights and feedback for potential real-world applications. The research questions guide developing, understanding, and achieving set objectives with a defined methodological approach for literature search processing.

2. Theoretical background

Performance measurement involves many assumptions and judgments that need to be made before the measurement result is visible. According to Liu et al. (2019), performance measurement is a vital tool for efficient and effective management, with the aim of:

- identify the organisation's success, customer satisfaction and where there are problems that can be improved,
- understand the processes in the organisation and determine what they are doing well or what they do not know,
- ensure effective decision-making and improve the performance of the organisation,
- determine whether the expected results of stakeholders have been met so that satisfaction with the results achieved can be enhanced in the future.

The performance measurement system (PMS), described by Carlsson-Wall et al. (2016), is a set of measures collectively used to assess organisational performance. PMS transforms input into output measures for performance evaluation and feedback as an information system. It determines relevance, signalling interventions for management, with impulses focusing on operational efforts and responsibilities (Hald, Mouritsen, 2018). The environment's and organisation's growing complexity is a significant obstacle to implementing effective PMS (Harkness, Bourne, 2015). Most researchers have focused primarily on examining the complexity of the external environment (Harkness, Bourne 2015). According to Nudurupati et al. (2011), it is necessary to understand the role of PMS as agents of change to understand the complexity of the PMS context. The question of how to solve complexity in organisations is addressed by a number of researchers, e.g., Bititci, Turner (2002), Nudurupati et al. (2011), Melnyk et al. (2014), Smith, Bititci (2017) and others.

The results of a systematic literature review conducted by Okwir et al. (2018) show that most research studies have identified social or technical controls as the basis for an effective PMS. Detailed views, characteristics and defining of included parts of these controls are stated in (Bititci, 2015).

Okwir et al. (2018) further identified six sources of complexity in PMM (performance measurement and management) dimensions: role, task and procedural types of complexity were associated with the social dimension, and methodological, analytical and technological types of complexity were associated with the technical dimension.

Understanding the dimensions of performance management, complexity theory, and the influence of internal and external factors is crucial to facilitating responsiveness and dynamism in organisations and for the effective implementation of PMS and PMM.

PMS is beneficial for properly evaluating business performance and can improve business management. However, developing PMS is challenging, especially in identifying and selecting performance indicators to be included, which are often challenging to implement (Cagno et al., 2019). One way to understand how a performance measurement system is designed, implemented and used is to categorise its critical factors for finding context, processing and understanding the content of the measurement (Cuthbertson, Piotrovicz, 2011; Pekkola, Ukko, 2016; Bubenik et al., 2022). It is essential to define the conditions under which the measurement

is performed, how it is performed and what is measured (Harkness, Bourne, 2015). They also argue that the development of performance measurement and management systems can be divided into three main phases:

- design of performance measurement performance measures and identification of strategic objectives,
- implementation of performance measures, data collection, collection, sorting and distribution,
- use of performance measures, measures that affect the measurement, control and reflection of the correctness of the selected performance evaluation measures. Important for performance measurement systems is the cascading or otherwise scaling up of key elements of the performance measurement system to understand the context, process and content of the measurements and incorporate performance indicators to enable employees to take responsibility for those indicators they affect (Hey, 2017; Ukko, Saunila, 2020).

Teplická et al. (2015) present the components of the performance measurement system divided into these areas: performance measurement, strategy management, communication, behavioural influences and areas of learning and improvement. The relationship between the performance measurement system and the performance management system is reciprocal because the PMS evolves in response to the strategy and the feedback signal from the PMS, and it also informs the strategy that is defined in the performance management system (Nudurupati et al., 2021). Cokins (2004) designed a performance management system consisting of components: vision, mission and strategy development, definition of strategic objectives, monitoring of strategy objectives, their interconnection and cause and effect relationships, meaning of initiatives to reduce performance gaps in achieving objectives, selecting the right strategic performance indicators, collecting data and comparing with set targets, creating action plans to close management gaps (Cokins, 2004).

Controls and evaluations of business performance based on quantitative and qualitative measures are impact factors that affect the quality and sustainability of the PMM system. One of the effects on the performance measurement and management system is changes that can take the form of risks and opportunities in the business environment (Hey, 2017). At the organisational level, Denisi and Smith (2014) outlined a conceptual model that includes external factors, such as national culture, organisational culture, corporate performance definition, and organisational strategy, that affect employee performance management, knowledge, skills, and abilities (Denisi, Smith 2014). Impact factors related to performance indicators include the duplication of data, which can reduce costs by reducing the amount of data and the effort expended to collect them. Reduced performance monitoring may require increased documentation (Hey, 2017). Factors influencing the performance management system, from a people's point of view and their organisational effectiveness, relate to aspects of performance improvement that include leadership, teamwork, problem-solving skills, fact-based decision-making, focus on results, change management, mentoring (coaching), ability to do work, open and honest communication, performance management based on behaviour, rewards for results (Ukko, Saunila, 2020).

Further research by Pichler (2012) has also identified relationships between managers and employees as a critical factor in the social context of performance management. In this respect, recent discussions between researchers and experts in improving performance management practices suggest a broad consensus that the relationship between managers and employees is critical to success (Pulakos, O'leary, 2011; Levy et al., 2017). Performance management systems include a support infrastructure ranging from a simple data collection and analysis method using Excel to a sophisticated information system that facilitates enterprise resource planning platforms or Business Intelligence solutions (Franco-Santos et al., 2012). According to Koman et al. (2019), working with diverse data in and around the enterprises using the Big Data solution can provide significant information value to improve the decision-making processes of the enterprise managers. In addition, Big Data can offer possibilities to support the innovation management process (Koman et al., 2018).

Currently, there are many relatively successful designs of performance measurement and management systems, and many of them have been successfully implemented in practice. Still, these systems do not provide a comprehensive view of performance management in the company and do not sufficiently address the individual dimensions of performance management. Unfortunately, few researchers still devote themselves to a comprehensive view of performance management, that is, a detailed study and knowledge of the performance measurement system, the performance management system, the factors influencing its implementation, further

development and sustainability. The contribution of this article lies precisely in a comprehensive view of enterprise performance management.

3. Methodology

The main objective of this paper is to propose approaches towards performance measurement and management based on the literature review.
The fulfilment of the main goal depends on the following specific goals:

1. Identify and analyse internal and external factors affecting the company and performance management system.
2. Define tools for improving the performance management system.
3. Define performance management system.
4. Define performance measurement system.
5. Characterise the cycle of continuous improvement.
6. Verify the possibility of introducing the approach towards performance management in the conditions selected companies.
7. Summarise the obtained results and conclusions.

A literature review was performed based on analysing books, articles and research studies found in various databases, such as Web of Science, Scopus, Science Direct, SpringerLink, etc. Appropriate literature was selected based on the chosen criteria. Literary sources published after 2000 were included in the selection. The entire design of the approaches towards the performance management process is expressed graphically and in detail. The resulting proposal was consulted with four companies operating in Slovakia. For this purpose, semi-structured controlled interviews were conducted with the managers of companies. These companies can be categorised as large according to the number of employees and turnover (OECD, 2021). Three companies are manufacturing. Two of these companies operate in the automotive industry (one is a car producer, the second produces parts for motor vehicles), the third deals with the production of ferroalloy and non-ferrous powders), and the other is a non-manufacturing - providing services - software development. Semi-structured controlled interviews were conducted with the top managers of these companies to verify the proposal's suitability. The companies were selected based on intentional technology. The suitability of the companies was determined based on the preliminary research that was performed.

This is only preliminary research to determine whether this model is suitable for businesses and applicable in practice. The authors are already preparing the next phase of the research, which will determine the applicability of this model in companies from different business areas through a questionnaire survey.

4. Approaches towards performance measurement and management

In the past, for example, the authors Stříteská and Jelínková (2018) have tried to capture a comprehensive proposal for the performance management process. This proposal can be considered very well processed, but it is processed only in general terms and does not go into detail. The basic steps of this proposal also form the basis for the newly created model in this article.

The proposal of the approaches towards performance measurement and management is shown below. It consists of individual parts. The external part captures external factors that affect the company and, at the same time, also performance measurement and management systems. Subsequently, internal factors directly influencing the performance management system are captured, as well as tools that can help ensure the continuous improvement of the entire system. The central part of the proposal is the performance management system, which consists of the performance measurement system, particular steps and parts.

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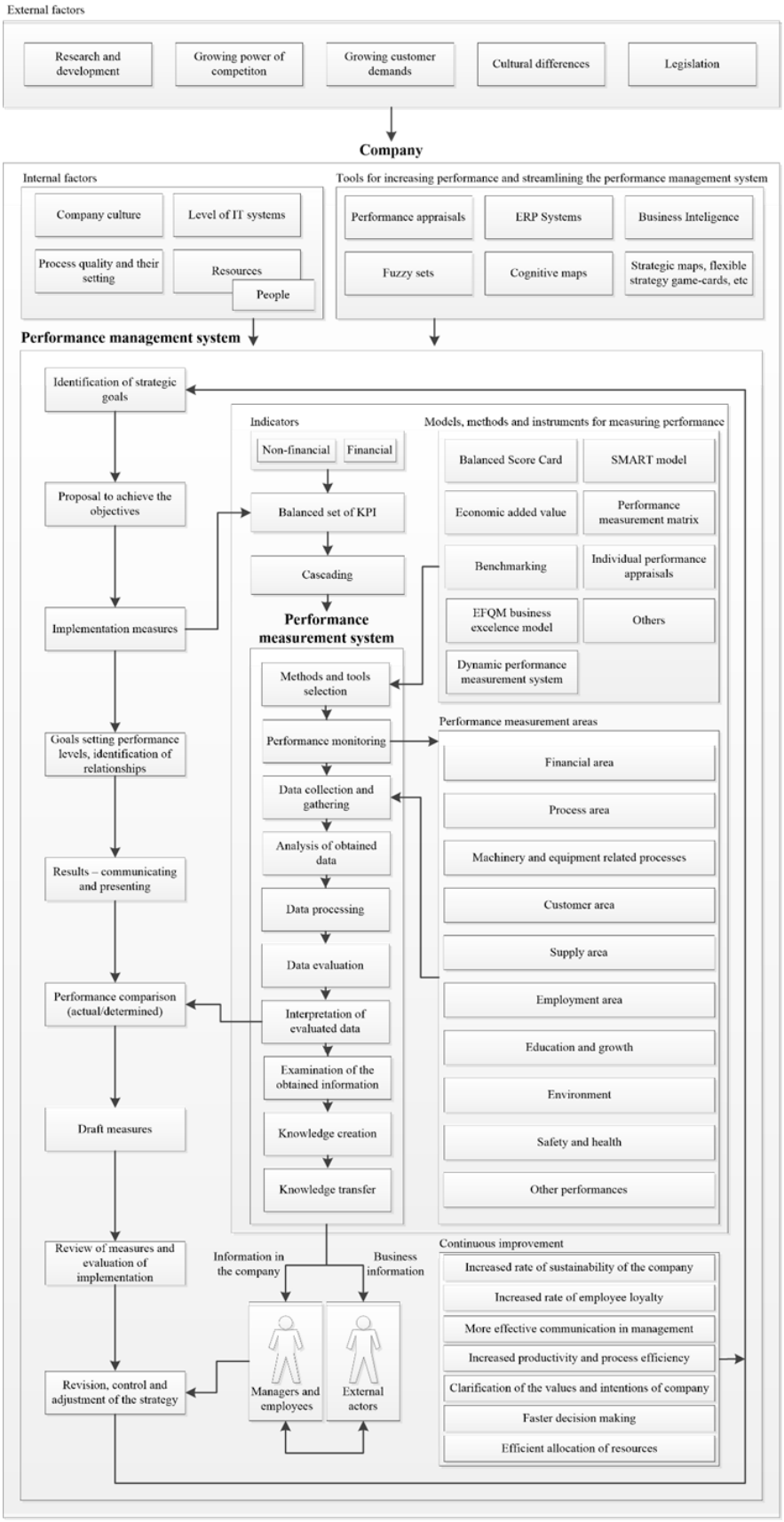

Figure 1. Graphical design of approaches towards performance measurement and management

Source: own elaboration

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4.1. Factors affecting the company and performance management system

The company, its functioning, management method, and thus its performance are influenced by various factors. Factors that come from within the company were defined as internal factors. The key to good performance is a strong corporate culture. This is because a positive and strong culture can motivate the average individual to achieve good performance, leading to better company performance (Mujeeb et al., 2011). Likewise, performance management only works with regular open communication, which is part of the corporate culture (Mckinsey et al., 2021). Most companies currently have much space to monitor performance and their processes. Technological progress is constantly improving this source of monitoring. IT systems significantly influence performance management, impacting quality and efficiency. Effective performance management is crucial, aligning employees, resources, and systems with strategic goals (Mckinsey et al., 2021). Organisational resources and process setup are closely linked. Processes involve transforming inputs into outputs using resources to achieve goals (Glavan, 2023). Companies increasingly prioritise employees, recognising their unique competitive advantage and significant impact on overall performance (Desa, Asaari, 2020).

The company's external environment significantly affects not only the company but also its processes, management and, thus, the overall functioning of the company. Research and development can dramatically affect the business environment and the company (Business Queensland, 2023). The development of ICT (information and communication technologies) is also a significant external factor (Schleck, 2022). Companies must prioritise customer satisfaction in a highly competitive landscape, adopting a modern business quality approach, as Cengiz (2010) emphasised. To stay competitive, companies should strive to innovate, recognising that offering the same or outdated products may prompt customers to seek novel solutions (Tšernov, 2023). In a globalised industry, it is crucial for executives, especially in multinational companies operating in different regions, to emphasise and be aware of the impact of national culture on business (Nazarian et al., 2017; Soviar et al., 2017). The impact of legislation cannot be ruled out of the operation of companies. Legislation and regulations affect the performance of any business. An example is the higher performance of companies seeking flexibility in recruiting temporary staff (Van Landuyt et al., 2017). This impacts frequent staff turnover, negatively affecting the company's costs and performance, as new employees are not as efficient at first as experienced employees (Defranzo, 2023).

4.2. Tools for improving the performance management system

The growing need for faster decision-making places increasing emphasis on managing business performance. This is what Business Intelligence (BI) supports. The role of BI is to support management in the creation of reports, analysis of results, prediction, and planning. Integrating BI into performance management is critical to quick decisions (BI-survey, 2023). Other ICT tools are digital communication channels (e-mail, internal communication platform and other team collaboration software), which are necessary even during a pandemic (Jouany, Martic, 2023). Performance appraisal is an essential aspect of performance management. It is a tool for correctly setting and managing employee performance, including further development (Omojaro, Taiwo, 2023). Related to this is a digital panel or dashboard, a tool for monitoring and collecting individual company data in real-time, i.e. for monitoring employees (Mišún, Mišúnová Hudáková, 2017). Real-time feedback applications allow managers and employees to provide, search for, and receive competency-based feedback using their computers, smartphones, or other devices (Rivera et al., 2021). Strategic maps are the most critical component of the BSC. They show the target status and the key goals and priorities the company must meet (Marr, 2023). Fuzzy logic or fuzzy sets can be a powerful tool for managers to use for evaluating the performance of personnel or teams within the performance management system (Beheshti, Lollar, 2008). The flexible strategy game card, comprised of two broad perspectives, enterprise perspective and customer perspective, can be used to play the strategy game in strategy formulation and execution (Sushil, 2010).

4.3. Performance Management System

Based on a literature search, an effective performance management system was defined, consisting of a set of the following steps:

- identification of strategic objectives,
- a proposal for achieving the goals,
- implementation of measures,

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- objectives setting performance levels and identifying relationships between them,
- results and their communication,
- comparison of performance (actual and determined performance),
- draft measures,
- review of measures and evaluation of implementation,
- revision, control and revision of the strategy.

4.4. Performance Measurement System

In a performance management system, it is first necessary to know the performance to manage it. This is the focus of performance measurement systems within a performance management system, which evaluate performance and provide feedback.

The areas of performance measurement that are shown in the graphical proposal of approaches towards performance measurement and management in the picture (Figure 1) are:

- financial area (includes measuring the performance of economic variables such as profit, cash flow, profitability and more),
- process area (using, for example, the six-sigma method),
- machines and equipment related to processes (measuring the performance of machines and equipment about process settings),
- customer area (finding and measuring the satisfaction of products or services from customers),
- supply area (evaluation of suppliers for their management, which is the creation of an optimal combination of the number of suppliers, their quality, speed of delivery of materials and costs),
- employee area (measuring employee performance, creating and adhering to established performance and quality standards, etc.),
- education and growth (innovation),
- environment, safety, and health (measuring environmental impacts, such as the amount of waste produced, etc.),
- other performance (individual performance measurements specific to the company).

First, it is essential to identify critical key performance indicators (KPIs) that need to be improved (Cai et al., 2009). By setting a balanced set of key performance indicators (KPIs), it is possible to monitor performance. That is why it is necessary to focus on indicators that support business performance (Capri et al., 2023).

In an ideal system, each company creates a cascade of indicators and individual goals at individual levels to make the performance measurement system as close as possible to the company's needs (Capri et al., 2023). It should be remembered that the sets of indicators should include financial and non-financial indicators to obtain relevant data (Bisbea, Malagueno, 2012).

The aim of the new PMS is, therefore, to achieve a greater balance between individual types of measures: financial and non-financial, short-term and long-term, delayed and prestigious or focused on control and improvement (leading and lagging), oriented towards shareholders and stakeholders, internal and external performance measures (Kennerly, Neely, 2002).

According to Landström et al. (2018), certain pitfalls must be identified when designing a business performance measurement system. The relationship must be known for the performance measurement system's effectiveness for different KPIs. Insufficient understanding of the relationships between indicators often leads to a lack of an overall picture as a systemic view of the organisation.

The mapping of the primary vital areas of performance, their indicators and causal links were dealt with, for example, by Paraschi et al. (2019).

Based on the literature review, a performance measurement system can consist of the following 10 steps:

- choice of methods and tools,
- performance monitoring,

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- collection and compilation of necessary data,
- analysis of the obtained data by selected methods,
- data processing,
- data evaluation,
- interpretation of the evaluated data,
- examination of information,
- knowledge creation,
- knowledge transfer.

The choice of methods and tools is the first step in measuring performance. Methodologies, methods and tools are not separate measurement systems. They are used for the structured development of specific performance measurement systems (Schreiber et al., 2020). The most well-known and most frequently used tools for measuring performance the following models, methods, and tools are, e.g.:

- Economic added value is an indicator of financial performance that can assess whether a company is successful in the market and predict its future direction (Worthington, West, 2002).
- Benchmarking in business compares industry best practices with business processes to identify performance gaps and gain a competitive advantage (Prašnikar et al., 2005).
- The Balance Score Card (BSC) is a strategic management performance metric used to identify and improve various internal business functions and their resulting external results (Lesáková, Dubcová, 2016).
- A dynamic performance measurement system is a performance measure that must be current and relevant to be helpful in a dynamic business environment. Thus, it is essential for a company that its performance measurement system is dynamic, either in terms of indicators and measures or strategy (Weicker, 2002).
- The SMART model is a method by which a company sets goals (Worden, 2014; Banks, 2023).
- The Performance Measurement Matrix (PMM) is one of the older systems used to measure business performance. PMM defines four measurement perspectives representing a company's internal and external, financial and non-financial views (Ossovsky et al., 2023).
- The EFQM Business Excellence Model is a tool that enables companies to understand the strengths and weaknesses of their defined vision and mission (Németh, 2020). His philosophy is to self-evaluate the organisation through clearly defined criteria and rules. The result of the self-assessment is a map of the organisation, which provides an overview of the advantages and disadvantages of the company (Moščáková, 2019).
- Individual Performance Appraisals represent a traditional assessment measuring performance against measurable goals (Cappelli, Conyon, 2018).
- The company creates its methods to reflect best the needs of measuring performance according to its specific requirements.

Performance monitoring and monitoring the specific area of performance measurement itself is the next step. Data are collected automatically by an information system, in an electronic form or manually based on paper outputs from monitoring. The analysis of the obtained data by selected methods is the analysis of the received information and their decomposition according to common properties for subsequent processing. Data processing can mean the creation of a basis for analysis for further data evaluation. Data evaluation is the comparison of acquired data. In the next step in interpreting the evaluated data, comparing the data will create information about possible deviations in performance. Interpretation of the estimated data is the point at which the data becomes full-fledged information that enters the performance management system as a basis that communicates to the management for performance management. By evaluating and obtaining information from performance measurement, the manager can compare the performance shift over time and propose measures. Examining the information obtained consists of its in-depth processing and its interrelationships with consequences. The setting of the system concerning the results is also discussed, based on which the company can learn and thus create knowledge. It is essential to develop understanding because it can stimulate new, innovative solutions or change to increase the chances of gaining a competitive advantage. Knowledge creation

is often cited as a resource for improving business performance (Adams, Graham, 2017). Knowledge transfer is the last step in a performance measurement system. In this step, stakeholders in the performance management system are given knowledge. Based on this result (acquired knowledge), a revision, control or possible strategy adjustment is performed. The performance measurement and management system has several stakeholders who enter the individual processes as users of results and managers. Still, simultaneously, the employees create a specific performance as performers of activities. In the created graphical design of approaches towards performance measurement and management (see Figure 1), stakeholders are divided as follows:

- Managers are seen in this proposal as a basis for making critical decisions and creating business strategies (Olsen et al., 2007). If the results are unexpected, managers can respond promptly and determine corrective action. Managers also use the measurement results to compare the results compared with the competition (Pavelková, Knápková, 2005). Thanks to the results, managers at the top and the middle or lower levels can react flexibly and adjust processes that do not show ideal results. Within the proposal, employees represent work performance (Wagnerová, 2008). Without their work, using the system would not be possible, as they are a source of necessary data that can be managed and influence their performance. Employees are also informed about the company's performance.
- External consultants can create a set of proposals and recommendations through the obtained results, which will help the company's top managers make fundamental decisions about its future direction.
- Based on the acquired results, shareholders decide whether the company is attractive to them and whether they are willing to continue to invest their capital in it (Fibírová et al., 2015).

4.5. A cycle of continuous improvement

It is a control framework that performs activities to improve processes continuously. The cycle consists of 4 parts: planning, implementation, evaluation and intervention (Song, Fischer, 2010). The cycle can improve the following areas described below:

Companies increasingly prioritise sustainability for their reputation and enhancing business processes and overall company value. More executives acknowledge the positive impact of sustainability programs on short-term and long-term company value (Capri et al., 2023).

Employee loyalty is crucial for workforce management. High loyalty reduces turnover, enhancing overall company performance in terms of cost and efficiency (Defranzo, 2023).

Achieving more effective communication across management levels is vital. Clear communication of the company's top goals is necessary for all management levels, improving overall output by avoiding misunderstandings. Effective communication and feedback are crucial for business performance, allowing continuous process improvement (Lumenwayworker, 2023).

When objectives are clearly defined, a performance management system can enhance individual and team productivity. Feedback is integral for improvement, but the system is more than just feedback—it involves various processes. For optimal results, managers must actively engage in the performance management system (Cardy, Leonard, 2015).

5. Verification of the findings

The possible applicability in practice was discussed with managers of selected companies, specified in more detail in the methodological part.

Respondents agreed that the submitted proposal is applicable and usable in practice. They did not identify any missing elements and stated that it is by logic and that its parts are designed in the correct sequence.

Respondents consider their currently implemented performance management systems more straightforward, less structured and organised. As in the present proposal, the individual steps are often performed in parallel, not sequentially. Specifically, these steps are included in the design of the performance management system,

such as the proposal of corrective measures and revision of the implemented strategy. Combining several design elements brings significant time savings for businesses. The steps in which the currently implemented system in one of the companies coincides with the submitted proposal are defining goals, monitoring performance, evaluating the achieved results and comparing the achieved results with the planned ones.

Cascading is used in three addressed companies, where the goals and set indicators are cascaded at individual levels of the company. Unfortunately, one of the companies does not use cascading at all and, at the same time, does not use KPIs. In contrast, another company states that it uses cascading and includes communication of results. It works similarly hierarchically as key performance indicators. Knowledge is sold from the lowest management level to the company's top management.

In the question concerning internal and external factors influencing the performance measurement and management system, it was found that companies perceive these factors and implement them into their processes. Corporate resources and corporate culture were identified as the most used internal factors. Upon closer examination, it was also found that the external factor of cultural differences needs to be given more attention. Because selected companies work mainly in Slovaks, minimal cultural differences exist. Changes in the factors affecting the company seek to promptly identify companies and thus ensure that their potential impact is minimised. One of the companies also identified other factors that affect their already established performance measurement and management system. It included the labour market among these factors and is currently significantly impacted by the coronavirus pandemic. This affected the supply of materials and raw materials and the number of orders, which decreased due to the pandemic. Part of long-term planning is also an effort to manage factors; within this planning, companies try to identify activities to reverse or mitigate the impacts that have come, either legislative or market. Planning on an annual basis if the situation can be influenced. If external or internal factors cannot be controlled, or if an unpredictable situation suddenly arises, companies respond as soon as possible to minimise the impact as much as possible. Another external factor that one of the companies considers to be vital and absent in the proposal is cooperation (Soviar et al., 2018; Holubčík and Soviar, 2021), as it is almost impossible for one entity to change anything, either from a market or labour perspective. Including cooperation with the public sector in the proposal would also be possible.

The proposal's tools, models and methods are mostly known to the respondents, and most are used in practice. However, the tool that the respondents needed to recognise was Fuzzy sets. The most used tool in the addressed companies is Benchmarking, which is used to streamline the systematic performance management process. No other tools, models, or methods companies know and use were identified.

The results obtained from the performance management system are communicated in a cascade from the lowest level to the managers. Only results that directly affect employees are displayed. Communication occurs in various ways, such as personal, telephone and e-mail communication or via the intranet, training, workshops and meetings.

According to the respondents, during the implementation of the submitted proposal into business processes, problems could arise regarding the reluctance of employees to change the already established system. Employees usually respond negatively to changes that occur in companies. They are used to already established systems, which they prefer to keep going. Another possible problem is the collection of data that does not benefit businesses. According to managers, a large amount of data is collected, but it is not essential for the operation and progress of the company. By processing large amounts of unnecessary data, businesses spend time they can use more efficiently. One of the companies also identified an outdated system for recording the obtained data as a possible problem.

The interviews showed that companies continuously strive to improve the established performance management system. The individual steps that are shown in the graphic design are sufficiently contained. Businesses focus mainly on effective communication, increasing productivity and clarifying the company's intentions.

Respondents described approaches towards performance measurement and management as well-structured, easy to understand and comprehensive. According to the respondents, their implementation is possible, but a

slight simplification would be needed. During its implementation, companies may need more knowledge of individual employees in performance measurement and management.

It is important to note that the proposal needs to be adapted to the conditions and requirements of a particular company. This general theoretical proposal should be used as a template or guide for the subsequent compilation of a specific company. The aim of the conducted interviews with the managers of selected companies was to obtain the opinions of experts from business practice on the above theoretical proposal so that it could be further improved.

Conclusions

As a practical implication of this paper, these claims are mainly that the proposed approaches towards performance measurement and management provide companies with a comprehensive view of performance. It presents a detailed performance management system as a sequence of individual steps and activities, follows the company's strategic management and resolves individual causal links and relationships. At the same time, it also solves the transfer of information and the issue of continuous improvement and sustainability of the entire system. It draws information from the performance measurement system, which lies at its "heart". The performance measurement system also contains a sequence of steps and activities that need to be performed. Indicators, their definitions, cascading, areas of performance monitoring, and models used for measurement and management are integral parts. The quality and maturity of the performance measurement and management system are ensured precisely by including individual components, steps, activities, and their interconnectedness, as well as the degree of their knowledge. The stability of the system and its sustainable development and effective functioning are strengthened by identifying and studying internal and external factors and tools. In addition, this proposal was marked as a complex solution for performance management and valuable in business practice based on interviews conducted with managers of selected companies.

Theoretical implications are conducting a detailed analysis and critical evaluation of the literature in the addressed area and proposal and a detailed description of the created theoretical proposal of approaches towards performance measurement and management.

Regarding the research limitation, this paper's stated approaches towards performance measurement and management are only preliminary research to determine whether these approaches apply in practice and need further development and testing according to the managers' opinions. Regarding the positive comments of managers on the given approaches, the authors in further research will focus mainly on establishing the broader applicability of the approaches in companies from various areas of business and also on the application of this proposal in selected companies and to monitor the results associated with it over time.

Given the breadth of the performance measurement and management field, there is scope for further research. These future research investigations could cover, for example, the following areas:

- Elaborate in detail on the individual steps of the proposed performance measurement and management system, define processes, tasks, and responsibilities at unique levels of management and documentation for each step.
- Dealing with a detailed analysis of the standards used in practice and identification of methods leading to ensuring their balance.
- To deal with the problem of the strategy review process based on the results of the obtained performance measurements.
- Analyse in detail the level of management of key external and internal factors in enterprises, i.e. monitoring the current state, identifying the specific impacts of these factors on the enterprise, how these factors are taken into account within the performance management system, etc. Also, examine the causality and degree of dependence of individual vital factors and performance factors using statistical methods, namely regression and correlation analysis.
- Investigate the difference between manufacturing companies and service companies, as it is evident that specific conditions exist within both groups of these companies.

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EMPLOYEE TURNOVER: CAUSES AND RETENTION STRATEGIES*

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Abstract. The research aims to determine the factors determining employee turnover and foresee possible management techniques for employee turnover management in the organization. The following research methods were applied: *analytical, descriptive, quantitative and statistical.* After using a quantitative research strategy and based on the respondents' (n=294) assessment results, the possible extent of employee turnover in the organization and the respondents' attitude toward work in the organization were identified, as well as the causes impacting employee turnover were specified based on which possible techniques for decreasing the employee turnover in the organization were determined. After analyzing the employee attitude toward work in the organization, the research data showed that even though a large number of respondents felt successful in their work and assessed the work in the organization as interesting and attractive, more than two-thirds (64.7%) of the research participants admitted that employee turnover in the organization is high. Even 51.7% of respondents were very often or often thinking about changing their jobs in the last half year. The research found that failure in job expectations, the lack of motivation and the professional skills required were the main personal factors impacting employees' willingness to change jobs. On the other hand, uncompetitive salaries and limited opportunities for career and professional development, as well as underestimation of work results and efforts, ignoring the individual needs of employees, restricted possibilities to show initiative and participate in decision-making processes and lack of room for self-expression and realization of one's personality are considered the most critical external reasons determining employee turnover in the organization. Based on the research results, it could be stated that employee turnover management requires complex decision-making at the organizational level, which covers the creation of a favourable psychological microclimate, the employee recognition and evaluation for their efforts, the creation of a flexible approach to the singularities of work organization, ensuring the relationship between colleagues and the manager and fostering its feedback. Moreover, in employee turnover management, it should be appropriate to ensure personal and professional development, improve the motivation system, and provide opportunities for choosing a flexible workload and schedule.

Keywords: employee turnover; causes of employee turnover; measures and methods for employee turnover reduction; desire to change the job; employees; motivation

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1. Introduction

The increasing labour supply, the opportunities to find a better job and the value of human resources in the organization in the context of today's labour market give particular importance to providing a competitive advantage to the organization, ensuring its harmonious functioning and development (Sinha, Sinha, Sarangi, 2018). Therefore, even though employee turnover is a natural and usual process in the organization (Žukauskaitė, 2008), relevant discussions about ensuring employee stability and managing employee turnover in the organization encouraged to carry out the research in this area.

The relevance of employee turnover management is revealed in scientific literature, highlighting its negative consequences. According to Abagelan and Tulu (2020), employee turnover is one of the biggest failures in the organization, causing great anxiety and concern to this day. Scientists agree that employee turnover could become one of the causes of social and economic losses in the organization arising at the time of employee dismissal and after employee dismissal due to the need for new employees. Based on these facts, employee turnover is assessed as hurting turnover rates (Lee, 2018) and also as a factor reducing the scope of efficiency of the organization, its labour productivity, profitability and activity (Abagelan and Tulu, 2020), as well as impacting a lower quality of work and its results (Koszela, 2020). Some scientists state that employee turnover is the decisive factor in organizational losses (An, 2019).

In contrast, Zhu et al. (2017), Chiat and Panatik (2019), and Gharbi et al. (2022) believe that searchers for new employees, their selection and employment, as well as training of new employees, require additional costs. Based on the works of scientists, Žukauskaitė (2008) stated that adverse effects of employee turnover are related to decreased work morale, the increased workload for remaining employees, the loss of human capital (experience, knowledge, skills), a reduced unity in a team and the increased possibility of conflicts. These facts bring to light the relevance of employee turnover management in the organization and confirm that employee turnover management is an inseparable area of human resource management in the organization, which is related to positive aspects of the existence of the organization, such as labour productivity, operational efficiency and the quality of results and ensures the continuity of essential processes.

When assessing the tendencies of employee turnover management in the organization, it is evident that the change in the concept in this area is developing in a positive direction. With the increased attention to human resources in the organization, the emphasis was laid on ensuring employee stability and fostering searches for employee turnover retention. Scientists admit that employee turnover management is a complex phenomenon covering the following aspects: the creation of a favourable psychological and microclimate in the organization (Bufquin, DiPietro, Partlow, 2018), encouraging teamwork (Alvi, Kayani, Mir, 2020), ensuring the quality of relationships between colleagues and the manager and its feedback (Krywalski, 2020), ensuring respect and recognition of employees and evaluation of their efforts, (Čuček and Kač, 2020; Zhu et al., 2017) providing their support (de la Torre-Ruiz, Vidal-Salazar, Cordón-Pozo, 2019; Alam et al., 2020) and improving motivation methods (Fletcher, Carter, Lyubovnikova, 2018; Navickas et al., 2023; Awais Bhatti and Alnehabi, 2023).

Employee turnover management is related to answering their needs by creating favourable working conditions and providing all the tools necessary for work (Imran and Ayub, 2017), and also creating opportunities for personal and professional development (Haider, Fatima, de Pablos-Heredero, 2020), trusting employees, (Demircioglu, 2021), granting them autonomy to act independently and make decisions (Abagelan and Tulu, 2020; Haider, Fatima, de Pablos-Heredero, 2020). According to scientists, these measures ensure the retention of highly qualified employees (Lutfiani Putri Windia, Singh, Rashid, 2021) and increase their inclusion in the activities performed (Weideman and Hofmeyr, 2020). However, it should be stated that in Lithuania, the preventive measures for reducing employee turnover still need to be fully developed, whereas targeted strategies for employee retention are not sufficient; therefore, the existing problems still need to be solved. Unfortunately, after assessing today's labour market and the constantly changing economic environment of the country, there is little hope that the present situation regarding employee turnover will decrease in the near future. On the contrary, in today's labour market, those employees who are self-confident, flexible and not afraid of professional mobility change their workplace more often (Žiogelytė and Kšivickaitė, 2014). On the other hand, it is evident that the increasing labour supply and better opportunities for finding a job still make the problem

of employee turnover relevant and encourage employers to search for effective ways of managing employee turnover.

Considering the insights of scientific literature on the need for employee turnover management in the organization, the research raises the following *aims*: After identifying the factors impacting employee turnover to predict possible ways for managing the situation of employee turnover in the organization.

Research objectives:
1. Discuss possible management techniques after analyzing scientific literature and the research related to the topic, theoretically substantiating the causes of employee turnover.
2. To investigate and compare the attitude to work of employees with more than five years of experience and those with less than five years of experience in the organization.
3. To determine the causes of employees who want to change their jobs.
4. To discuss possible techniques for employee turnover reduction in the organization.

In this context, it is necessary to assess the employees' attitude toward work in the organization, identify the factors impacting job satisfaction, identify the causes for the desire to change jobs and foresee possible perspectives of employee turnover management. No doubt revealing the extent of employee turnover and the factors impacting employee turnover could allow us to understand not only the importance of the problem, its causes and consequences but it could also encourage us to take measures and look for methods how to manage the situation of employee turnover.

2. The causes of employee turnover and the opportunities for its reduction: a theoretical aspect

In today's labour market, the emphasis is laid on investigating employee turnover management to ensure the effectiveness of the organization's activities. Usually, employee turnover is described as a dynamic phenomenon when an employer loses an employee (Ngo-Henha, 2017; Gharbi et al., 2022) due to a conscious and deliberate desire of the employee to leave the organization (Abagelan and Tulu, 2020). Some researchers state that employee turnover is a phenomenon arising from the incompatibility of values, interests and behaviour (Olubiyi et al., 2019). Accordingly, after analyzing the patterns of employee turnover, Lee (2018) and Lee et al. (2017) drew attention to the complexity of this phenomenon and pointed out that internal and external factors impact the process between a person and an organization.

Employee turnover is a complex phenomenon or a combination of several decisions; however, it is evident that this impacts both an employee and his organization. On the one hand, employee turnover could be useful to the organization when newly hired persons bring new knowledge and ideas that help solve particular problems and more quickly adapt to the changing labour market conditions. On the other hand, employee turnover has a negative side as well. The scientists who analyzed negative aspects of employee turnover (Žukauskaitė, 2008; Caesens, Stinglhamber, Marmier, 2016; Anuradha and Ghuman, 2017; Čuček and Kač, 2020; Demircioglu, 2021) draw attention to the fact that a frequent employee turnover affects the volatility of work results to be achieved in the organization, since employee turnover may interfere with a quick adaptation of new employees in the work environment. Some scientists relate the adverse effects of employee turnover in the organization to the turnover rates, which negatively affect the organization's activities (Lee, 2018), production (Skelton, Nattress, Dwyer, 2020) and operational efficiency and profitability of the organization, (Abagelan and Tulu, 2020) as well as require additional costs for new employee searches, their selection, employment and training (Zhu et al., 2017; Chiat and Panatik, 2019; Gharbi et al., 2022) whereas sometimes cause considerable losses when an unplanned necessity to change management plans and the existing strategies arises (An, 2019). The researches of other scientists show a direct relationship between employee turnover and turnover when the employee dynamics in the organization negatively impact turnover (Abagelan and Tulu, 2020), which may directly reduce the quality of work or its results, which, according to Koszela (2020), may increase customer dissatisfaction with the services provided or production. Skelton, Nattress, and Dwyer (2020) noted that employee turnover costs might cost an organization more than 100 per cent of one employee's monthly salary. Moreover, the employee turnover should be related not only to financial losses, as one of the negative effects to the organization. Based on the results of other scientists Žukauskaitė (2008) stresses that employee turnover in

the organization evokes such consequences as decreased work morale, an increased workload for the remaining employees, the loss of human capital (experience, knowledge, skills), an impaired group socialization and a decreased unity in a team, as well as an increased possibility of conflicts, which according to some scientists, can foster other employees to leave the job. The previously mentioned effects were stressed by other scientists, based on which it could be stated that a prevailing employee turnover in the organization impacts the loss of knowledge and accumulated experiences (Žiogelytė and Kšivickaitė, 2014). As seen from the results obtained, employee turnover evokes financial and social losses for the organization that cover the employee experiences, knowledge, and skills and negatively impacts the microclimate in the organization and the unity of a team. On the other hand, employee turnover may become the factor affecting a decreasing work quality and an obstacle to the productive functioning of the organization, which, when operating under difficult competitive market conditions, complicates the successful functioning of the organization.

After assessing the negative impact of employee turnover in the organization and bearing in mind the fact that human resource management plays an integral part in providing a competitive advantage to the organization (Sinha, Sinha, Sarangi, 2018) and seeking to avoid economic (financial) and social consequences as well as trying to ensure uninterrupted execution of critical processes it is necessary to distinguish the most important components of the object analyzed, to identify the factors affecting employee turnover and to search for techniques how to reduce them.

In recent decades, research has raised the question about the factors that lead to employee turnover. Some scientists (Lazauskaitė-Zabielskė and Urbanavičiūtė, 2018) define employee turnover as a complex phenomenon and relate it to the employee reaction arising from a general dissatisfaction with work, which is impacted by various processes occurring within the organization. Researchers who expanded on the reasons for work dissatisfaction believe that it can be caused by the lack of balance between the work requirements and their control, the feedback between the direct manager and colleagues, the limitation of freedom in decision-making related to work goals (Lazauskaitė-Zabielskė and Urbanavičiūtė, 2018), and the lack of employee support (or its complete absence) (de la Torre-Ruiz, Vidal-Salazar, Cordón-Pozo, 2019) as well as zero provision of tools necessary for work (Imran and Ayub, 2017). Moreover, work dissatisfaction can be caused by a limited application of motivation methods, the balance between the work performed, the efforts made, and the lack of reward when the resources used do not meet the expectations of employees (Fletcher, Carter, Lyubovnikova, 2018) and also the lack of respect and employee recognition (Čuček and Kač, 2020). As stated by scientists, all these causes may impact the employee's decision to change their workplace and look for a job in another organization. Some researchers analyzing the causes of employee turnover emphasized the organizational culture relating it to the organizational impact created by employees, which is based on the unity in a team and participation in its activity and also the uniqueness of the organization and teaching elements, the lack and absence of which foster the employee to leave the organization (Imran and Ayub, 2017). Meanwhile, according to Abagelan and Tulu (2020), Haider, Fatima and de Pablos-Heredero (2020), inadequate human resource management policies and strategies can increase employee turnover when employees feel unsafe and disrespected or cannot make decisions independently. Therefore, employee turnover is a process which is inseparable from job dissatisfaction. Job satisfaction is considered one of the factors leading to employee engagement and a stronger commitment to the organization. The relationship between the organization's characteristics and job satisfaction is analyzed in detail in published works. Some scientists stress the importance of greater autonomy for employees to act independently and provide the conclusion that a more flexible approach to organizing tasks has a positive impact on employee involvement in work, which decreases employee turnover (Demircioglu, 2021; Weideman and Hofmeyr, 2020). Other scientists draw attention to a flexible arrangement of work, which enables employees to independently decide where, when and how to do a specific task, which is one of the ways to motivate and retain highly qualified employees (Lutfiani Putri Windia, Singh, Rashid, 2020) and increase the employee involvement in the activities performed (Weideman and Hofmeyr, 2020). Based on this opinion, it is evident that the aforementioned circumstances impact the establishment of a responsible attitude toward employees in the organization by properly managing a motivation process, which, according to Žiogelytė and Kšivickaitė (2014), creates a mutual benefit –for meeting the needs and expectations of both the employee and the organization. Some scientists admit that a financial reward (Fletcher, Carter, Lyubovnikova, 2018) and the creation of favourable working conditions (Imran and Ayub, 2017) could increase employee work satisfaction, decreasing the desire to leave the job. On the other hand, the

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emphasis is laid on a social aspect when teamwork in the organization is encouraged (Alvi, Kayani, Mir, 2020), while the employees who are on good terms with their colleagues are adapted to the social environment (Bufquin et al., 2018) and work in the organization when the work environment is predictable. The organization is stable (Haider, Fatima, de Pablos-Heredero, 2020), and they have fewer intentions to leave the job. The importance of a social aspect is raised by many scientists who stress that evaluation of employee efforts, considering individual needs and interests and recognition of the employee as a specialist could be one of the ways to decrease employee turnover (Zhu et al., 2017). The aforementioned opinion is supported by other scientists who stress employee empowerment, the provision of full support for employees (Goldstein et al., 2017) and ensuring the importance of internal communication while seeking to decrease the sense of uncertainty of employees concerning their roles in the organization (Krywalski, 2020) and increasing their job satisfaction, which would impact a decrease in employee turnover. de la Torre-Ruiz, Vidal-Salazar and Cordón-Pozo (2019) research shows that the organization's concern for the well-being of employees and providing not only mandatory social guarantees but also additional support are the factors that influence the employee's involvement in the organization and evoke the sense of identification oneself with the organization, which could decrease the employee turnover. The importance of the aforementioned social aspect is emphasized by many scientists who admit that social support is one of the factors ensuring job satisfaction. These insights could be formed after assessing the research data by Alam, Hassan, Bowyer and Reaz (2020), which confirm the relationship between social support and job satisfaction. According to the scientists, social guarantees positively correlate with a higher motivation of employees and engagement in activities. Whereas other scientists (Haider, Fatima, de Pablos-Heredero, 2020), after establishing the relationship between the increased level of employee competence and the decreased level of employee turnover, assume that employee training and the opportunities for qualification improvement and professional development evoke a higher level of job satisfaction, which impacts the employee retention in the organization. The insights of other scientists are also important in as much as they discern the causes of employee retention. For exa mple, Shakil's (2020) research found that a positive correlation between motivation and employee job satisfaction confirms that motivation strategies are acceptable to employees and their application could reduce employee turnover. The importance of employee motivation and the improvement of motivation methods as one of the factors decreasing employee turnover was emphasized by Žiogelytė and Kšivickaitė (2014), who noted that to retain employees, it is necessary to apply various motivational techniques, which, according to the scientists, encourage employees to perform their work better, impact the employee job satisfaction and ensure operational productivity of the organization. Other scientists, when discussing the possibilities of employee retention, emphasized the balance between career opportunities and the personal and working life of the employee, as well as a flexible arrangement of work, manager support, and employee involvement (Lutfiani Putri Windia, Singh, Rashid, 2021; Weideman and Hofmeyr, 2020) the wage flexibility and social services (Alam et al., 2020). Therefore, employee satisfaction with job conditions and their content, which covers the specifics of work organization and personnel management, ensuring learning and professional development opportunities, a proper motivational strategy, and inner communication, could decrease employee turnover. Moreover, implementing employee turnover management is related to improving a favourable microclimate in the organization and continuously running important processes and work. In summary, it could be stated that to manage the employee turnover phenomenon, it is necessary to find out the attitude of employees to work, their expectations and needs and also to properly select motivational tools and foresee the aspects affecting the overall job satisfaction of employees and their involvement into the work processes.

3. The research methodology

Research organization and the scope of research participants. The research covered 294 respondents (persons working in Lithuanian organizations), 173 (58.8%) of whom were women and 121 (41.2%) men. After assessing the respondents according to their work experience, it could be noted that more than two-thirds of the research participants had up to 5 years work experience in the organization where they are currently working (n = 185; 62.9%), whereas a minor part of the participants had more than 5 years' work experience (109 (37.1%)) in the organization where they are currently working. In the last half year, most (93.8%) of the research participants were at least once thinking about changing their jobs and leaving the organization where they are currently working. In comparison, only 6.2% of the respondents never considered changing their careers in the last half year.

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The survey questionnaire was distributed with the help of an electronic system, which was one of the reasons for the passive involvement of employees in the survey and impacted small-scale research. Therefore, to go deeper into the topic investigated, in the perspective of further research when seeking for a greater representativeness so that according to the obtained results, it would be possible to decide on the general whole it would be appropriate to expand the scope of the research participants.

During the research, the ethical principle of free self-determination was observed. The study was conducted anonymously, while the results obtained were processed and presented, ensuring data confidentiality.

Research methods. Analytical descriptive method. Systematic analysis of scientific literature and the research related to the topic under consideration was based on comparative and generalization methods (the reasons impacting employee turnover were investigated based on a theoretical aspect, and discussions were provided on possible techniques for managing employee turnover in the organization. *Quantitative research method (questionnaire)* To investigate the factors of employee turnover and seeking to reveal the measures for reducing employee turnover, a questionnaire was prepared. The questionnaire statements were made considering theoretical insights and the criteria distinguished in scientific literature, with the help of which using a quantitative research method, the research investigated the employee attitude toward work in the organization where they are currently working, and the causes of employee turnover were identified, which can help foresee the tools for the employee turnover reduction. The questionnaire validity and reliability were determined by calculating *Cronbach's alpha* meanings in each group of the questionnaire statements separately. The results of statistical data analysis show that the level of internal consistency of the questionnaire statements on *The employee attitude toward work in the organization where they are currently working* is high enough (Cronbach's alpha = 0.843), and it varies from 0.837 to 0.862. After checking the internal consistency of the questionnaire statement on *Causes of employee turnover*, it was calculated using Cronbach's alpha = 0.852, and it varied from 0.836 to 0.872. Considering the fact that the internal consistency should be from 0 to 1 and the coefficient value of Cronbach's alpha is 0.60 and it is considered suitable for the research (Pakalniškienė, 2012), Cronbach's alpha, which was calculated in the course of the research performance shows that the groups of questions are coordinated with each other and the variables included into the questionnaire represent the research part and are oriented toward the investigation of the causes of employee turnover in the organization and its reduction opportunities. In defining the main *Causes of employee turnover* and applying *the Varimax* spinner, the analysis of the principal component factors and constructs was discerned. The results show that the data is suitable for the factor analysis. KMO=0.786 (it should be not less than KMO=0.6), while the meaning of Bartlett's test of specificity is $p<0.001$. The factor analysis results show that the questionnaire's statements on *Causes of employee turnover* form two factors, while the factor weights in each factor vary from 0.63 to 0.791. The level of internal consistency of each factor was calculated using (Cronbach's alpha), and the number of statements is presented in Table 1.

Table 1. Causes of employee turnover: internal consistency of factors

Factors	The number of statements	Cronbach's alpha
Internal causes related to the processes occurring in the organization	17	0.652
Personal reasons	11	0.816

Methods of statistical data analysis. The data obtained during the research was processed using the descriptive statistics of the data - calculation of percentage frequency. For describing the values of Likert scale the average (M) was used, while its standard deviation (SD) and *Stjudent t - the test* used to compare the average of variables of Likert scale in two independent samples. When the significance level is less than 0.05, the difference in signs is considered statistically significant. The statistical data analysis was performed using software SPSS data package of 17 version and MS Excel 2016 software.

4. Causes of employee turnover and their reduction opportunities: analysis of the empirical research results

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The increasing employee turnover raises the problem of opportunities for employee turnover reduction, which remains relevant and triggers new scientific discussions. It also encourages looking for opportunities to manage the situation related to employee turnover. The questionnaire was conducted to determine the opportunities for employee turnover reduction. Indicators covering the factors impacting employee turnover are these: the plans (desires) of respondents to change their jobs, the opinion of employees about working in the organization, as well as personal and external reasons, leading to searching for new jobs, which helped determine possible tools for the employee turnover reduction.

After analyzing the assessment results of the attitude of employees toward working in the organization where they are currently working in the total sample (see Figure 1), it was found that the respondents assessed *the interest in the activity* (M=4.07) with the highest average estimates. The research participants also admitted that they are *successful at work in the organization* (M=3.96) and *like it* (M=3.82). The lowest average estimates show that according to the respondents' assessment, their *workload could be more appropriate and evenly distributed* (M=1.87). Besides, the principle of justice is not observed in *distributing work, duties, tasks and rewards* (M=2.16). On the other hand, the statistical analysis data showed that the research participants lack *recognition as professionals* (M=2.28) and *opportunities to develop one's personality* (M=2.12). At the same time, work in the organization only *partly meets their expectations* (M=2.47). Low average estimates show that the research participants admit that they *lack career* (M=2.3) and *professional development* opportunities (M=2.52).

In contrast, high average estimates show that some of the research participants *are disappointed with the work in the organization where they are currently working* (M=3.46). Therefore, despite the interest in the activity (work) that was revealed during the research and the sense of being successful at work, which could be related to the lower probability of leaving the job, the lack of motivation in the organization or an improper application of motivation methods, when employees' expectations are not met, the workload is not appropriately distributed. The principle of justice is not observed when distributing work, duties, tasks and rewards when the opportunities for the development of one's personality and recognition of professional qualifications are not ensured, evoking the employees' disappointment with their work, which could be the causes to leave the job and search for a new one. The results show that an equal distribution of work and duties, considering employees' individual needs and expectations and improving the professional development promotion and implementation system, would help decrease employee turnover rates.

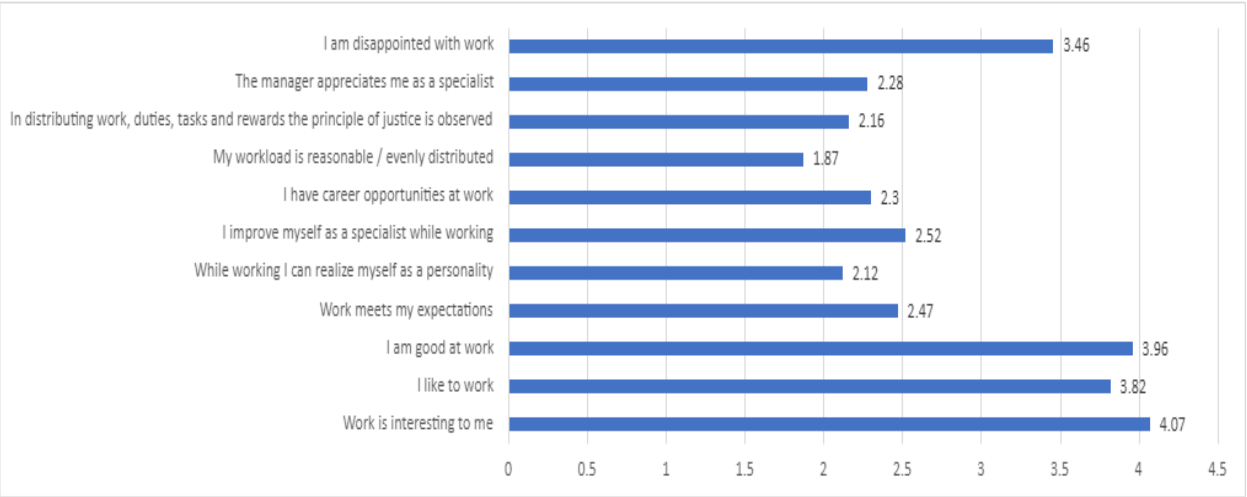

Figure 1. The assessment of employee attitude to work in the organization where he is currently working (n = 294; the average value (M), Max=5)

A comparative analysis was performed on the work in the organization where the employee works in the employee groups of different work experiences, which revealed statistically significant average differences (see Table 2). After calculating t – test, it was found that employees who have less than 5 years of work experience in the organization where they are currently working assessed *their interest in the activity* by significantly higher

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average estimates (M=4.12), compared to those whose work experience in the organization was more than 5 years (M=3.6). The obtained statistically significant differences (p<0.05) showed that employees whose work experience in the organization where they are currently working is less than 5 years assessed the work as the one which they *like* (M=3.92), compared to those whose work experience was more than 5 years (M=3.54). On the other hand, based on the assessment results of the employees whose work experience in the organization where they are currently working is more than 5 years significantly higher average estimates show that their *work met their expectations* (M=3.19). They feel that *the manager appreciates them as specialists* (M=3.32), compared to those whose work experience is less than 5 years (respectively: M=2.25 and M=2.12). Whereas significantly lower estimate averages found out in the latter group show that employees whose work experience is less than 5 years lack *the opportunities to realize themselves as personalities* (M=1.83) and seek for professional development (M=2.08) as well as *climb up the career ladder* (M=1.94), compared to the assessment results of those whose work experience was more than 5 years in the organization where they are currently working (respectively: M=3.06; M=3.24 and M=2.9). Moreover, after calculating *Stjudent t-test statistically significant average estimates were identified* (p<0.05), which show that the research participants whose work experience in the organization is less than 5 years *less often experience success at work* (M=3.78) and are more *disappointed with work* (M=3.98), compared to the assessment results of those whose work experience is more than 5 years (respectively: M=4.02 ir M=2.73).

After performing comparative data analysis in the groups of respondents whose work experience is more than 5 years in the organization and those whose work experience is less than 5 years statistically significant differences in the assessment results with regard to *workload distribution* and *work, duties, tasks and rewards distribution while observing the principle of justice* were not identified (see Table 2), which shows that the attitude to work in the organization where the respondent is currently working is assessed disregarding the employee's work experience in the organization.

Table 2. The assessment results of employees whose work experience in the organization where they are currently working is more than 5 years ((n = 109) and those whose work experience is less than 5 years ((n = 185) (average estimates (M), standard deviation (SD) and the level of significance of differences; Max=5; when p<0.05)

Indicators reflecting the opinion about work in the organization	Work experience: less than a year five years		Work experience: more a year five years		t	p
	M	SD	M	SD		
Work is interesting to me	4.12	1.36	3.6	1.02	2.625	**0.024**
I like to work	3.92	1.21	3.54	0.98	1.804	**0.032**
I am good at work	3.78	1.08	4.02	1.29	1.687	**0.047**
Work meets my expectations	2.25	0.46	3.19	0.71	3.529	**0.004**
While working, I can realize myself as a personality	1.83	0.2	3.06	0.65	4.416	**0.001**
I improve myself as a specialist while working	2.08	0.41	3.24	0.7	4.24	**0.001**
I have career opportunities at work	1.94	0.28	2.9	0.57	3.751	**0.002**
My workload is reasonable / evenly distributed	1.93	0.34	1.76	0.23	1.43	0.052
In distributing work, duties, tasks and rewards, the principle of justice is observed	2.06	0.382	2.18	0.46	1.36	0.056
The manager appreciates me as a specialist	2.12	0.38	3.32	0.83	4.38	**0.001**
I am disappointed with work	3.98	1.2	2.73	0.48	4.421	**0.001**

After summarizing the assessment results of the research participants of the attitude to work in the organization where they are currently working, it could be stated that those whose work experience in the organization is more than 5 years think that the manager appreciates them, are more successful at work. Their expectations are met compared to those whose work experience in the organization where they are currently working is less than

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5 years, since their average estimates are significantly lower, which shows that the latter respondents do not see the opportunities for self-realization, professional development and career opportunities, which impacts their disappointment with work and may evoke the desire to leave the job and move to another organization. In predicting the tools of employee turnover management and seeking to decrease the number of employees who want to leave the job, it is necessary to consider the needs and expectations of employees of different work experiences, i.e., to ensure the opportunities of self-expression and professional development of those who have less work experience and to appreciate their efforts and contribution to common goals of the organization. In contrast, those with more work experience should have the possibility to share their experiences at work.

After analyzing the situation of employee turnover management, the research results showed that although most respondents assessed their work as interesting and successful, employee turnover is still a relevant issue. This could be seen from the research results (see Figure 2). The relevance of the employee turnover problem could be confirmed by more than two-thirds (64.7%) of respondents admitting that employee turnover is high in the organization where they are currently working. In contrast, only a tiny part of respondents working in the organization *are interested in saving their jobs* (26.3%) and are *loyal (faithful) to the organization* (18.7%). The research results also revealed that according to the assessment results of most respondents, *employees are not interested in saving their jobs* (44.2%) and *are not loyal (faithful) to the organization* (46.2%). Therefore, based on the research results, the organization's employee turnover problem is evident. On the other hand, the latter results make us believe that a more attractive job offer would impact the desire to leave the current job.

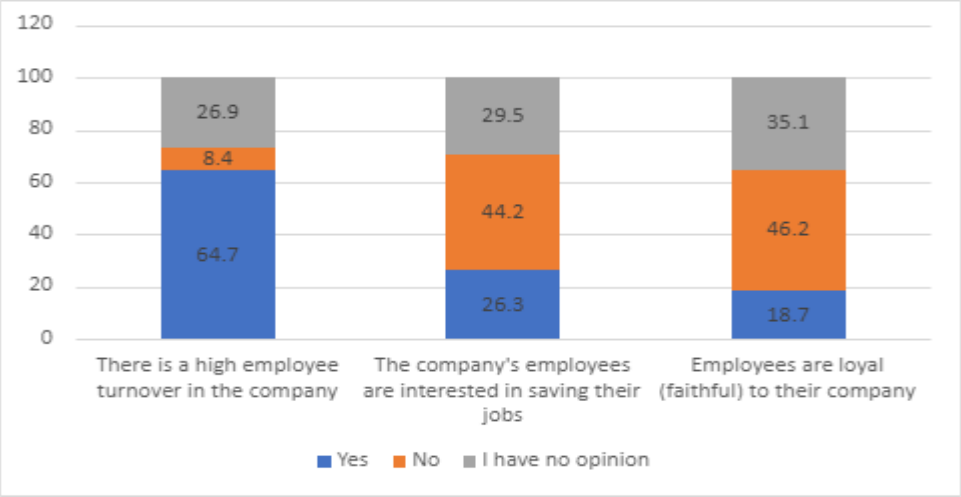

Figure 2. The assessment of the situation of job turnover in the organization (n = 294; %)

The need to take action to decrease employee turnover is demonstrated by the respondents' desire to change their current jobs (see Figure 3). The research results showed that more than half (51.7%) of the research respondents admit that in the last half year, they were *very often* (19.2%) or *often* (32.5%) thinking of changing their jobs. Based on the results obtained, it could be stated that this group of employees is "the most vulnerable" one, and a change of some circumstances (after receiving an offer of a high-paying job) would encourage them to change the job. The results obtained demonstrate (see Figure 3) that less than a quarter (23.6%) of the research participants *seldom* (17.4%) or *never thought* (6.2%) about changing jobs. Estimating why respondents are willing to change their jobs accurately is challenging. However, based on the research results, the working conditions for employees in the organization are unacceptable, which could impact their desire to change jobs. The tendencies revealed in the research foster persons concerned about identifying the reasons for employee turnover and implementing a system of employee turnover reduction, which would decrease the desire to change jobs.

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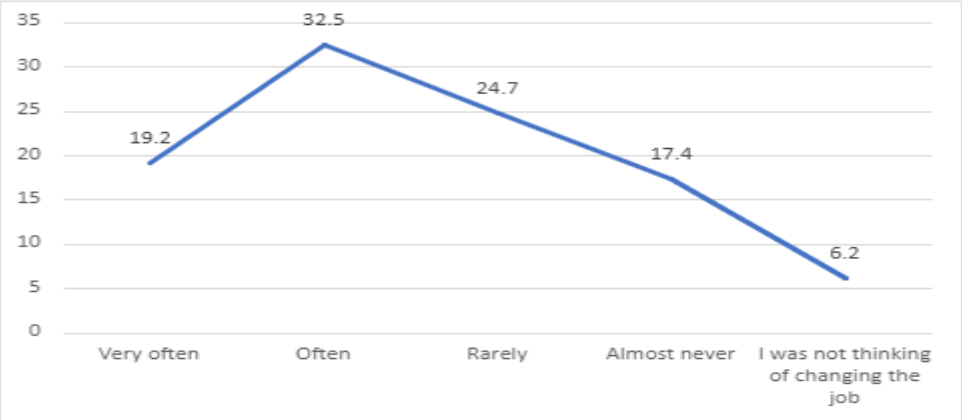

Figure 3. The assessment of the desire of employees to change their jobs in the last half year (n = 294; %)

Causes of employee turnover. The scientists who analyzed the employee turnover discerned the following reasons: individual personal beliefs and values, interests and motivation, as well as external factors related to the processes within the organization, the application of motivation systems, a competitive salary, workload, working conditions, meeting the needs and expectations of employees, the creation of microclimate, ensuring the relationship between colleagues and the manager and other aspects. Therefore, in discerning the reasons for employee turnover, the emphasis was placed on identifying employees' personal and external reasons that encourage them to change their jobs.

After analyzing the external factors that could affect employee turnover, the data analysis in the general sample was used, which showed (see Figure 4) that according to the assessment results, the reasons for employee turnover are often related to a financial aspect: more than two-thirds of respondents pointed out that *finding a high-paying job* (76.9%) and *non-competitive salary* (68.3%) were the main reasons for leaving the job. Moreover, according to the opinion of most respondents, employee turnover could be impacted by *poor career opportunities* (52.6%) and *limited opportunities for professional development* (54.7%). On the other hand, based on the assessment of the research participants, the reasons for employee turnover are these: *undervaluing the efforts and results of employees* (56.8%), *limited opportunities for self-expression and self-realization at work* (57.2%), *disregarding the individual needs of employees* (53.5%) and *limited opportunities to show initiative and participate in decision-making processes* (42.7%). The respondents also admitted that an *inflexible work schedule* (44.3%), *an improperly distributed workload* (46.8%) and *the lack of a favourable microclimate based on open communication in the organization* (43.6%) could also be the factors affecting employee turnover.

The least important reasons for employee turnover are these: *vaguely defined requirements and duties* (30.1%) and *being on bad terms with the manager* (21.7%) or *colleagues* (24.6%). Accordingly, based on the obtained results of the research participants, it was found that *unsuitable physical working conditions* (20.3%), *difficulties in adapting to a new team* (18.6%) and *the lack of training for new employees* (20,1%) are the reasons which affect employee turnover to the slightest degree.

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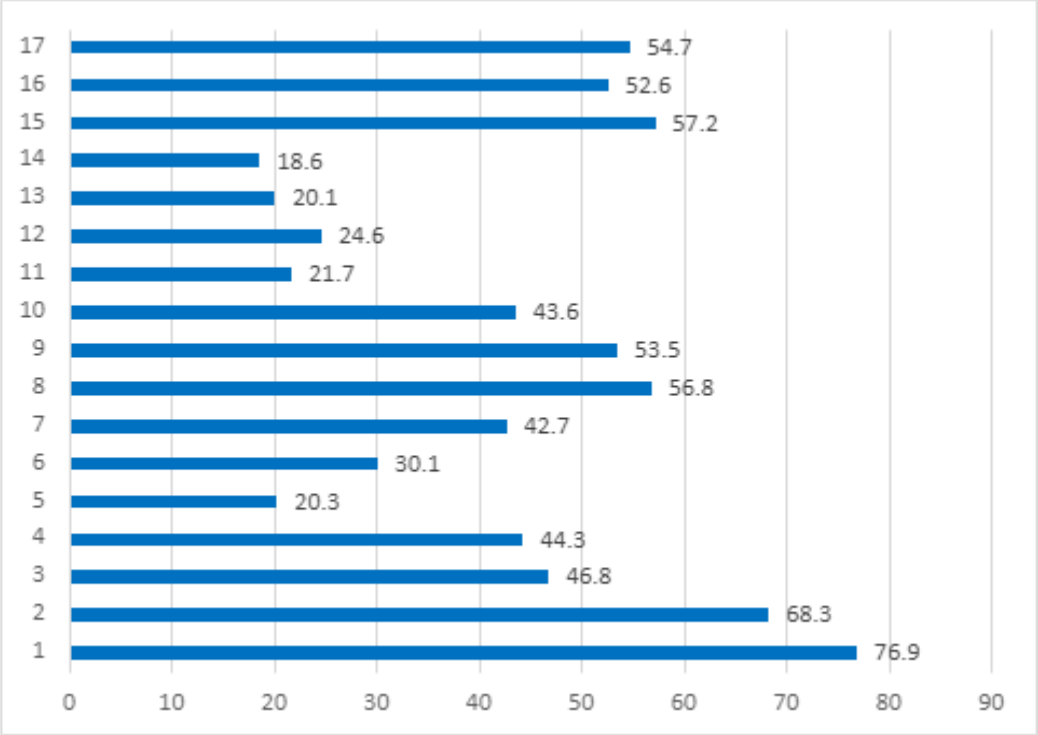

Figure 4. External, related to the processes taking place in the organization, the reasons for employee turnover (n = 294; %)

Remarks:

1. Finding a high-paying job
2. Non-competitive salary (wage)
3. Inappropriately/ unevenly distributed workload
4. Inflexible workload
5. Inappropriate physical working conditions
6. Vaguely defined requirements and duties
7. Limited opportunities to show initiative and participate in decision-making processes
8. Unappreciated work results and efforts
9. Individual needs of employees are not taken into account
10. The lack of a favourable psychological microclimate based on open communication
11. Being on bad terms with the manager
12. Conflicts with colleagues
13. The lack of training for new employees
14. Difficulties in adapting to a new team
15. Limited opportunities for self-expression and self-realization as a personality at work
16. Limited career opportunities
17. Limited opportunities for professional development (participation in training sessions, courses, seminars)

When analyzing the reasons for employee turnover, it is essential to review them not only from an organizational perspective. The problem of employee turnover could be analyzed when discerning the following personal reasons: the *physical condition of a person, his motivation, personal qualities, compliance of work with the employee's education, the place of residence, etc.*

The following tendencies were identified in determining personal reasons that could affect employee turnover (see Figure 5). As is seen from the research results, more than two-thirds of respondents relate employee turnover to *unfulfilled expectations* (68.9%) and t*he lack of motivation* (63.7%). Based on the assessment results of more than half of respondents, *the work which does not match the education or specialization of the employee* (53.6%), *the lack of necessary professional skills* (54.1%) and *necessary personal qualities* (50.8%) could be the factors that impact employee turnover. The latter results confirm the fact highlighted in the scientific literature that compliance with professional activity with his skills and education affects his attitude to the job, raises his motivation and establishes a higher level of satisfaction in his professional activity. On the one hand, dissatisfaction with one's work, which does not comply with a person's education or profession, and the lack of necessary personal qualities and professional skills could be one of the risk factors for searching for a new job. On the other hand, it was found that a *desire to try oneself in another area* (49.3%) and *physical health problems or disease* (46.2%) could be personal reasons impacting employee turnover.

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A small number of the research participants relate employee turnover to *changes in family situation*s (30.2%) and *the incompatibility of personal life and work* (26.3%). Alternatively, *changing the place of residence and moving to another town* (20.4%) and *the opportunity to work abroad* (18.1%) are the least influential factors increasing employee turnover; the least number of respondents chose them (see Figure 5).

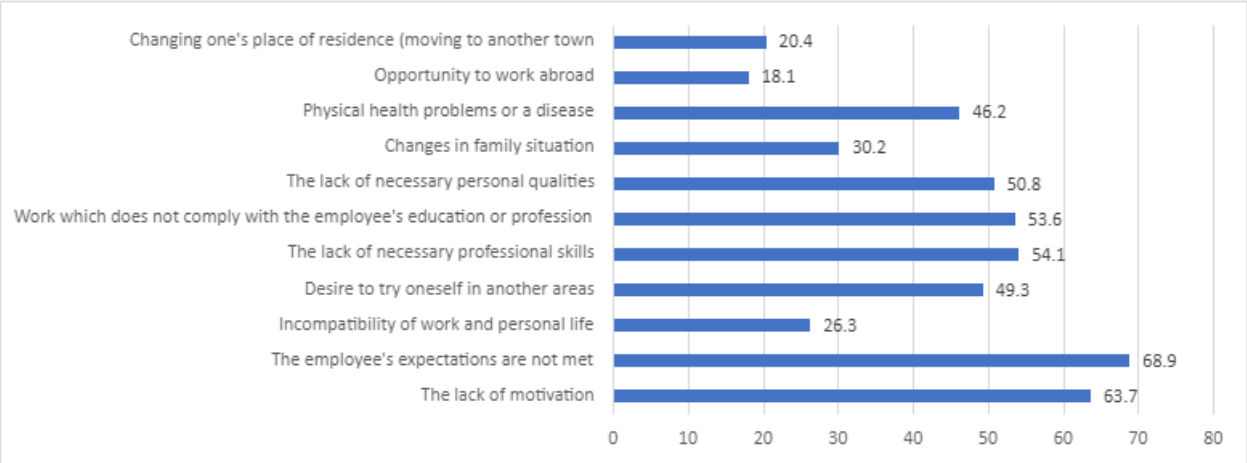

Figure 5. Personal reasons for employee turnover (n = 294; %)

After summarizing the research results, it is evident that causes of employee turnover are determined not only by external conditions, working conditions of the organization, motivation system and micro-climate in the organization but also by personal reasons related to personal motivation and the lack of professional skills and interests. Therefore, the problem of employee turnover should be analyzed by emphasizing both the external reasons at the organizational level and personal reasons which could impact the change of a job. However, based on the research results, it could be stated that the research participants are less likely to relate personal reasons to the reasons impacting the decision to leave the job; in this group, average estimates vary from 68.9% to 18.1%. After summarizing the results, it became evident that the majority of the research participants chose the factors related to the reasons occurring at the organization level, the specifics of work organization and personnel management; in this group, average estimates vary from 76.9% to 18.6%.

Opportunities for employee turnover reduction. Based on the research results, it is evident that a suitable motivation strategy covering material and non-material motivation, ensuring a competitive salary, recognition of a person and evaluation of his efforts, the opportunities to work independently and make decisions, as well as considering his individual needs of employees could reduce employee turnover. However, almost every person relates his work to self-realization in his professional activity. Hence, ensuring opportunities for career and professional development and self-realization in one's professional activity could be one of the factors affecting employee satisfaction and devotion to work, which may be one of the tools for employee turnover management.

After identifying the causes of employee turnover and relating this phenomenon to the processes that take place in the organization the following factors were distinguished: 1) *application of motivation system*, related to the creation of the effective incentive mechanism, a competitive pay for work, social guarantees, working conditions, a flexible work schedule, when considering the individual interests of every employee, the distribution and decreasing of workload, providing a balance between a personal life and work, etc.; 2) *the opportunities for self-realization at work* related to the opportunities for personal and professional development and self-realization, the creation of the system for career development, promotion perspectives and the opportunities to strive for a higher position, etc.; 3) *recognition and evaluation of employees*, covering the recognition of progress and efforts of every employee, considering his individual needs and expectations, as well as involving employees into decision making processes and ensuring the opportunities for independent work and initiative; 4) *micro climate in the organization*, which covers such aspects as open communication and friendly relationships and psychological climate in the team, when there is no tension between colleagues and the manager, encouraging the expression of emotional intelligence in order to establish friendly

relationships between the members of the team and the organization, providing support in case of difficulties, etc. The discerned organizational level factors are believed to be significant components in managing employee turnover.

Conclusions

1. The theoretical scientific literature analysis revealed that the existing employee turnover, the loss of human capital, decreased operational efficiency, profitability and poor indicators of work results and their quality hinder the organization's successful functioning in complicated competitive market conditions. The aforementioned negative consequences highlight the relevance of employee turnover management in the organization.

2. The research has identified the following factors determining the current employee turnover:

2.1. According to the results of more than two-thirds of the research participants, employee turnover in the organization is high, and in the last half year, even more than half of the respondents were very often or often thinking about changing their jobs. At the same time, only a smaller part of the respondents believe that employees want to save their jobs in the organization (26.3%) and they are loyal employees (18.7%), while only 6.2% of the research participants did not want to change their jobs in the last half year.

2.2. As seen from the research results, even though the majority of the research participants are successful at work and assessed their work as interesting, the lowest average estimates show that the respondents are not provided with favourable opportunities for their careers, self-realization and professional development, they lack an appropriate distribution of workload and the principle of justice when distributing work, duties, tasks and salaries is not observed.

2.3. The primary factors impacting the employee's decision to change his job are the lack of motivation, professional development opportunities, and personal qualities. Finding a high-paying job, non-competitive salary, limited career and professional development opportunities, underestimation of the efforts and work results of employees, ignoring their individual needs, limited opportunities to show initiative and participate in decision-making processes, inflexible work schedules and unevenly distributed workload, as well as limited self-expression and self-realization opportunities are considered as the main factors determining the employee turnover.

3. Employee turnover management in the organization requires complex solutions, which could cover the following aspects: determining salaries based on clear and objective criteria, creating a favourable psychological microclimate, the employee evaluation and assessment of his efforts, a flexible attitude to peculiarities of work organization, ensuring the quality of relationship and its feedback. Nevertheless, in managing the employee turnover processes, it is advisable to provide opportunities for personal and professional development, determine career opportunities, improve the motivation system, and ensure a flexible workload and schedule.

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THE INFLUENCE OF SELECTED INDICATORS ON THE CHANGE IN THE VALUE OF THE ENTERPRISE ASSETS*

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Abstract. This article examines the newspaper and magazine publishing industry in the Slovak Republic. Business entities need to ensure the growth of enterprise value. For that, companies need to achieve the planned sales, provide the highest possible operational performance of the enterprise, and expand their market share. The article aims to investigate the influence of the indicators of sales, EBITDA, and age of the enterprise on the change in the value of the enterprise's assets. The assumption is that these three indicators affect the growth or decline in the value of the enterprise assets. This assumption is investigated separately for each indicator through hypothesis testing. The results of the hypotheses are interpreted and commented on. Subsequently, multiple linear regression analysis is used to analyse the joint influence of the indicators. The result of the research is that two different analytical procedures, simple linear regression analysis and multiple linear regression analysis, showed similar influence of the indicators. Sales and EBITDA indicators positively affect the growth of the enterprise assets, while the indicator of the age of the enterprise has the opposite effect.

Keywords: newspaper and magazine publishing industry; Slovak Republic; assets of the enterprise; sales revenue; EBITDA; age of the enterprise; valuation

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JEL Classifications: D20, Z10, Z19

1. Introduction

The transformation of the political and economic system in the Slovak Republic since 1989 has enabled the emergence of free media. The centrally controlled economy was transformed into a market economy; consequently, the state monopoly on the ownership of the mass communist media fell. The demand for new media formats has increased in the newspaper and magazine publishing industry, and new independent editorial offices have been established. The newspaper and magazine publishing industry is being demonopolised. Liberalising the market has allowed the birth of new periodicals, newspapers and magazines. Holina (1999) writes about the initial boom, which was reflected in an increase in the number of copies sold. The number of daily newspaper and magazine titles published increased, and there was also a boom in regional press. However, this situation has changed since around 2010. Štětka (2015) characterises this period in the Slovak media market by three stages of the evolution of newspaper and magazine publishing industry ownership. Vizcarrondo (2013)

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describes similar developments in the media market (monopoly → market liberalisation → media oligarchisation) with a specific time lag in developed economies.

However, the competitive situation in the market, the rise of digital media and economic crises have gradually stimulated the acquisition activity of media owners. This activity has resulted in the establishment of big media houses. They currently own a broad portfolio of titles in various genres, including print and digital media. It follows that media houses owned by oligarchs have a significant market share in Slovakia. Media houses have sophisticated technological and distribution facilities. In addition to the big publishers, there are also many smaller independent publishers in this market.

The competitive advantage of publishing houses over smaller publishing houses lies mainly in the possibility of allocating fixed costs among the individual entrepreneurially separate entities and balancing profits and losses across a portfolio of titles. Therefore, the economic results, measured, for example, by EBITDA, are also acceptable for these publishing houses. The newspaper and magazine publishing industry has the advantage of a skilled workforce and cooperation with a number of external collaborators (translators, graphic designers, editors, etc.). There is a tradition of reading periodical and non-periodical publications in the Slovak Republic. The specific advantage of publishing printed newspapers and magazines is that the market is not threatened by the import of this type of product from abroad.

2. Theoretical background

Many criteria assess the market situation: sales volume, profit, market share, the number of enterprises, size of customers and vendors, conditions of entry, and service differentiation. Behaviour is indicated by the pricing policy, agreements, mergers, or business entities. Business activities are related to the industry results, such as product or service quality, productivity, profit, and distribution efficiency (Reschiwati, Syahdina & Handayani, 2020; Peleckis, 2022; Du, Wang & Li, 2022).

The size of the enterprise's assets indicates the company's position in the market and its market value. Large enterprises are valued more than smaller ones. This idea is based on the principle that the risk profile of a business changes depending on its size, which affects its overall value. Larger enterprises generally have a more diversified portfolio of products, customers and suppliers, which reduces business risk. Small and medium enterprises are the ones that make the economy stable.

The manifestation of the sustainability of the business is the growth of the volume of the enterprise's assets and its stabilisation, the required performance of the enterprise and its expression by the EBITDA indicator, the period of the continuous existence of the enterprise expressed in the number of years from its inception to the current period. The age of an enterprise is the number of years of operation, i.e. the number of completed years of activity of the enterprise. The age of an enterprise is an essential criterion for examining enterprises. It differentiates the economic performance of young and old enterprises. In this way, it explores the impact of the lifespan on the enterprise (Maggina & Tsaklanganos, 2012). Age and size are significant factors to consider. Capabilities and resources influence successful internationalisation. Capabilities and resources are closely connected to age, with young firms having limited access to resources and fewer capabilities than older firms. The age or size of these firms leads them to have higher international market performance (Adarov & Stehrer, 2019).

Assets are items of value that an enterprise owns or leases for operation. Assets are purchased or created to add value to the enterprise or to benefit its operations. Assets are important because they generate revenue, assist in running the business, and increase its value. Thus, an asset is a resource with economic value that is anticipated to provide future benefits (generates cash flows, reduces costs, helps increase productivity, efficiency, company earnings, etc.). The effect of firm size, as measured by the amount of enterprise assets, on the value of the enterprise has been examined by Reschiwati, Syahdina and Handayani (2020). They confirm that the enterprise's size depends on the assets' value. The relationship between investment in intangible assets and firm size and the age of the enterprise has been examined by Seo and Kim (2013). OECD (2011) identifies intangible assets as a source of growth and business sustainability. According to Maggin and Tsaklanganos (2012), in large

enterprises, the growth of assets is higher; this is also related to the enterprise's market position. Thus, it also impacts the market share (Maggin & Tsaklanganos, 2012). An extensive study on the impact of assets on enterprise performance growth and development was conducted by Adarov and Stehrer (2019). The asset management role is researched by Maletic et al. (2020). They argue that good asset management improves the enterprise's sustainability through effective management of expenditures and activities to achieve both short- and long-term planned impacts, including sustainability of operations, and to generate benefits in terms of sustainability of the enterprise's performance.

Sales revenues are the amount of money that the enterprise obtains through the sale of products, goods, and services during the monitored accounting period and are the main financial source of the enterprise. They provide cash flow and express the enterprise's profitability level and its position in the market. They are decisive financial resources that pay the costs and taxes of the enterprise, pay dividends, and develop the enterprise. The physical volume of production and service structure of sales, product prices, collection method and payment period, and other factors are decisive factors for the amount of sales. Sales revenue is one of the most important indicators of its economic performance and is a fundamental source of income generation. Growth in sales revenue provides funds for investments, market expansion, and business process improvement. Since sales revenue is the enterprise's primary income source, their proper management, growth, and maximisation are critical factors for its financial stability, prosperity, and sustainable growth. Sustainable growth ensures that the enterprise has enough resources for long-term development and maintaining competitiveness within the market (Hrynyuk et al., 2021; Avi, 2022).

The enterprise's total financial performance is measured by EBITDA. Indicator EBITDA stands for earnings before interest, taxes, depreciation and amortisation. It is valuable in providing insight into whether a business can successfully generate income and how that income changes over time. EBITDA provides information about the value of the enterprise and creates insight into the enterprise's sustainable growth opportunities. It measures the overall financial performance of the enterprise. It focuses on the financial outcome of operating decisions by eliminating the impact of non-operating management decisions concerning interest, taxes, depreciation and amortisation. Lin et al. (2022) write that EBITDA can evaluate the cash flow aspect of an enterprise; it can be used to assess the renewal capabilities of asset equipment and operational performance. EBITDA has been chiefly used to evaluate and credit an enterprise's business value and financial situation.

This work also confirms the importance of EBITDA for entrepreneurs' decision-making regarding business sustainability. They also demonstrate its impact on the development of the business and thus its ability to expand its market share. To predict the actual profit of the fashion industry, because of its great importance for the valuation of economic sectors, Rubio, Gutiérrez-Rodríguez and Forero (2021) used EBITDA. By modelling EBITDA, it was possible to study the future behaviour of the industry, which facilitated decision-making regarding growth and value maximisation. The use of EBITDA and its modifications in different economic sectors can be found in Mao, Gan and Zhao (2019); Enodien et al. (2021); Agrawa l(2021); Szewieczek, Dratwińska-Kania and Ferens (2021).

The age of an enterprise is related to its life cycle. The passage of time is expected to affect sales volume growth, market share growth, asset size change, and profitability. If these economic indicators are developing as owners expect, and the enterprise is successful in the market, it has the potential to build and achieve a sustainable business. They also demonstrate the influence of the age of the enterprise on its development and, thus, its ability to stay on the market. Theoretically, the longer an enterprise is established on the market, the stronger the trust of customers and investors. It is assumed that the longer an enterprise has been established, the more profits it has than younger enterprises. As the age of an enterprise grows, enterprise tends to become more experienced and efficient. This has the effect of making them more competitive and successful. The older the enterprise is, the more experience they gain for better operation and management, which can positively impact its value (Lambey et al., 2021).

In their research, Jantyik, Balogh and Török (2021) found that, in contrast to other company-specific features, the age of the enterprise does not affect the likelihood of survival. Among the characteristics of the industry, the level of growth, concentration, and intensity of entry play a significant role in the survival chances of small-

scale breweries. They found a negative and convex relationship between firm age and profitability measured by return on assets, return on equity, or gross profit margin. It means that younger businesses experience a decline in their profitability from the beginning, but they may become profitable again at an old age. It also confirms the conclusion that older enterprises have higher profits and value. Badulescu et al. (2018) state that Santos, investigating a consistent sample of Portuguese SMEs, stated that" the involvement of SMEs in the external community is directly related to the size of the enterprise and its operational age". They also found a significant impact between the age of the enterprise and Corporate Social Responsibility. The age of the enterprise not only plays a role in economic indicators but also impacts the social commitment of enterprises. The study of Rubio, Gutiérrez-Rodríguez and Forero (2021) analysed the moderating effects of the firm age and the industry condition on the relationship between entrepreneurial performance and the entrepreneurial experience. Firm age plays a vital role in the process of promoting entrepreneurial performance. Firm age is an essential consideration for the growth of entrepreneurial enterprises because different stages of business growth affect entrepreneurial performance over time. Lincényi and Fabuš (2020) claim that the decreasing interest of people in print media will also be related to the decreasing volumes of advertising in the sector.

3. Research objective and methodology

The research topic is the newspaper and magazine publishing industry in the Slovak Republic. This article aims to investigate the impact of selected economic indicators in the newspaper and magazine publishing industry in the Slovak Republic. We characterise the newspaper and magazine publishing industry as a competitive business environment in the Slovak Republic.

Our work investigates the relationship between selected economic indicators: enterprise assets, sales revenue, EBITDA, and age. We formulate the research questions, define hypotheses and test them with an adequate statistical test. We are interpreting and commenting on the results. The observation period is the years 2015 and 2022.

Economic indicators, or variables, that influence each other are:

- the volume of the enterprise Assets – dependent variable, amount of the enterprise's assets
- the value of Sales revenue – independent variable,
- the value of the EBITDA indicator – independent variable, and
- the Age of the enterprise – independent variable.

In this article, we analyse the interrelationships of indicators (variables):

- Assets express the value of assets in Euros. Assets are all the factors of production that an enterprise acquires as its property, in the run of its business, and uses to achieve its objectives,
- Sales revenue is the sum of revenue from the sale of goods and own products and services in Euros,
- EBITDA (Earnings before Interest, Taxes, Depreciation and Amortisation) expresses the indicator's value in Euros. EBITDA is used to evaluate the operating performance of an enterprise. The operating performance of an enterprise can be characterised as its ability to valorise the resources invested in its activities, to produce profit, to increase the value of the enterprise, and at the same time it is the ability to ensure the sustainability of the business activity,
- Age measures the difference between the year under study and the year of enterprise establishment. The data represent the absolute numerical value of the age of enterprises.

The names of the variables in the text will be written in capital initial letters: Assets, Sales revenue, EBITDA, and Age.

The object of observation is concrete publishers of newspapers and magazines. We surveyed the core group of 154 enterprises. These enterprises declare business in the newspaper and magazine publishing industry; they are classified according to NACE (Nomenclature of Economic Activities), the European statistical classification of economic activities). We verified each single enterprise through an individual check from public sources.

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We found that 129 enterprises have real sales from the business. Next, we investigated the number of years in business. We determined that the conditions required enterprises to be active in the market since 2015. Therefore, we excluded another 22 enterprises due to the short period (age) of business. After this revision, the research sample consists of 107 enterprises. We identify these enterprises as a representative statistical sample. We made 856 observations in total.

We had authorised access to the economic data of these enterprises through the FinStat database (FinStat. Financial information on Slovak companies, 2023) and publicly available data from the Register of Financial Statements, Ministry of Finance of the Slovak Republic (2023). The sample included publishers who publish annual financial statements according to Slovak Accounting Standards, Act no. 431/2002 Coll. on Accounting. This is in accordance with the directive of the European Parliament and the Council on annual financial statements, consolidated financial statements, and related reports for certain types of enterprises (Council of Europe, 2019; Official Journal of the European Union, 2004).

We characterise the current newspaper and magazine publishing market by quantifying the concentration level of the examined sample of enterprises using the Herfindahl-Hirschman index (HHI) (The United States Department of Justice, 2015). We applied this calculation only for the year 2022. In the research sample, the HHI index has a value of 1,037.58. According to the US Department of Justice and the Federal Trade Commission's guidelines on horizontal mergers, we can characterise this market as non-concentrated. However, it should be noted that the market share of the first two companies is 49.49%, and the first four companies up to 60.59%. Based on this, we can characterise the market as an oligopoly.

The data were analysed using the statistical software Jamovi (the Jamovi project was founded to develop a free and open statistical platform) and Microsoft Excel Data Analysis. Statistical evaluation of data, values and comments were processed according to Hanák (2015). We will investigate the causal relationship between the variables by linear regression analysis, and we will quantify these relationships in an exact way.

4 Results and discussion

4.1 Variables, test for normal distribution and correlation

We first characterise the variables (Assets, Sales revenue, EBITDA and Age) using selected descriptive statistics. The research sample is n = 856 observations in total. The results are in Table 1 below.

Table 1. Selected indicators of descriptive statistics

Variables	Assets	Sales	EBITDA	Age
N	856,00	856,00	856,00	856,00
Mean	1 604 875,15	1 112 986,82	124 624,77	15,60
Median	87 310,50	110 016,00	6 655,00	15,00
Standard deviation	7 294 487,55	3 961 527,63	622 776,00	6,81

Source: own processing, Jamovi

The next step was using Shapiro-Wilk test for normality of data distribution. We report the results of the test in Table 2.

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Table 2. Shapiro -Wilk test for normality data distribution

Variable	statistic	p
Assets	0.21195	< 0.000
Sales	0.27986	< 0.000
EBITDA	0.24357	< 0.000
Age	0.98355	0.000

Source: own processing, Jamovi

All tests for the normality of data distribution came out statistically significant, therefore all variables (Assets, Sales, EBITDA, Age) are not normally distributed.

We used correlation to examine the interdependencies between variables. By post-power correlation, we can calculate a measure of linear interdependence between two variables, which means that the values of one variable tend to co-occur with the values of the other variable (see Table 3).

Table 3. Correlation matrix by Kendall's Tau-B

Variables		Assets	Sales	EBITDA
Sales	Kendall's Tau B	0.61741***	—	—
	p-value	< 0.000	—	—
EBITDA	Kendall's Tau B	0.42693***	0.40764***	—
	p-value	<0.000	<0.000	—
Age	Kendall's Tau B	0.02107	0.02268	-0.07616**
	p-value	0.365	0.329	0.0011

Note. * p < .05, ** p < .01, *** p < .001
Source: own processing, Jamovi

Assets and Sales correlation value. The impact of Sales volume on the value of Assets is strong to very strong. Kendall's Tau-B (0.61741) show high positive values.

Assets and EBITDA correlation value. The impact of the EBITDA volume on the value of Assets is great. The values of Kendall's Tau-B (0.42693) express that the correlation between the variables is positive and strong.
Assets and Age correlation value. The values of Kendall's Tau-B (0.02107) are very low; the correlation practically does not exist.

Another significant positive correlation is between the indicators of Sales and EBITDA; Kendall's Tau-B (0.40764) is a strong association.

The Age variable shows a very weak negative correlation with other indicators, or the values show that the correlation practically does not exist.

4.2. Testing of hypotheses

4.2.1. First research question

Using linear regression analysis we examine the causal relationship between the two variables and to quantify this relationship. We will test the interrelationships between the dependent variable amount of the enterprise's Assets and the independent variables value of Sales revenue, EBITDA, and Age of the enterprise. We test these relationships using a linear regression model by defining the research questions and hypotheses.

The first research question: “Does the value of Sales revenue affect the amount of the enterprise's Assets?“. We set the assumption “Value of Sales revenue has an impact on the amount of the enterprise's Assets“. We formulated the hypothesis (H):

Hypothesis (H0) “Value of Sales revenue does not affect the amount of the enterprise's Assets.“
Hypothesis (H1) “Value of Sales revenue has an impact on the amount of the enterprise's Assets.“

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Results of linear regression analysis: the relationship between the amount of the enterprise's Assets and value of Sales revenue. Commentary (Table 4):

Table 4. Model 1 Fit Measures

				Overall Model Test			
Model	R	R^2	Adjusted R^2	F	df1	df2	p
1	0.8692	0.7555	0.7552	2 639	1	854	<0.001

Model Coefficients - Sales

			95% Confidence Interval				
Predictor	Estimate	SE	Lower	Upper	t	p	SE
Intercept	-176 438.81	128 133.79	-427 932.86	75 055.24	-1.377	0.169	
Sales	1.600	0.03116	1.539	1.662	51.370	<0.001	0.8692

Note SE – Standard Estimate
Source: own processing, Jamovi

The value of Multiple R = 0.8692 expresses that there is a high strength of interdependence between the variables Assets of the enterprise and Sales revenue. The R Square indicator has a high value of 0.7555. This means that Sales influence 75.55% of the change in the value of Assets. The other factors have 24.45% influence. The level of description of the interrelationship between variables indicates F = 2 639 and Sig. < 0.001. These values are lower than the accepted level of statistical significance of $p \leq 0.05$. The model can describe the correlation between variables.

The relationship between the variables is described by the regression equation, which takes the form Of Y = -176 438.81 + 1.6000 * Sales.

The confidence intervals for assets are (-427 932.86; 75 055.24). Within our interval, the parameter we are looking for has a value greater than zero. The relationship between the variables exists, the strength of the correlation between the variables is great. Value of Sales of the enterprise has an influence on the amount of Assets.

We accept the alternative hypothesis H1: “Value of Sales revenue has an impact on the amount of the enterprise's Assets“. This means that an enterprise that generates a higher Sales revenue by volume also has a higher Assets amount. It is also true that as the size of assets increases, so does the volume of sales. This can also cause growth in market share. The sales volume creates adequate resources to ensure the enterprise's and business's sustainability.

Creating a competitive market environment in Slovakia in the publishing industry of newspapers and magazines created new business opportunities for the emerging Slovak capital-forming class. This class of entrepreneurs has both economic and political influence. It comprises individuals or groups of business people who can be described as oligarchs. They have business activities in the Slovak Republic and some countries in Europe and Asia, where they are active in various economic sectors, including the media. In the Slovak Republic, they created media houses. There are currently four such businesses. These companies publish four titles from six opinion-forming daily newspapers and eighty magazine titles of various genres. As the media houses are part of the business activities of the aforementioned business groups, they possess assets of high value. Assets represent an enterprise's various forms of property; they are used for its development and the business itself. In 2022, these four media houses owned up to 73,42% (75,43%) of the total assets of the surveyed sample. The situation regarding the share of sales revenue of these four media houses in 2022 (2021) is 60.59% (62.52%).

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4.2.2 Second research question

The second research question is: "Does the EBITDA value affect the amount of the enterprise's Assets?" We set the assumption "The value of EBITDA has an impact on the amount of the enterprise's Assets". We formulated a hypothesis (H):

Hypothesis (H0): "The level of EBITDA does not affect the amount of the enterprise's Assets."
Hypothesis (H1) "Amount of the enterprise's assets growth with the growth of the EBITDA indicator value. The enterprise with higher EBITDA also has a higher amount of the enterprise's Assets."

Results of linear regression analysis show the relationship between the amount of the enterprise's assets and the value of the EBITDA indicator. Commentary (Table 5):

Table 5. Model 2 Fit Measures

				Overall Model Test			
Model	R	R^2	Adjusted R^2	F	df1	df2	p
2	0.8468	0.7170	0.7167	2 164	1	854	< 0.000

Model Coefficients - EBITDA

			95% Confidence Interval				
Predictor	Estimate	SE	Lower	Upper	t	p	SE
Intercept	368 824.576	135 337.2165	103 192.038	634 457.12	2.725	0.007	
EBITDA	9.918	0.2132	9.500	10.34	46.519	< 0.000	0.8468

Source: own processing, Jamovi

The Multiple R = 0,8468 expresses a high strength of interdependence between the Asset and EBITDA variables of the enterprise. The R Square indicator has a high value of 0.7170. This means that the EBITDA variable influences 71.70 % of the change in the amount of Assets. The other factors have a 28.30 % influence. The level of description of the interrelationship between variables indicates F = 2 164 a Sig. < 0.000. The model can describe the correlation between variables.

The relationship between the variables is described by the regression equation, which takes the form of Y = 368 824.576 + 9.918 * EBITDA.

The confidence intervals for Assets are (103 192.038; 634 457.12). Within our interval, the parameter we are looking for has a value greater than zero. The relationship between the variables exists, and the strength of the correlation between the variables is great. The value of EBITDA of the enterprise influences the amount of Assets.

We accept the alternative hypothesis H1: "Amount of the enterprise's assets grows with the growth of the EBITDA indicator value. The enterprise with higher EBITDA also has a higher amount of the enterprise's Assets". This means that an enterprise that generates a higher EBITDA by volume also has a higher Assets volume. As the amount of EBITDA grows, the value of Assets grows". That is, an enterprise that generates a higher EBITDA volume also has a higher enterprise's Assets.

EBITDA is a key indicator of an enterprise's performance, profitability, value growth and ability to repay debt. The main advantage of EBITDA is that it is a relatively accurate indicator for year-on-year comparisons of a company's operating performance or for potential comparisons with other companies in the same sector. The four top enterprises shared 77,30 (80.26%) of the total EBITDA generated in 2022.

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4.2.3 Third research question

Third research question: "Does the Age of the enterprise affect the value of the Assets of the enterprise?". We set the assumption "The Age of the enterprise, the period of its existence, has an impact on the value of the Assets of the enterprise". We formulated a hypothesis (H):

Hypothesis (H0): "The Age of the enterprise does not impact the value of the enterprise's Assets."
Hypothesis (H1): "The Age of the enterprise has an impact on the value of the enterprise's Assets."

Results of linear regression analysis, the relationship between Assets (dependent) and Age of the enterprise (variable). Commentary (Table 6):

Table 6. Model 3 Fit Measures

				Overall Model Test			
Model	R	R^2	Adjusted R^2	F	df1	df2	p
3	0.1435	0.0203	0.0194	17.9428	1	854	0.000

Model Coefficients - Age

			95% Confidence Interval				
Predictor	Estimate	SE	Lower	Upper	t	p	SE
Intercept	4 002 537.519	617 533.271	2 790 476.75	5 214 598.29	6.4815	0.000	
Age	-153 668.687	36 277.712	-224 872.6096	-4.2359	-4.2359	0.000	-0.1435

Source: own processing, Jamovi

Multiple R value = 0.1435. This value is also very low. This means that there is only a very weak correlation between the variables Assets and Age of the enterprise. The R Square indicator also has a meagre value of 0.0203. This means that Age affects 2.03% of the change in the enterprise's Assets. The other factors have a 97.97% influence. The level of correlation between variables is F = 17.9428 a Sig. = 0.000. These values are also lower than the accepted level of statistical significance. The model can describe the correlation between these variables.

The relationship between the variables is described by the regression equation, which has the form Y = 4 002 537.519 + (-153 668.687) * Age. The value of p is, in this case, lower than the statistical limit of confidence required to accept the alternative hypothesis H1.

The confidence interval for Age is (-224 872.6069; -4.2359). There is no zero within our interval; the parameter we are looking for is less than zero, and the value is negative. It is confirmed that there is a fragile relationship between the variables. The effect of the Age variable is, therefore, practically non-existent. Length of time in business does not affect the value of Assets.

It is confirmed that there is no relationship between the variables. Therefore, the effect of the variable Age is none. The length of time in entrepreneurship in the newspaper industry does not affect the value of the enterprise's Assets. We confirm hypothesis H0: "The age of the enterprise does not impact the value of the enterprise's Assets."

The age of the company is an important variable. During the company's life cycle, we assume the company's sustainability on the market. We found that the age of the business does not affect the value of Assets. Significant acquisitions took place between 2017 and 2020. Media houses Mafra Slovakia and News and Media Holding acquired a portfolio of titles from Bauer Media SK and Ringier Axel Springer Slovakia. Several smaller publishers also sold their titles to this media house. Thus, the company's age is not necessarily related to the size of the Assets. The financial possibilities of media houses and acquisitions influenced the value of Assets.

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After 1989, the state monopoly practically ended in the Slovak Republic. The national economy was demonopolised, creating a competitive market environment for independent newspapers publishing. For this reason, the age of the oldest media is no more than 33 years. Only since 1990 can we speak of a competitive environment in the newspaper and magazine publishing industry. Even within the genres of newspapers and magazines, there was no competition. Newspapers and magazines have changed their previous mission.

The editorial offices were practically transformed into business entities. There was a demand for new, then mainly print media. New titles began to appear, a plurality of genres emerged, and publishing newspapers and magazines became an interesting business activity. The four most important media companies (News and Media Holding, Petit Press, MAFRA Slovakia, FPD Media) are 9, 23, 11 and 10 years old. These media companies are owned by influential financial groups that started their business activities after 1990. The financial groups bought some existing newspaper and magazine titles and concentrated them in new media houses.

4.3. Multiple linear regression analysis

We used multiple linear regression analysis to specify the dependence between Assets and predictors. The relationship is represented by the formula: $Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \varepsilon_i$. The dependent variable (Intercept) is Assets β_0, the predictors are X_1= Sales β_1, X_2 = EBITDA β_2, X_3 = Age β_3 and εi represents the random error. The interrelationship of the variables is depicted as follows model (Table 7):

Table 7. Multiple linear regression

				Overall Model Test			
Model	R	R^2	Adjusted R^2	F	df1	df2	p
4	0.8954	0.8018	0.8011	1149.0609	3	852	< .000

Model Coefficients – Assets

			95% Confidence Interval				
Predictor	Estimate	SE	Lower	Upper	t	p	SE
Intercept	809 002.7033	283 844.21	251 886.85	1366118.56	2.8502	0.004	
Sales	1.0024	0.05281	0.8988	1.1061	18.9809	< 0.000	0.5444
EBITDA	4.4421	0.3380	3.7788	5.1055	13.1436	< 0.000	0.3793
Age	-55 976.7264	16 523.69	-88 408.63	-23 544.82	-3.3877	0.001	-0.05225

Source: own processing, Jamovi

The accepted level of statistical significance $p \leq 0.05$ is met for both dependent and independent variables. The multiple regression equation has the resulting form:

$$Y = 809\,002.7033 + 1.0024*Sales + 4.4421*EBITDA - 55\,976.7264*Age + 283\,844.2090$$

The correlation coefficient = 0.8954 is statistically significant and indicates a strong correlation. Adjusted R^2 interprets 80.11% of the variance of the dependent variable Assets is caused by the change of variable variables, F statistic 1149.0609, p <0 .000. The significance of the model is confirmed. It indicates a statistically significant relationship between the independent variables and the dependent variable.

The value of the Sales coefficient is 1.0024, which means that an increase in sales by one unit will only slightly affect the growth of Assets. The value of the EBITDA coefficient is 4.4421; it is a positive value and indicates a positive relationship. This means that the higher the value of EBITDA, the higher the volume of Assets. The value of the Age coefficient is negative and has a value of -55 976.7264. The relationship between the variables is negative. This means that as the Age of the company grows, the value of its Assets decreases.

The overall normality test, applied to the variables of the multiple linear regression analysis, was measured by the Shapiro-Wilk test. The Shapiro-Wilk test has a statistical value of 0.3536 and p <0 .000. These results detect that the data is not normally distributed. Durbin–Watson test for Autocorrelation shows a value of 0.6102, which means positive autocorrelation, DW statistic is 0.7796 and p <0.000. Collinearity Statistics for variables:

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- Sales: the VIF (variance inflation factor) value is 3.5365, that is, moderately correlated, there is a correlation with another variable, and the T (Tolerance) value (reciprocal of the variance inflation factor is known as the tolerance) is 0.2828, which means low tolerance and high multicollinearity.
- EBITDA: the VIF value is 3.5794, moderately correlated; there is a correlation with another variable, and the T value is 0.2794, which means low tolerance and high multicollinearity.
- Age: the VIF value is 1.0229, i.e. uncorrelated, and the variance of the standard error is 2.29%; on the contrary, T 0.9776 shows high tolerance and low multicollinearity.

The results of multiple regression analysis show that the influence of individual indicators has different qualities. The first variable, Sales, shows a shallow value. This means that with an increase in sales of 1 euro, assets will increase by 1.0024 euro. A value of 1,000 euros would provide a realistic picture, which would bring an increase in sales by 2.10 euros, assuming that the value of EBITDA and Age remain constant. The model further describes the impact of EBITDA. This indicator has a value of 4.4421. In this case, an increase in the EBITDA indicator by 1 euro will cause an increase in the value of Assets by 4.44 euros; at 1,000 euros, the value of Assets will increase by 4 442.10 euros. Again, the value of Sales and Age is assumed to remain constant. The Age of enterprise indicator has a negative impact on the value of Assets. The coefficient is negative, -55 976.7264, and means that if the age changes by 1 year, the value of Assets will decrease by this amount. Logically, we could attribute this decrease in the value of Assets to the impact of depreciation and amortisation. The value of the dependent variable Assets is 809 002.7033, and the value of the random error is 283 844.2090. It should also be noted that these three indicators affect up to 80.18% of the change in the Assets value.

Conclusions

In our article, we examined the influence of selected factors (Sales revenue, EBITDA indicator and Age of the company) on the change in the size of the enterprise's Assets in the newspaper and magazine publishing industry. The newspaper and magazine publishing industry is part of the cultural and creative industries. This industry in the Slovak Republic has the character of an oligopoly; a few media houses dominate it. The publishing of newspapers and magazines is changing, like a specific product, from printed to digital form. The digital form of newspapers and magazines enables greater interactivity between the customer and the product. This form of publishing is becoming a sign of sustainable entrepreneurship development.

Our decision to examine the enterprise assets as a dependent variable stems from the fact that we did not discover similar research in available scientific sources. Therefore, our study is novel.
This article brings new knowledge about the mutual influences of the factors mentioned above. The practical value of the research is given by the results of our study, which will help managers in the newspaper and magazine publishing industry in making decisions about the growth of the value of the enterprise's assets, managing sales and estimating the effects of development and profitability measured by the EBITDA indicator in different phases of the enterprise's life cycle.

Enterprises' assets are items of value that they own to do business. They are a means of creating value in business. Assets are important because they make it possible to generate income, i.e. generate money, increase the value of the enterprise and make it easier to run the business. The size of the enterprise's assets indicates its position in the market and conditions its market value.

The high value of the enterprise's assets generally indicates that the enterprise has accumulated significant resources over time, owning significant valuable resources such as cash, inventory, property, or investments. This may result, for example, from factors such as successful business operations, profitable business activities, sound financial management, etc. The high value of the assets also indicates an enterprise's financial strength and can increase the enterprise's ability to generate revenue, support growth initiatives, and withstand financial challenges. It can provide a solid foundation for the operation of the enterprise and positively impact the business's overall financial health and stability.

Sales revenue results from the enterprise's business activity and determines its position in the market. Sales revenue generates financial resources and profit. The correlation between Assets and Sales confirms that the influence of Sales volume on the value of Assets is strong to very strong, and, at the same time, the variable indicates a high positive value. The relationship between the variables exists, and the strength of the correlation between the variables is great. The value of enterprise sales influences the amount of assets. With a change in the value of Sales revenue, the value of the enterprise's Assets changes in direct proportion. We assume that an increase (decrease) in sales will cause an increase (decrease) in the value of the enterprise assets. The reason for the growth of assets is investments in new digital and information technologies. If the company does not invest in assets, it becomes technologically obsolete and loses its competitive ability.

The influence of the value of the EBITDA indicator on the amount of assets is significant. The correlation between the variables is positive and strong. The relationship between the variables exists, and the strength of the relationship between the variables is great. The value of EBITDA of the enterprise influences the amount of Assets. The bigger the Assets, the bigger the EBITDA. The reverse is also true: the more significant the EBITDA, the greater the enterprise's assets. This is how the potential is created for the enterprise's wealth and profitability growth. A high positive correlation proves that enterprises in a given industry pay particular attention to their Asset utilisation level. If enterprises decide to invest in specific assets, they aim to create the greatest possible financial effect for them. Another significant positive correlation is between the indicators of Sales and EBITDA; there is a strong association between these indicators. In the monitored industry, the value of the EBITDA indicator also increases with sales growth.

The value of the correlation of Assets according to the Age of the enterprise is shallow; the correlation practically does not exist. It is confirmed that there is a fragile relationship between the variables. The influence of the variable Age is, therefore, almost zero. The length of time in business (Age of the enterprise) does not affect the value of the Assets. The age of the enterprise is a function of time, and it is related to the fact that it is in different phases of its life cycle. During this life cycle, the enterprise's assets have various productive resources that create the potential for entrepreneurship, providing productive activity and inputs to the enterprise process. During their existence, enterprises strive to ensure revenue growth and use their assets rationally. In connection with the increase of the enterprise's age, the purpose of the enterprise is to establish itself in the market and grow the enterprise. The age of the enterprise has a very weak negative correlation with other indicators, respectively, and the values of statistical calculations confirm that the influence practically does not exist.

The limitation of our research is that the results and conclusions below are valid only for a specific country, period and sample of enterprises. While investigating the context of the interrelationship of selected economic indicators, we found that such research has yet to be conducted in the newspaper and magazine publishing industry. Therefore, we cannot compare this industry with other countries. By studying scientific papers, we discovered similar research, but they were related to different industries and situations. Other research limitations result from the availability of free scientific contributions and other public resources on the given topic, as well as from the research design, the nature of the research set of a specific business area and the research methods used. The research results are valid only for the examined group of enterprises.

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EXPLORING THE LINK BETWEEN MOTIVATION AND PROCRASTINATION IN THE WORKPLACE: A CASE STUDY OF SMES IN SLOVAKIA*

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Abstract. This article presents a qualitative study conducted among office workers in small and medium enterprises (SMEs) in Slovakia, aimed at enhancing work motivation and preventing procrastination. The study was conducted with a sample size of 253 employees, utilising the Work Engagement and Intrinsic Motivation Scale (WEIMS) and the Procrastination At Work Scale (PAWS) standardised questionnaires. The objective of this research was to explore the link between work motivation and procrastination tendencies among office workers in SMEs and identify effective strategies for enhancing motivation and preventing procrastination in this specific context. The qualitative methodology employed in this study allowed for in-depth exploration and understanding of the experiences, perceptions, and challenges employees face in relation to work motivation and procrastination. Based on the results, practical recommendations are provided to enhance work motivation and prevent procrastination in office settings within SMEs. This article contributes to the existing body of knowledge by providing insights into work motivation enhancement and procrastination prevention specifically tailored to the context of office workers in SMEs in Slovakia**.**

Keywords: work procrastination; self-determination theory; motivation at the workplace; small and medium enterprises, employee

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JEL Classifications: M10, L26, O15

1. Introduction

In today's fast-paced and demanding work environment, employees often find themselves grappling with the challenge of managing their tasks effectively. Heightened risk of job loss, substantial alterations in work roles and responsibilities, the need to acquire new skills, and shifts in management practices frequently result in reduced work performance sustainability (Rózsa et al., 2022a). This also happens in small and medium-sized enterprises (SMEs), which are recognised as comprising approximately 90% of businesses worldwide (Azman & Abdul Majid, 2023), (Šimberová et al., 2022) and employing roughly half of the global workforce. Small businesses play a crucial role in the economy (Ribeiro-Soriano, 2017), (Krajčík et al., 2023) and the social development of a country (Rozsa et al., 2022b), (Cherednichenko et al., 2023) also emphasises that these businesses serve as catalysts for community transformation and development. Small and medium enterprises (SMEs) make a substantial contribution to fulfilling the critical indicators of the national economy (Ključnikov

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et al., 2022a), (Rózsa et al., 2023), (Civelek & Krajčík, 2022) and they have a positive influence on macroeconomic indicators (Vojtovič et al., 2016), (Tomášková & Kaňovská, 2022).SMEs also take a substantial role in producing value-added goods and services (Ključnikov et al., 2022b) and export volumes of countries. Although some studies (Vávrová, 2022), (Lincényi & Bulanda, 2023) mentioned that SMEs have more disadvantages than large enterprises regarding socio-economic outcomes. Appelbaum and Kamal (2000) claimed that small and medium enterprises (SMEs) are more likely to survive and maintain a competitive advantage than larger firms. They propose that this can be achieved by enhancing employee satisfaction and reducing labour turnover and absenteeism while decreasing production costs (Pauhofova & Stehlikova, 2018). Satisfied employees will likely be more engaged, productive, and committed. They may be more willing to contribute innovative ideas, improve processes, and identify cost-saving measures. These factors can ultimately result in streamlined operations, decreased waste, and more efficient resource utilisation, leading to cost savings for SMEs (Appelbaum & Kamal, 2000). On the other hand, SMEs often compete with larger organisations with greater resources and economies of scale (Małkowska & Uhruska, 2022). To stay competitive, SMEs need to maximise their productivity. That's why it is crucial to maintain highly productive employees who can deliver better quality products or services, provide excellent customer service, and respond quickly to market demands, giving the business an edge over competitors.

2. Theoretical background

This section discusses theoretical perspectives on the relationships between SME prosperity and the strategies managers in SMEs can use to enhance employees' work motivation and eliminate their tendency to procrastinate during working hours. Numerous explanations for procrastination have emerged in the past few decades, primarily focusing on academic procrastination. Nevertheless, a lack of research exists on work procrastination and its association with work motivation. It is crucial to emphasise the importance of considering the motivational basis behind impaired goal pursuit, specifically in terms of alignment with personal values and fundamental needs (Heckova et al., 2022). While a motivational perspective on procrastination has been explored previously (Klingsieck, 2013), (Borisov & Vinogradov, 2022), our contribution is distinctive in integrating complementary theoretical perspectives, methodological approaches, and analytical levels.

Additionally, we explicitly address key motivational concepts relevant to procrastination in their inherent energetic implications rather than treating them solely as sub-processes of self-regulation (Wolters, 2003). Motivation poses a common challenge for all organisations, whether in the public or private sector. It is characterised as the readiness to invest significant effort in pursuit of organisational objectives, influenced by the potential of fulfilling individual needs through that effort (Saraswathi, 2011). According to Armstrong (2007), a motive is an incentive to do something, and consequently, motivation is a set of external and internal factors that influence human behaviour. Motivation can be defined as behaviour that wants to reach a goal. In the context of work motivation, he further advises that it is best if the employee is internally motivated to perform the given work at a high quality and put a lot of effort into it (Armstrong, 2007). This state, although most desirable, is rather exceptional. To effectively motivate their employees, employers need to have a comprehensive understanding of their unsatisfied needs. The level of motivation significantly impacts all aspects of the organisation's overall performance. One prevalent and counterproductive behaviour that frequently emerges in workplaces is procrastination—postponing or delaying tasks despite potential negative consequences. Ferrari and Díaz-Morales (2014) identified procrastination as a behavioural pattern with several negative consequences. These include ineffective time management (Straková et al., 2021), decreased performance levels, delayed study behaviours, reduced frustration tolerance, tendency to avoid tasks, ego depletion, trade-offs between speed and accuracy, and difficulty in regulating negative emotions (Ferrari & Francisco Diaz-Morales, 2014). This assumption is also confirmed by Prem et al. (2018), who claimed that procrastination refers to an employee's intentional postponement of tasks, and it represents a failure in self-regulation, where tasks are irrationally delayed despite the possibility of negative outcomes (Prem et al., 2018).

Procrastination in the workplace is characterised by two dimensions, namely soldiering and cyberslacking. Soldiering is a type of workplace procrastination that inhibits work-related activities by prioritising mainly non-work tasks without malicious intent.

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Cyberslacking is using the Internet or mobile devices for personal purposes during working hours. Although the Internet often allows employees to perform their work tasks faster and more safely than before, it also makes it easier for them to use it for personal purposes, resulting in high financial costs associated with less time spent at work (Vitak et al., 2011).

However, procrastination at work in general not only hampers individual productivity but can also harm overall organisational performance. To address this issue, researchers and practitioners have turned to psychological theories, such as Self-Determination Theory (SDT), to gain insights into the underlying motivational factors that contribute to procrastination behaviour at the workplace. According to Ryan, Sheldon, Kasser, and Deci (1996), Self-Determination Theory (SDT) defines needs as universal necessities that are vital for optimal human development and integrity (Smerek, 2022), (Ližbetinová et al., 2020). In this context, needs are essential nutrients for promoting psychological health. SDT posits that something is regarded as a need only when its satisfaction contributes to psychological well-being.

In contrast, the deprivation or thwarting of that need can negatively impact psychological health (Ryan et al., 1996). According to Self-Determination Theory (SDT), the satisfaction of three psychological needs - competence, autonomy, and relatedness - significantly impacts work motivation, which, in turn, affects outcomes. SDT represented in Figure 1 suggests that motivations that are more intrinsic and internalised lead to more favourable outcomes than extrinsic and less internalised motivations. In the future of work, where increased uncertainty and interdependence are prevalent, these psychological needs and motivations may be influenced. The changing nature of work might impact individuals' sense of competence, autonomy, and relatedness, which, in turn, can shape their motivation levels and subsequent outcomes in the workplace (Gagné et al., 2022).
On the other hand, when employees feel a lack of autonomy, competence or relatedness over their work, negative effects such as procrastination may arise. Nguyen et al. (2013), (Grmanova & Bartek, 2022) discovered that employees who had jobs that offered less intrinsic value, such as recognition, and had more limitations were prone to higher levels of procrastination compared to employees whose jobs required greater levels of intrinsic motivation skills (Nguyen et al., 2013). These dependencies became important and have been considered in measures aimed at successful employer value proposition design (Samoliuk et al., 2022). Furthermore, the Internet has recently become an essential component of daily life and is extensively utilised in both work and educational settings (Zaidi et al., 2022). It helps in resolving employment-related tasks (Balcerak & Woźniak, 2021). However, it has many disadvantages, like technostress (Bencsik & Juhasz, 2023). Online activities that serve as constant distractions from planned tasks can contribute to procrastination and may even be regarded as a significant aspect of problematic internet use. This phenomenon primarily impacts the younger generation (Beutel et al., 2011), (Mura, 2020).

The results of several studies create the prospect of providing actionable guidance to organisations aiming to strengthen their approaches for enhancing employee well-being across dimensions such as life well-being, workplace well-being and psychological well-being (Jaškevičiūtė et al., 2024).

In our subsequent analysis, we will concentrate on examining the connection between procrastination and work procrastination among adolescents, specifically office workers employed (Mura et al., 2023) in small and medium-sized enterprises (SMEs) in Slovakia. Additionally, we will explore potential associations between work procrastination, gender, age, and level of education.

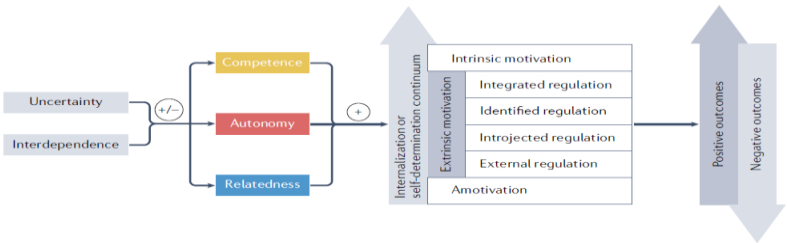

Figure 1. Self-determination theory
Source: Gagné et al. (2022)

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3. Research objective and methodology

To solve the research problem and fulfil the goal, data were obtained through quantitative research conducted online using the CAWI questionnaire data collection method - computer-assisted web interviewing among 253 employees of small and medium-sized enterprises. The questionnaire focused on the research of statistically significant differences when comparing the relationship of motivation to procrastination and the demographic specifics of employees of small and medium-sized enterprises.

To measure intrinsic and extrinsic work motivation, we used the Czech version of the WEIMS scale - Work Extrinsic and Intrinsic Motivation Scale presented by Šmahaj and Cakirpaloglu (Šmahaj and Cakirpaloglu, 2015; Hitka et al., 2023). The scale is originally from the authors Tremblay et al. (2009). It consists of 18 items divided into six subscales: intrinsic motivation, integrated regulation, identified regulation, introjected regulation, external regulation and amotivation (Tremblay et al., 2009). This scale is based on the theoretical foundations of the theory of self-determination, which has three parts: internal motivation, external motivation and amotivation (Ryan & Deci, 2000). The items are scored on a 7-point Likert scale from 1 - "does not match at all" to 7 - "exactly matches", where respondents determine the reason for staying in their current job.

Examples of items of individual WEIMS subscales:

- Intrinsic motivation (IM): "I am very happy to learn new things."
- Integrated regulation (IntegR): "I chose this type of work in order to achieve a certain lifestyle."
- Identified regulation (IdenR): "Because I want to succeed in this job, otherwise I would be very ashamed of myself."
- Introjected regulation (IntrjR):" Because I want to be successful in this job. I would be very ashamed if it wasn't so."
- External regulation (ExtR): "Because thanks to it I earn money."
- Amotivation (Amo): "I ask myself this question too. I do not think I am capable of handling the important tasks related to this job."

Respondents' procrastination behaviour in the work environment was measured using the 12-item Work Procrastination Scale (Metin et al., 2018). The Work Procrastination Scale (PAWS) consists of two dimensions, namely soldiering (intentionally slowing down the pace of work so that the employee avoids a full day's work, e.g., by taking longer coffee breaks) and cyberslacking (using the Internet or mobile devices for personal purposes during working hours). The soldiering dimension is assessed in the work procrastination scale with 8 items such as "I take a long coffee break at work". The dimension of cyberslacking is measured by 4 items such as "I do online shopping during working hours". The items are scored on a 7-point Likert scale from 1 – "never" to 7 – "always or daily ".

In addition to the application of general-logic methods, the above secondary input data needed to be processed through appropriate statistical methods. The choice of the optimal method depended on the nature of the problem to be solved, the nature of the available data as well as the experience with the application of the chosen method in previous empirical studies. We used both descriptive statistics methods (descriptive characteristics) and inductive statistics methods. We used the methods of correlation and regression analysis. We based the following general form of the regression model:

$$y_t = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_k x_k + \varepsilon_t \quad (1)$$

where

- y_t is the explanatory (dependent) variable represented by the individual performance indicators,
- $\beta_0 - \beta_k$ are the model parameters (regression coefficients),
- $x_1 - x_k$ represent the explanatory (independent) variables - i.e., the individual potential determinants of performance,
- ε_t is the random component.

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We constructed the individual models in such a way that the assumptions of using regression analysis were met, which we subsequently verified (Kalirajan, 1993). We used the Arellano-Bond estimator to correct for the presence of potential heteroskedasticity and autocorrelation in the individual models. Regression methods for panel data analysis are frequently used, particularly in more recent work of a similar type (Asimakopoulos et al., 2009).

4. Results and discussion

In selecting the research instrument, we also focused on assessing the reliability of the questionnaires. A reliable questionnaire minimises unreliability and enables us to obtain correct information and effectively measure and examine the relationships between different variables. This reduces our risk of misleading results and increases measurement accuracy (Table 1).

Table 1. Reliability of the questionnaire WEIMS - Work Extrinsic and Intrinsic motivation scale.

WEIMS **Item reliability for all sub-constructs**	**Cronbach's alpha**
Intrinsic motivation	0,896
Integrated regulation	0,850
Identified regulation	0,905
Introjected regulation	0,877
External regulation	0,887
Amotivation	0,956
Motivation (total score)	0,734

Source: own processing

Respondents' procrastination behaviour in the work environment will be measured using the 12-item PAWS Work Procrastination Scale (Metin et al., 2018). The Procrastination at Work Scale (PAWS) consists of two dimensions, namely soldiering (deliberately slowing down the pace of work to avoid working all day, e.g., by taking longer coffee breaks) and cyberslacking (using the Internet or mobile devices for personal purposes during working hours) (Table 2).

Table 2. Reliability of the questionnaire PAWS Procrastination at work scale.

PAWS **Item reliability of sub-constructs**	**Cronbach's alpha**
Soldiering	0,984
Cyberslacking	0,915
Procrastination (total score)	0,980

Source: own processing

In our research, we constructed several hypotheses that we tested. In this paper, we report the validation of the hypothesis that we statistically investigated the relationship between overall motivation and soldiering as a type of offline procrastination among SME employees. We hypothesised that there is a statistically significant negative relationship between motivation and soldiering among SME employees. We deal with soldiering where the p-value reaches $p<0.001$ and thus we can say that there is a significant relationship between these variables. The correlation coefficient has a value of -0.851, which indicates a very strong negative relationship between these variables.

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We confirm this hypothesis as we have shown that there is a statistically significant negative relationship between motivation and soldiering as a type of offline procrastination of SME employees. If an employee does not have sufficient motivation to complete his/her work tasks, he/she may procrastinate. This may put him/her in a situation where he/she has little time to complete his/her tasks and will try to avoid his/her duties. Instead, he will engage in other activities that will not stress him out. It is important for employees to identify and resolve the causes of their procrastination so that they can focus on completing their work tasks efficiently (Figure 2).

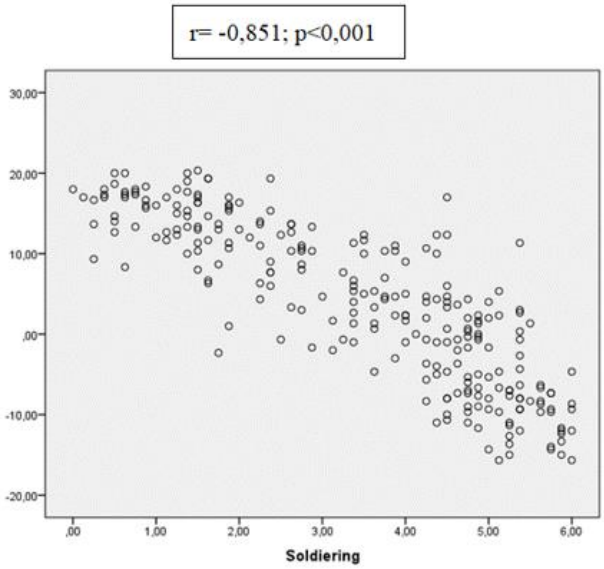

Figure 2. The link between total score of motivation and soldiering of SME employees.
Source: own processing

Grund and Fries (2018) suggested that interventions targeting procrastination should focus on motivation, such as goal setting, rather than solely emphasising the implementation of goals. It is important to note that not all forms of passive procrastination need intervention from managers (Grund & Fries, 2018). Some employees may procrastinate because they are experiencing difficulties with a specific task. These challenges can be related to cognitive, emotional, or social factors, leading to stalled progress (Ahern & Manathunga, 2003). Additionally, according to Wan et al. (2014), factors such as unclear job responsibilities, vague tasks, limited influence in decision-making, and a scarcity of challenging assignments are associated with decreased energy and motivation. These conditions can ultimately result in feelings of boredom (Wan et al., 2014), (Zsigmond & Mura, 2023).

Therefore, regarding these conclusions, boredom at work can lead individuals to procrastinate to escape or avoid the monotony and dullness of their tasks. Procrastination becomes a means of filling time or seeking more stimulating activities instead of focusing on uninteresting tasks. This behaviour can deplete motivation, creating challenges for individuals in mustering the necessary energy and determination to initiate or finish their work tasks.

The quantitative research aimed to examine the relationship between several variables. Among the main variables, we included motivational tendencies based on self-determination theory and work procrastination with variables such as cyberslacking (online procrastination) and soldiering (offline work procrastination). Table 3 summarises the key findings from the quantitative research. The first finding deals with intrinsic motivation where the p-value is $p<0.001$; hence, we can talk about a significant relationship between these variables. The correlation coefficient has a value of -0.644, indicating a strong negative relationship between these variables. Therefore, there is a statistically significant negative relationship between intrinsic motivation as one of the motivational tendencies and procrastination of SME employees.

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Table 3. Summary of results

The link between procrastination and motivational tendencies	**r**	**p**
Intrinsic motivation	-0,644	<0,001
Integrated regulation	-0,482	<0,001
Identified regulation	-0,340	<0,001
Introjected regulation	-0,206	0,001
External regulation	0,088	0,162
Amotivation	0,703	<0,001
The relationship between motivation and the types of procrastination	**r**	**p**
Soldiering	-0,851	<0,001
Cyberslacking	-0,768	<0,001
The link between age and procrastination	**N**	**Std. Deviation**
Overall rate of procrastination and age	75 113 65 4	1,46491 1,69216 1,70739 1,71895
The dependence between gender and procrastination	**N**	**Std. Deviation**
Overall procrastination rate and gender	127 130	1,65661 1,65615
The relationship between education level and procrastination	**N**	**Std. Deviation**
The link between education level and procrastination	73 67 90 27	1,46491 1,69216 1,70739 1,71895

Source: own processing

The second finding deals with integrated regulation, where the p-value is p<0.001, and thus, we can speak of a significant relationship between these variables. The correlation coefficient reached -0.482, which indicates a moderately strong negative relationship between these variables. There is also a statistically significant negative relationship between integrated regulation as one of the motivational tendencies and procrastination of SME employees.

The third finding describes the relationship of procrastination with the identified regulation, where the p-value is p<0.001, and thus, we can speak of a significant relationship between these variables. The correlation coefficient reached -0.340, which indicates a moderate negative relationship between these variables. There is a statistically significant negative relationship between the identified regulation as one of the motivational tendencies and the procrastination of SME employees.

The fourth relationship describes the relationship with introjected regulation, where the p-value is less than 0.05 (p=0.001), and thus, we can speak of a significant relationship between these variables. The correlation coefficient reached -0.206, indicating a weak negative relationship between these variables. We have shown a statistically significant negative relationship between introjected regulation as one of the motivational tendencies and procrastination of SME employees.

Regarding the next observation, we consider the external regulation where the p-value reaches p=0.162; hence, there is no statistically significant relationship between these variables.

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Within amotivation (Amo), the p-value is p<0.001; therefore, these variables have a significant relationship. The correlation coefficient has a value of 0.703, which indicates a strong positive relationship between these variables. There is a statistically significant positive relationship between amotivation as one of the motivational tendencies and procrastination of SME employees.

For soldiering, we found a p-value of p<0.001 and thus we can speak of a significant relationship between these variables. The correlation coefficient has a value of -0.851, which indicates a very strong negative relationship between these variables. There is a statistically significant negative relationship between motivation and soldiering as a type of offline procrastination of SME employees.

In the case of online procrastination (cyberslacking), the p-value reaches p<0.001, and thus, we can indicate a significant relationship between these variables. The correlation coefficient is -0.768, which shows a very strong negative relationship between these variables. There is a statistically significant negative relationship between motivation and online procrastination or cyberslacking of SME employees.

Within the association of respondents' age with offline procrastination (soldiering), the p-value was higher than 0.05 (p=0.104), and thus, there is no statistically significant relationship between these variables. However, across generations (Table 4), we found online procrastination, especially among the youngest Generation Z. This generation has grown up with technology and digital devices, which means they are much more used to working with computers and smartphones. This can lead to higher rates of online procrastination as they are more likely to be exposed to Internet distractions. Generation Z is also known for their addiction to social networking sites, which may be one of the main causes of online procrastination.

Table 4 Average rate of procrastination by age group.

Age group	Mean	N
Gen Z	3,7389	75
Millennials	3,3260	113
Gen X	3,4038	65
Boomers	1,6458	4

Source: own processing

Regarding the overall procrastination rate and gender men 3,3150 and women 3,5622 the slightly higher rates of procrastination in case of women may be related to women's tendency to switch between multiple tasks at once. This behaviour can lead to online procrastination, as they can easily become distracted by different online activities instead of focusing on one task. They can also be affected by their emotional states as men. When they feel stressed, tired, or frustrated, they may switch off and exhibit online procrastination. Women may be subjected to more pressure and expectations around their work performance and family commitments, which can lead to more stress and anxiety. This stress can increase the likelihood of seeking an escape from procrastination.

Regarding education and procrastination, our findings suggest that employees with lower levels of education have a higher tendency to procrastinate on tasks and are more likely to use strategies such as procrastination or "looking for alternative activities" to avoid unpleasant tasks. However, it is important to emphasise that procrastination is not only a problem for employees with lower education levels and can affect anyone, regardless of their education. The causes of procrastination are varied and can differ from person to person, so it is essential to focus on addressing the causes and creating healthy habits to help manage procrastination.

Regarding the results of the statistical validations and their interpretation, we consider that correlation is not one-sided and is not identical to causality. In the qualitative part, which was conducted through structured expert interviews with managers of small and medium-sized enterprises, we conclude that addressing the issue of work motivation and procrastination is not a priority in every case. Several reasons may explain this finding. For example, managers often have many duties and responsibilities to take care of, which seem to be more important

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than employee motivation. They may have time constraints on project planning, responsibilities for managing budgets and finances, or ensuring that teams are productive and meet deadlines. Equally, managers don't always have the expertise to deal with and procrastination.

These problems are often complex and may require knowledge of sociology and psychology. Not every manager has this knowledge and, therefore, may not feel competent to deal with and deliberately avoid these problems. In practice, however, employees are also often expected to be motivated and productive without the manager constantly monitoring and motivating them. Managers may feel that it is the employees' responsibility to feel motivated and perform their tasks in a timely and quality manner. However, in the intervention process, some managers may not have sufficient tools to monitor and address motivation and procrastination issues.

Special tools to monitor and manage employee productivity and motivation may be necessary in many cases, which can be costly for managers. Our research has limitations that may affect the results and their interpretation, such as the sample's specificity, the respondent's subjective assessment that may affect the consistency of the results, and the dynamics of time; our research was conducted over two years, 2022-2023. We also consider the cultural differences between different cultural groups as limiting. Some results may not be applicable to other cultures.

5. Conclusions

Lack of work motivation and prevalent procrastination can cause long-term problems that take time and patience to resolve. As it was stated in the literature review, according to self-determination theory, the satisfaction of three psychological needs (competence, autonomy, and relatedness) influences work motivation, which affects outcomes. This might be the most practical way for managers to enhance motivation and reduce procrastination regarding their employees.

- **Autonomy** - requires internal behavioural support so that employees experience a sense of control over their actions. The need for autonomy is manifested in the desire to have the possibility of self-realisation by one's own integrated meaning. The need for autonomy is related to work meaningfulness because if employees can choose their work tasks and how to do them and feel supported and in control of their destiny, it will likely lead to more meaningful work.
- **Competence** - refers to the desire to deal effectively with one's environment and a sense of effectiveness in one's activities. In a work context, employees want to succeed in their work tasks and anticipate development and growth in terms of their skills and expertise to satisfy their need for competence. Achieving goals, responding successfully to challenges at work, and experiencing growth can lead to feelings of competence that provide a sense of meaning at work.
- **Relatedness** - includes a sense of mutual connection and belonging. Relatedness needs are satisfied by creating and maintaining interpersonal relationships with colleagues and superiors. Fostering a relationship refers to behaviours demonstrating ongoing and authentic interest, care, and friendship among employees. This involves active listening, perspective-taking, mentoring and opportunities to develop relationships with others.

By implementing specific steps based on promoting autonomy, relatedness, and competence based on Self-determination theory, managers can increase employees' motivation and create a more engaged and productive workforce.

Like other developed countries, small and medium-sized enterprises are Slovakia's most common form of entrepreneurship. They are the basis for the social and economic development of regions, helping to reduce unemployment and increase the growth of the standard of living. However, when adverse changes hit the economy, these enterprises also must think about survival and maintaining optimal functioning. The nature of work is changing, and employees must also develop new skills to remain competitive. In this context, managing and supporting employees sustainably is critical, especially for employees more prone to negative work habits such as procrastination in completing work tasks. Based on our research, in the specific conditions of the Slovak

Republic, we have identified the most effective ways managers can learn to communicate effectively, build relationships, and create a team atmosphere that contributes to achieving collaboration and increasing the efficiency of small and medium-sized enterprises.

Overall, small and medium-sized enterprises in Slovakia need a strategy to increase work motivation and eliminate employee procrastination because motivated employees are more productive, loyal, and less prone to fluctuation. When employees feel that they can contribute to the development and improvement of the business, they will be more willing to put forward new ideas and solutions. Motivating employees is crucial for companies because it helps increase employee efficiency, productivity, and performance, encourages teamwork, and fosters creativity and innovation. An anti-procrastination strategy can also help employees improve their organisation and planning, leading to better use of time and higher productivity. It gives employees more control over their work and time, increasing satisfaction and motivation. SMEs can thus gain a competitive advantage through more efficient use of employees' time and resources. When employees are better organised and planned, businesses can perform better and improve their market position.

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APPLYING ARTIFICIAL INTELLIGENCE IN THE LOGISTICS SECTOR OF LITHUANIA: PROSPECTS AND OPPORTUNITIES

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Abstract. Logistics has been one of the most important sectors of Lithuania's economy. However, recent economic, social and political challenges significantly impacted sector development, making its representatives search for new ways of business development by changing conservative models with more advanced ones. For instance, changes in the logistics sector affected by the implementation of remote work opportunities have created possibilities for providing logistics-related services across the globe. Most of the attention is being paid to solutions based on the application of artificial intelligence, and the future of logistics sector development is closely dependent on it. The paper aims to discover new prospects in applying artificial intelligence in the logistics sector by bringing forward an overview of the main sector's activities, performing historical economic data analysis and conducting a survey with representatives of leading companies from the logistics sector in Lithuania. The multicriteria method is used in data analysis, helping establish the main prospects in the sector's development.

Keywords: Artificial Intelligence; Internet of Things; Logistics; Multicriteria Analysis

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JEL Classifications: M10, O32, R40

1. Introduction

Lithuania's logistics sector has been crucial to the country's economy. As a complex sector, it includes many sub-sectors, where, according to *Euromonitor International* (2023a), the main ones are:

- Transport and storage are the aggregations of cargo handling, warehousing and travel agencies, communications, and transport.
- Cargo handling, warehousing and travel agencies are an aggregation of cargo handling, storage and warehousing, travel agencies, freight forwarding and other supporting transport activities.
- Post and courier services are an aggregation of courier services and national post.
- Air transport is an aggregation of non-scheduled air transport and scheduled air transport.
- Road passenger and freight transport is an aggregation of freight transport by road, non-scheduled, and scheduled passenger transportation.
- Transport via pipelines is an aggregation of pipelines of petroleum and natural gas and transportation of other liquids.
- Transport via railways is an aggregation of freight services, other transport services and passenger services.
- Water transport is an aggregation of inland water transport and sea and coastal transport.

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According to *Euromonitor International* (2023a) data, the transport and storage sector takes second position by reaching 14,633.2 mln. USD in turnover and letting only the retail and wholesale sectors forward (see Figure 1). Moreover, the compound average growth of the industry may achieve 3.6 per cent annually by 2027, making it one of the fastest-developing sectors of the Lithuanian economy.

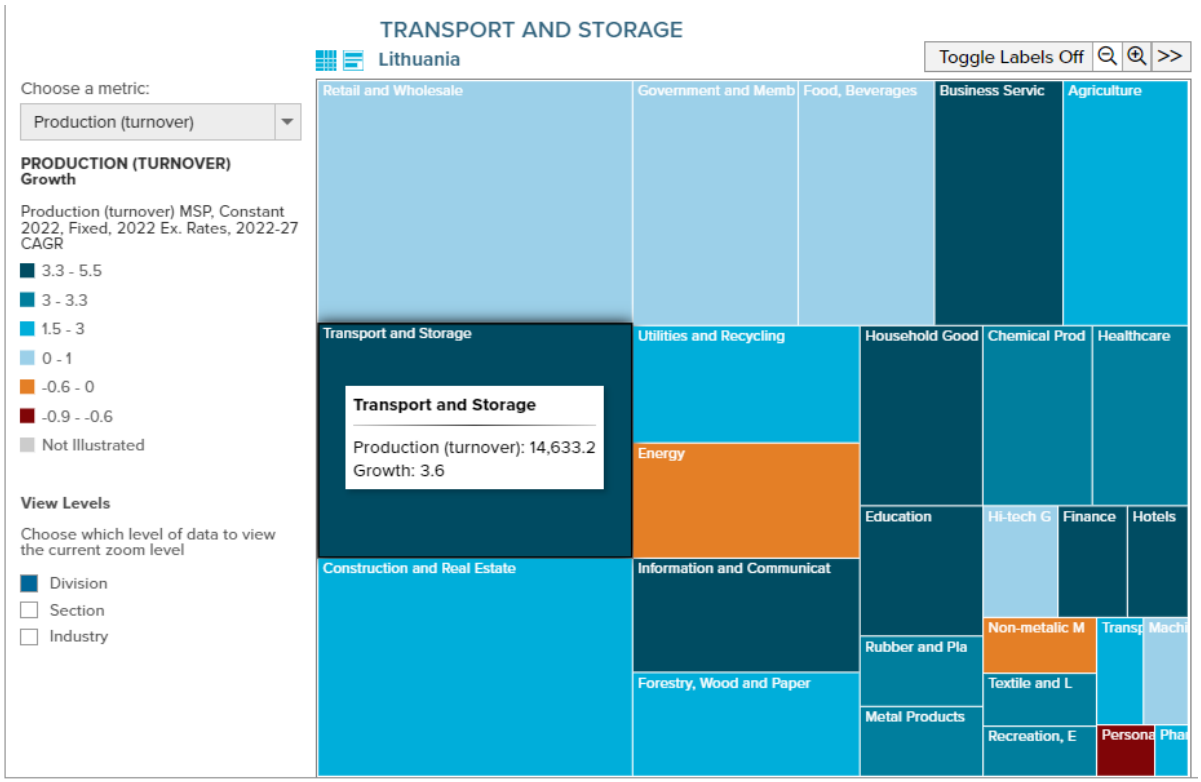

Figure 1. Transport and storage, among other sectors of the Lithuanian economy

Source: Euromonitor International, 2023a

Despite the challenging geopolitical situation, Lithuanian exports and imports of the transport and storage sector flourish (Table 1). Regarding 2022 data, the main countries of Lithuanian exports were Japan (7,431.2 mln. USD), the United States of America (3,849.1 mln. USD) and the United Kingdom (1,309.1 mln. USD), while imports came mainly from Switzerland (1,518.1 mln. USD), the USA (1,078.1 mln. USD) and Japan (959.5 mln. USD). It reflects flexibility in Lithuanian politics and a fast decision-making process in Lithuanian enterprises.

Table 1. Lithuanian imports and exports in transport and storage in 2017-2022, mln. USD

	2017	2018	2019	2020	2021	2022
Imports	2,304.1	2,663.4	2,941.9	2,558.3	3,486.1	4,156.1
Exports	6,327.8	7,715.3	9,019.8	8,211.9	10,654.0	12,516.8

Source: Euromonitor International, 2023a

As a result, all types of transport demonstrate promising results in cargo turnover, except road transport and oil pipelines. This can be explained by terminating economic relations with the Republic of Belarus and the Russian Federation (Table 2).

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Table 2. Cargo turnover by all types of transport in Lithuania in 2018-2022, thousand tkm

	2018	2019	2020	2021	2022
Railway transport	16 884 825	16 180 599	15 864 679	14 565 850	7 375 058
Road transport	43 590 351	53 117 436	55 291 543	57 755 186	53 772 526
Inland water transport	1 200	1 622	1 164	3 809	10 583
Air transport	77	82	8 101	578	2 799
Oil pipeline	326 443	329 541	209 342	130 133	107 526
All types of transport	60 802 897	69 629 280	69 629 280	72 455 555	61 268 493

Source: State Data Agency "Statistics Lithuania", 2023

However, some negative changes might also be observed in the logistics sector's development. For instance, after gaining an impressive 31 rank in 2017, the Logistics Performance Index Rank has lost 12 ranking points in 2022 compared to the situation back then. Although the overall Logistics Performance Index Score remains relatively stable, the biggest challenge might be evaluating the timeliness of international shipments, tracking and tracing consignments, and quality of logistics services. The Logistics Performance Index Score reflects perceptions of a country‘s logistics based on the efficiency of the customs clearance process, quality of trade- and transport-related infrastructure, ease of arranging competitively priced shipments, quality of logistics services, ability to track and trace consignments, and frequency with which shipments reach the consignee within the scheduled time (Euromonitor International, 2023b) (see Table 3).

Table 3. Logistics performance indices in Lithuania in 2017-2022

	2017	2018	2019	2020	2021	2022
Logistics Performance Index Rank	31.0	54.0	50.0	46.0	45.0	43.0
Logistics Performance Index Score	3.5	3.0	3.1	3.2	3.2	3.3
- Logistics Performance Index: Efficiency of Customs and Border Clearance	3.3	2.8	2.9	3.0	3.1	3.1
- Logistics Performance Index: Quality of Trade and Transport Infrastructure	3.3	2.7	2.9	3.0	3.2	3.3
- Logistics Performance Index: Ease of Arranging International Shipments	3.3	2.8	2.9	3.0	3.2	3.3
- Logistics Performance Index: Quality of Logistics Services	3.4	3.0	3.1	3.1	3.1	3.1
- Logistics Performance Index: Tracking and Tracing Consignments	3.5	3.1	3.1	3.1	3.1	3.1
- Logistics Performance Index: Timeliness of International Shipments	4.1	.3.6	3.6	3.6	3.6	3.6

Source: World Bank, 2023; Euromonitor International, 2023b

Many companies apply various new technology-based methods and tools to improve different aspects of the Logistics Performance Index, including remote work opportunities and possibilities in providing logistics-related services globally. Therefore, more attention should be paid to solutions based on artificial intelligence applications.

Therefore, the paper aims to discover new prospects for applying artificial intelligence in logistics. The objectives include theoretical background analysis, revealing the main directions in using artificial intelligence solutions, and surveys with representatives of the leading companies operating in the logistics sector in Lithuania. The multicriteria method is used in data analysis, helping establish the main prospects in the sector's development.

2. Theoretical background analysis

The roots of the application of artificial intelligence solutions might be found in the Internet of Things (IoT) development process. According to Hassan (2018), Kevin Ashton devised the term "Internet of Things" for a new computer application that automatically collects data around us to automatically control many daily activities in 1999. Nowadays, the Internet of Things might be understood as a model for smart applications (Atzori et al., 2010), any smart solution developed based on IoT technology, including devices, services, application appliances, platforms, and ecosystems (Qinxia et al., 2021), or any Internet system designed to collect data and then exchange and analyze information (Ram Kumar et al., 2016). (Ahmad et al., 2020) provide

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a list of main IoT products, such as wearable devices, advanced metering infrastructure, agricultural drones, autonomous robots, remote monitoring systems, and fire alarm systems, and mention fleet management as one of the examples.

IoT markets are rapidly growing, and service providers ensure a wide range of IoT-based solutions to facilitate various aspects of life (Naem et al., 2022). By analysing theoretical sources, four aspects of the Internet of Things can be distinguished:

- Consumer IoT,
- Business IoT,
- Infrastructure IoT,
- Industrial IoT.

Consumer IoT, as the name suggests, proposes a consumer-oriented approach to help new consumers choose IoT products that best serve their needs from available products (Naem et al., 2022). In other words, IoT is based on ideas to connect and create communication among every living and dead object (Arif et al., 2019). In short, authors tend to analyse behavioural patterns (Subiyakto et al., 2023; Zhang & Peer, 2023) and improved experience of customers (Hoffman & Novak, 2018), supported with IoT application here.

Business IoT investigates the impact of IoT-based innovations on business models and patterns. For instance, Yin (2022) analyzes changes in the sharing economy affected by IoT big data, and Hanafizadeh et al. (2021) use business model innovation (BMI) to describe the efforts made by the business to find new business logic or new ways of value creation. Interestingly, Kulakli & Arikan (2023) have shown that scientific publications on the Internet of Things about business model innovation have increased gradually since 2019.

Infrastructure IoT deals with the appropriate ecosystem creation needed to apply IoT-related solutions successfully. Teckshawer (2023) analyzes the ramifications of 5G technology for enterprises in developing countries and highlights how 5G technology might boost IoT capabilities through higher device densities, lower latency, and faster data transmission rates. Shankar & Maple (2023) examine the effects of ethics and technology on the security of IoT-enabled systems in smart city infrastructure and present a Secure Smart City Infrastructure using Blockchain and Deep Learning (SSCI-BDL) framework to ensure privacy protection and trustworthiness among IoT communication in smart cities.

Finally, *Industrial IoT* provides a complex understanding of IoT-related applications that change business principles in specific industrial areas and directly impact artificial intelligence applications. Flores-García et al. (2023) propose a data model for multichannel communication that facilitates IoT-enabled digital service for smart production logistics, essential for capturing, processing, and transferring information across products, services, and software databases (see Table 4).

Table 4. Main aspects of Industrial IoT

Aspects of Industrial IoT:	Research areas in logistics:	Authors:
Autonomous robots	Unmanned vehicles, Autonomous Mobile Robot (AMR), Automated Guided Vehicle (AGV), Robot operating system (ROS), Cyber-physical system (CPS), Intelligent logistics system (IIS), Simultaneous localization and mapping (SLAM)	Hsiang-Chen et al., 2023; Chang et al., 2023
3D printing	Computer-assisted methods, distribution networks, logistics consulting services, customization, reverse logistics	Ehler, 2023; Demir, Eyers & Huang, 2021; Esenduran, Leitizia, Ovchinnikov, 2022; Boon, van Wee, 2018
Augmented reality	Smart materials, binoculars, wearable technology, virtual reality	Rejeb et al., 2021; Reif, Walch, 2008
Simulation	Transportation planning, assistive listening systems	Demir, Eyers & Huang, 2021
Big data analytics	Software frameworks, big data, technological innovations, customer satisfaction, edge computing, predictive analytics	von Stietencron, 2022; Guan, 2020; Bag et al., 2021; Sodero, Jin & Barratt, 2019; Govindan et al., 2018

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Cloud computing	Blockchains, multicasting (computer networks), intelligence levels, information storage, retrieval systems, quality of service	Fan, 2022; Fu et al., 2021; Wang, Yin & Wang, 2023
Cybersecurity	Supply chain management, quantum computing, security systems, wired telecommunications carriers, Internet Publishing and Broadcasting and Web Search Portals, Security Systems Services, Internet security, encryption protocols	Cheung, Bell & Bhattachariya, 2020; Enache, 2023

Source: conducted by authors

Based on a literature review, the Industrial IoT comprise the relevant and vital aspects for assessing the impact of the newest solutions on transport and logistics-related challenges. According to Boon and van Wee (2018), location, needs, and transport resistance are essential. The city-level hubs can coordinate material flows and gather expertise faster, mass-individualisation and personification dictate the need for changes, and more efficient distribution networks optimize the process of materials shipping.

According to Manners-Bell and Lyon (2023), the benefits of the Internet of Things include:

- Monitoring the status of assets, parcels and people in real-time.
- Measuring how assets are performing (and what they will do next).
- Reducing fuel costs by optimization of fleet routes.
- Automating business processes to eliminate manual interventions.
- Optimizing how people, systems and assets work together and coordinate their activities.
- Applying analytics to identify wider improvement opportunities and best practices.
- Mentoring inventory to reduce stock-outs (see Figure 2 below).

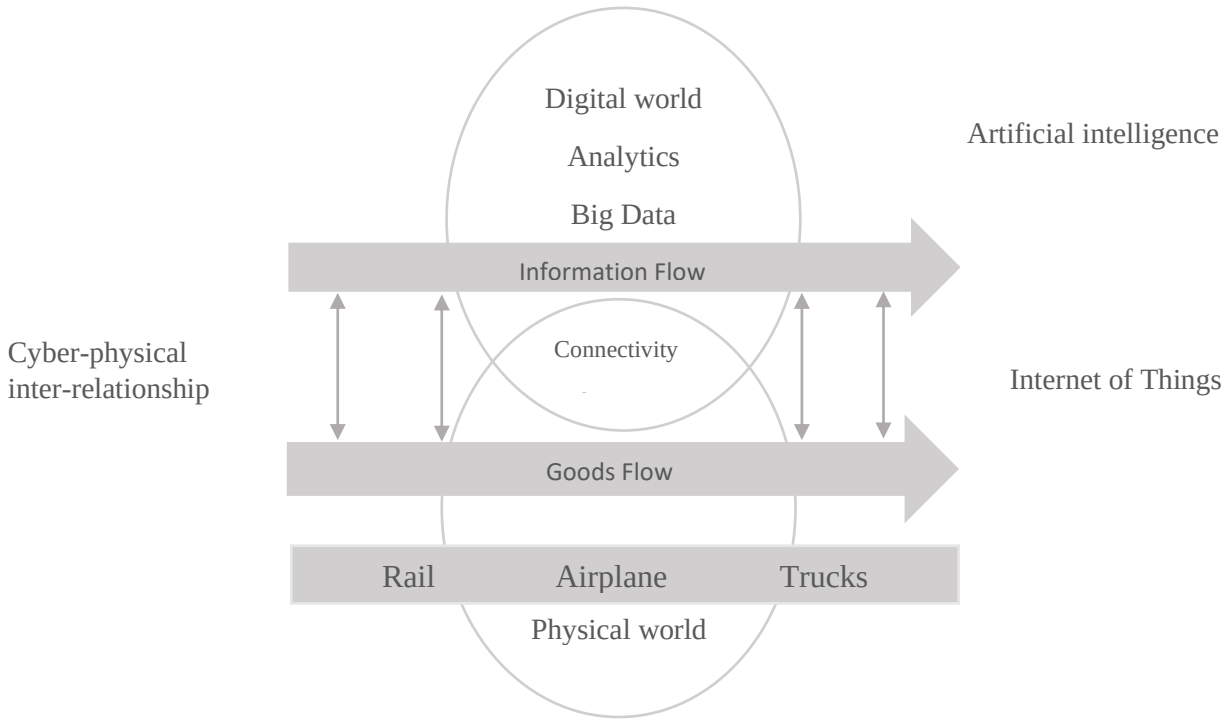

Figure 2. The cyber-physical relationship in the supply chain
Source: Manners-Bell, Lyon, 2023

Manners-Bell and Lyon (2023) highlight the main directions in applying artificial intelligence in logistics:

- Connected consumers.
- Autonomous vehicles.
- Delivery flexibility.
- Warehouse automation.

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Connected consumers. Artificial intelligence (AI) has the power to revolutionize the way *businesses interact with their customers* (Mclean & Osei-Frimpong, 2019) and radically change the marketplace (Bock et al., 2020). Specifically, AI advances can improve the *customer experience* by increasing companies' knowledge about their preferences and buying patterns (Evans, 2019). Deploying AI technologies strategically at different key customer contact posts can bring significant benefits to companies and a possible increase in customer satisfaction (Ameen et al., 2021). Therefore, AI increases *customer satisfaction* in service delivery (Aguiar-Costa et al., 2022).

Autonomous vehicles. There is undoubtedly a big potential for autonomous vehicles shortly, and their numbers are rising dramatically (Jadhav et al., 2023). For example, nowadays, a smart car's effective driving direction and precise lane location can be determined based on the current driving lane. Xianping & Xueliang (2021) state that the ultimate goal of developing autonomous vehicles is to establish an automated platform connected and informatized by integrating humans and cars, capable of implementing real-time, all-weather, and efficient autonomous driving. Moreover, the authors believe that autonomous driving technology can significantly increase social productivity and produce tremendous social benefits while improving the way people travel. Nurgaliev, Eskander & Lis (2023) investigate the use of drones and autonomous vehicles in logistics and delivery. The authors indicate high transportation costs, difficulty in meeting customer demands, and environmental concerns as main challenges; however, integrating drone and autonomous vehicle technology can address these challenges by reducing transportation costs, increasing speed and reliability of delivery, and improving efficiency. Using drones and autonomous vehicles can bring significant benefits such as increased efficiency, cost savings, improved safety, accessibility, and real-time tracking (Nurgaliev, Eskander & Lis, 2023).

***Delivery flexibility*.** Delivery flexibility is essential in some specific areas, such as healthcare. Hassanzadeh, Atyabi & Dinarvand (2019) evaluate the significance of artificial intelligence in drug delivery system design. The problem might be solved in logistics by optimizing transportation routines from a network perspective of supply and demand nodes (Lam, 2021).

Warehouse automation. Li et al. (2021) think that warehouse management can solve its problems by improving the main aspects of warehouse design and planning and integrated warehouse management.

The list of central aspects of applying artificial intelligence in logistics is still being determined. For instance, Klumpp & Ruiner (2022) highlight the importance of the human factor, especially in digital logistics; Pawlicka & Bal (2022) investigate possibilities of implementing AI and sustainable supply chain finances for innovative omnichannel logistics, and Emam et al. (2021) suggest algorithms to solve complex and multimodal problems that face transportation logistics sector.

3. Research objective and methodology

The research aims to discover new prospects for applying artificial intelligence in logistics. The empirical research has a double objective: first, to discuss the importance of established theoretical directions using AI in logistics sector development, and second, to evaluate how results may be implemented on the company's managerial level by improving logistics to achieve better business results.

The research methodology consists of three parts:
1. Delphi analysis with experts in the logistics sector.
2. Interviews with logistics sector representatives.
3. Evaluation of interviews' results based on multicriteria analysis of opinions.

The ***Delphi method*** supports decision-making processes when selecting or implementing objectives (Kozak & Frączkiewicz-Wronka, 2023). It generates consensus among experts dealing with complex issues (Robertson et al., 2017). It is a unique type of survey when a group of anonymously participating respondents with good knowledge of logistics are selected to evaluate and analyse a topic. In the empirical research, the Delphi method

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allowed us to establish the importance of various theoretical directions in logistics sector development supported by AI applications.

Interview is the broadly used qualitative method of gathering information about a specific area. According to Bazaras et al. (2009), the results of the interviews can indicate critical trends affecting the logistics sector. In the empirical research, the representatives of companies operating in Lithuania's logistics sector provided their opinions regarding AI application-related topics.

Multicriteria analysis of opinions represents. Commonly, experts' opinions differ (Podvezko, 2011). Therefore, assessing the degree of compatibility of their views is crucial. This method ranks possible alternatives when respondents evaluate all indices depending on their opinions and acquired knowledge (Ambrusevič, 2016). The degree of compliance provides information regarding representatives of the results (Kardelis, 2002).

By having compatible opinions, multicriteria data analysis has to be performed, revealing the opinion of one respondent and representing the results of all participating specialists (Malhotra and Birks, 2012). An expert survey helps identify the most critical indexes according to the experts' opinions (Podvezko, 2011).

The correlation coefficient can quantify the agreement between two respondents. Suppose the number of respondents is greater than two. In that case, the group's compatibility level is indicated by the concordance coefficient *W*, which is calculated based on the ranking of the analyzed objects.

Ranking is a procedure where the most critical object gets a rank equal to one, the second most important gets the rank of two, and the last in terms of importance gets the rank *m*. Equivalent indicators get the same arithmetic average of values. The Kendall concordance coefficient is linked to the sum of the ranks of each object about all respondents:

$$c_i = \sum_{j=1}^{r} c_{ij}$$

where, c_i – matrix of objects evaluations;
i – rank of an object given by a respondent j $(i = 1, 2, \ldots, m)$;
r – number of respondents.

The mean squared deviation is expressed by the deviation of c_i comparing to average value $\bar{c}$:

$$S = \sum_{i=1}^{m} (c_i - \bar{c})^2$$

Average value $\bar{c}$ is calculated by using the following formula:

$$\bar{c} = \frac{1}{2} r(m+1)$$

Concordance coefficient is the ratio of dispersion *S* and its possible maximum value:

$$W = \frac{12S}{r^2 m(m^2 - 1)}$$

In case of compatible opinions, the value of concordance coefficient *W* is equal *1*; if the value differ, *W is* near *0*. Concordance coefficient can be for Simple Additive Weighting data analysis, if χ^2exceeds critical value ${\chi_{cr}}^2$. It indicates, that respondents' opinions can be considered as compatible:

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$$\chi^2 = \frac{12S}{rm(m+1)}$$

For Simple Additive Weighting data analysis, a matrix of weighted normalized values is formed:

$$\tilde{r}_{ij} = \frac{r_{ij}}{\sum_{j=1}^{n} r_{ij}}$$

where, $\tilde{r}_{ij}$ - *i*-indicators normalized value for *j*-object; r_{ij} - *i*-indicator mean for *j*-object.

The total of all weighted normalized values for each object need to be calculated:

$$S_i = \sum_{i=1}^{m} \omega_i \tilde{r}_{ij},$$

where, w_i – weight of *i*-indicator; $\tilde{r}_{ij}$ - normalized *i*-indicator for *j*-object.

The biggest value of *Sj* shows the opinion of a certain respondent, who expresses the opinion of all respondents.

4. Results and discussion

In the Delphi survey, 5 experts were selected for participation. During the first round, each expert anonymously provided their list of main areas of logistics suitable for artificial intelligence applications. During the following rounds, the experts evaluated a general list of suggestions from all members. Finally, seven subjects were considered suitable for artificial intelligence applications: autonomous vehicles, big data analysis, cloud computing, connected consumers, cybersecurity, delivery flexibility, and warehouse automation.

During the interviews 8, respondents representing business units operating in the logistics sector were asked to express their opinions to evaluate the main direction of AI applications suitable for their companies. They had to assess theoretically established directions from the answers of the Delphi survey with anonymous experts (see Table 5).

Table 5. The matrix of the ranging of the evaluation of respondents

Nr.	Evaluated objects	Respondents								Sum of ranges	Mean squared deviation
		Nr.1	Nr.2	Nr.3	Nr.4	Nr.5	Nr.6	Nr.7	Nr.8		
1	Autonomous vehicles	2,5	1,5	3	1,5	1,5	1	2	4	17	413,44
2	Big data analysis	6,5	6,5	6,5	6	6,5	5	5,5	5,5	48	113,78
3	Cloud computing	6,5	6,5	6,5	6	4	2,5	5,5	7	44,5	51,36
4	Connected consumers	2,5	3,5	1,5	1,5	1,5	7	5,5	2	25	152,11
5	Cybersecurity	5	5	4,5	3,5	4	5	5,5	5,5	38	0,44
6	Delivery flexibility	2,5	1,5	4,5	3,5	6,5	5	2	2	27,5	96,69
7	Warehouse automation	2,5	3,5	1,5	6	4	2,5	2	2	24	117,78
	Total	28,0	28,0	28,0	28,0	28,0	28,0	28,0	28,0	224,00	1105,61

Source: conducted by authors

The concordance coefficient *W* expresses the reliability of the expertise, as the degree of agreement between the opinions of respondents is quite high: $W = \frac{12S}{r^2 m(m^2-1)} = \frac{12\times1105,61}{64\times7\times(49-1)} = 0,56$.

The obtained results can be used for Simple Additive Weighting data analysis, as χ^2exceeds critical value $\chi_{cr}{}^2$:

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$$\chi^2 = \frac{12S}{rm(m+1)} = \frac{12 \times 1105{,}61}{8 \times 7 \times (7+1)} = 26{,}94$$

$$\chi_{lim}{}^2 = \chi^2_{(v=m-1\,;\,\alpha=0{,}05)} = 12{,}59$$

The results of the Simple Additive Weighting data analysis are provided in Table 6 below:

Table 6. The matrix of weighed normalised values

Evaluated objects	Respondents							
	Nr.1	Nr.2	Nr.3	Nr.4	Nr.5	Nr.6	Nr.7	Nr.8
Autonomous vehicles	0,1897	0,1138	0,2277	0,1138	0,1138	0,0759	0,1518	0,3036
Big data analysis	1,3929	1,3929	1,3929	1,2857	1,3929	1,0714	1,1786	1,1786
Cloud computing	1,2913	1,2913	1,2913	1,1920	0,7946	0,4967	1,0926	1,3906
Connected consumers	0,2790	0,3906	0,1674	0,1674	0,1674	0,7813	0,6138	0,2232
Cybersecurity	0,8482	0,8482	0,7634	0,5938	0,6786	0,8482	0,9330	0,9330
Delivery flexibility	0,3069	0,1842	0,5525	0,4297	0,7980	0,6138	0,2455	0,2455
Warehouse automation	0,2679	0,3750	0,1607	0,6429	0,4286	0,2679	0,2143	0,2143
Total	4,5759	**4,5960**	4,5558	4,4252	4,3739	4,1551	4,4297	4,4889

Source: conducted by authors

The results obtained show that the opinion of respondent Nr. 2 reflects the opinions of the whole group at the best level. According to experts' evaluation of all evaluated objects regarding their importance, tier 1 includes autonomous vehicles and delivery flexibility, tier 2 – connected consumers and warehouse automation, tier 3 – includes cybersecurity, and tier 4 – big data analysis and cloud computing.

Conclusions

The logistics sector remains one of the largest and most important sectors in the structure of the Lithuanian economy. However, historical economic data analysis revealed negative aspects of its development. Although all types of transport demonstrate promising results in cargo turnover, road transport and oil pipeline cargo turnover are declining. The termination of economic relations with the Republic of Belarus and the Russian Federation can explain that. Moreover, the Logistics Performance Index Score analysis indicated the main challenge in evaluating the timeliness of international shipments, tracking and tracing consignments, and quality of logistics services. It is concluded that in order to improve different aspects of the Logistics Performance Index, many companies apply various new technology-based methods and tools, including remote work opportunities and possibilities in providing logistics-related services across the globe. Therefore, more attention should be paid to solutions based on artificial intelligence applications.

Theoretical background analysis established the roots of the application of artificial intelligence solutions in the development process of the Internet of Things, which was divided into four aspects: consumer IoT, business IoT, infrastructure IoT, and Industrial IoT. The last, industrial IoT, provides a complex understanding of IoT-related applications that change business principles in specific industrial areas and directly impact artificial intelligence applications. The most significant impact of industrial IoT is established in the following areas: autonomous robots, 3D printing, augmented reality, simulation, big data analytics, cloud computing, and cybersecurity. Detailed scientific literature analysis highlighted the main directions in applying artificial intelligence in logistics: connected consumers, autonomous vehicles, delivery flexibility, and warehouse automation.

The results obtained from theoretical background analysis were tested by conducting empirical research. It aimed to discuss the importance of established theoretical directions applying AI in logistics sector development and, second, to evaluate how results may be implemented on the company's managerial level by improving logistics to achieve better business results. Therefore, a complex research methodology was used, consisting of Delphi analysis with experts of the logistics sector, interviews with logistics sector representatives, and

evaluation of interviews' results based on a multicriteria analysis of opinions. As a result, the following prospects in applying artificial intelligence in the sector's development were established: regarding the importance of tier 1 includes autonomous vehicles and delivery flexibility; tier 2 – connected consumers and warehouse automation; tier 3 – cybersecurity; and, finally, tier 4 – big data analysis and cloud computing.

Limitations of the research are related to the narrow scope of participants and the quite general nature of results at the end. This can be explained by the early stages of artificial intelligence application and the need for practical evidence from Lithuanian business practices. However, the results distinguish the main directions in logistics sector development and provide a structural sequence for further investigation.

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THE COMMUNICATION STRATEGY OF CORPORATE SOCIAL PERFORMANCE: A STUDY OF CHILEAN COMPANIES*

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Abstract. Companies face growing pressure to act responsibly across the environmental, social and governance domains. To demonstrate their ESG commitment, some companies regularly disclose environmental and social indicators in annual reports on their websites. The focus on environmental responsibility has gained popularity, enhancing organisations' credibility with stakeholders. However, there's still much room for improvement in the social realm. This research aims to pinpoint the areas where Chilean companies are most engaged socially. We analyse what they disclose in their sustainability reports regarding their concerns in the community, human resources, suppliers, and product and customer domains and compare these claims with their actions. The methodology involves analysing statements about concerns and actions based on the Global Reporting Initiative's 400 series. The key findings reveal that companies often communicate strong concerns for social aspects to stakeholders, projecting a socially responsible image. However, the discrepancy arises in translating these concerns into tangible actions. While many companies express concern, only some of them perform actions.

Keywords: Bluewashing; Global Reporting Initiative (GRI); Social performance; Chile

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1. Introduction

Corporate social responsibility (CSR) is an essential issue for organisations. Stakeholders such as consumers, investors, and governments have increased pressure on organisations to provide information about their ESG (environmental, social, governance) performance (Walker and Wan, 2012; Gatti et al., 2019; De Freitas et al., 2020; Caratas et al., 2021).

Hence, companies increasingly seek to demonstrate their commitment to society and the environment to gain a competitive advantage, strengthen their relationship with stakeholders, and improve their corporate image and reputation (Arribas et al., 2019). The relationship between financial and social performance has been extensively studied in scientific literature (e.g., Chen et al., 2021).

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Some authors propose that CSR has a significant impact on firms' idiosyncratic risk, suggest that managers make a mistake if they do not include CSR considerations in the overall strategy of their firms and show that CSR positively affects firm performance by improving firms' financial stability (Brooks and Oikonomous, 2018; Saha et al., 2020; and Mishra and Modi, 2013). However, there is a need for more clarity regarding whether and how CSR practices generate additional financial returns for firms (Taylor et al., 2018).

Companies often showcase these practices by emphasising the eco-friendliness of their products or employing branding and marketing strategies that spotlight green qualities, sometimes to camouflage or obscure environmental harm. They even present general or inaccurate information that implies improved performance of environmental indicators without clarifying whether they are still harming the environment. It is not uncommon for companies that claim to be socially responsible to become embroiled in media scandals because of their irresponsible behaviour (Arribas et al., 2021).

'Bluewashing' and 'greenwashing' are terms used to describe misleading communication practices about a company's social and environmental performance. Bluewashing occurs when an organisation uses its involvement in social or charitable projects as a marketing tactic without a genuine commitment to the cause. Only a few studies have been conducted on social measurements in this field. Greenwashing occurs when a company makes false or exaggerated claims regarding its commitment to environmental protection (Wakahara, 2017; Uyar et al., 2020).

To avoid misleading practices, companies must use reliable measurement and communication tools. One such tool is the Global Reporting Initiative (GRI), an internationally recognised sustainability reporting methodology. By applying the GRI standard, companies can communicate their social, economic, and environmental performance transparently and reliably.

The main objective of this study is to contrast what companies state they are concerned about and their actions regarding social issues. The different categories and criteria employed to evaluate companies' attitudes and actions towards social issues in the social realm are based on the GRI standard. This research contributes to the knowledge of firms' social responsibility while encouraging transparency in companies' current practices concerning human resources and the wider community. The study analyses the behaviour of 94 companies operating in Chile, identifying what they say they care about and their actions in three social categories: Community, Human resources, Suppliers, products and customers.

The findings reveal that the companies in the sample display a primary concern for human resources welfare, with a secondary focus on the local community where the business operates. The area of least concern is the social aspect of their suppliers, products and customers. Furthermore, the actions taken by these companies only sometimes align with their stated concerns. This research indicates that companies' social performance is sometimes primarily symbolic.

Section 2 provides a literature review of the relevant concepts. Section 3 describes the construction of the database and the methodology. Section 4 discusses the results. Finally, section 5 presents the main conclusions.

2. Literature Review

Companies have willingly integrated sustainability aspects into their reports to establish legitimacy. Reporting on sustainability initiatives has become crucial for addressing stakeholder concerns (Uyar et al., 2020). How companies self-report frequently shapes stakeholders' perceptions of their performance in social responsibility. CSR reporting can improve a company's legitimacy through various communication methods, regardless of whether its performance aligns with its social commitment. Independent of how companies choose to publicise their social responsibility – whether by participating in a UN program, adhering to a local social program, through marketing activities, etc. – the essential factors are the accuracy, transparency, and depth of information disclosed.

The institutional theory postulates that compliance with reporting requirements might be purely symbolic, aimed at improving legitimacy with stakeholders rather than bringing about actual internal change (Macellari et al., 2021).

Some studies suggest that companies may use misleading disclosures regarding their performance to improve their public image (Sanchez García and Orsato, 2020; Ortas et al., 2019). This lack of transparency is commonly referred to as 'greenwashing' for environmental issues and 'bluewashing' for social problems. Greenwashing is a misleading communication that has become a recurrent practice in marketing and corporate strategies aimed at concealing the most controversial aspects of environmental sustainability (Siano et al., 2017; Gatti et al., 2019). In the case of bluewashing, there is no agreed definition among academics. However, we can define it as mere symbolic social commitment without actual actions.

Simply having concerns about the environment is insufficient. Social responsibility requires companies to integrate the three essential ESG elements (Da Silva et al., 2020). Most current sustainability research has prioritised environmental performance, the methodologies for assessing environmental aspects, and the influence of communicating environmentally friendly actions on a company's financial results. Only a few studies have been conducted on social measurements in this field. Furthermore, research on social issues predominantly employs subjective rather than objective evaluations (Kang et al., 2016). Therefore, it is imperative to identify an appropriate approach for measuring corporate social performance, which has yet to receive much attention. Researchers agree that investigating corporate social engagement poses significant challenges. This stems from the absence of a universally agreed-upon vocabulary, where delineations often remain unclear (Sailer et al., 2022).

Berliner and Prakash (2015) and Macellari et al. (2021) suggest that companies promote themselves as socially responsible by participating in voluntary programs such as the United Nations Global Compact. Yet, their study demonstrates that companies adhering to these voluntary initiatives yield improvements that are minor and which hardly consume company resources. There is no significant improvement in those areas that require greater investment, even though their impact on society would be more significant. Moreover, the same authors argue that United Nations Global Compact (UNGP) members only superficially discuss the genuine objectives of CSR rather than implementing substantial but expensive changes in their environmental and human rights performance.

Andreoli and Nogueira (2021) and Wakahara (2017) argue that companies engage in false marketing by claiming social responsibility when seeking to improve their social image without acting upon it. The literature has recognised this behaviour (Peope and Waeraas, 2016; Ruiz-Blanco and Fernandez-Feijoo, 2021).

3. Database and methodology

This paper aims to identify the areas of social concern in which Chilean companies are most active. More specifically, we aim to determine whether they carry out concrete actions that demonstrate their commitment to social issues or simply express concern without taking concrete action. To achieve this goal, we suggest a measurement technique in this study to determine the genuine social responsibility of firms.

An initial filter was applied from a database of 21,154 large companies with over 100 employees acquired from www.basesdedatoschile.cl, excluding government, educational, and consultancy entities, resulting in 222 companies. Next, companies that disclosed integrated or sustainability reports between 2018 and 2020 were selected, which reduced the sample size to 94 companies. Of these companies, we gather information on the sector according to the classification of The Global Sustainability Standards Board (Materials and Basic Needs; Transport, Infrastructure, and Tourism; Industrial; Other Services and Light Manufacturing), the location of the head of the business group (Chile or foreign) and whether or not they adhere to the GRI standard.

Out of the companies in the sample, 32% belong to the Other Services and Light Manufacturing sector, 49% to Materials and Basic Needs, 6% to Industrial, and 13% to Transport, Infrastructure, and Tourism — meanwhile,

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65% of the companies adhered to the structure proposed by the GRI standard. Additionally, 78% of the sample consisted of companies based in Chile.

The GRI standard is currently the most extensively employed for sustainability reporting (Halkos & Nomikos, 2021). This categorisation is the most detailed and far-reaching social and environmental information source.

Table 1 shows the indicators related to social responsibility used in our research, as defined by the GRI standard, together with adjustments for our analysis. These modifications are being implemented to enhance comprehension of corporate reality.

Table 1. Definition of the GRI standards used and their adaptation to our methodology

GRI standard	GRI standard description	Indicator employed in the study
401 Employment (2016)	Addresses the issue of employment. It includes the organisation's approach to job creation: hiring, recruiting, and retention.	Local job creation: Company actions related to supporting the development of local entrepreneurs, work placements for young people from the locality in which the company is located and the hiring of employees with preference given to those from neighbouring communities.
402 Company worker relations (2016)	Addresses issues of the employee–company relationship and the consultation practices of organisations with employees and their representatives, including the approach to communicating significant operational changes.	Employee relations and work-life balance: The company's communication with workers and benefits enable them to enhance their personal and family life.
403 Health and safety at work (2018)	Establishes requirements for providing information on health and safety at work.	Occupational health and safety: Measures taken by companies to prevent and guarantee workers' safety and health and evaluate and minimise risks in these areas.
404 Training and teaching (2016)	Establishes the notification requirements on the topic 'training and teaching' and includes the focus on employee skills improvements, performance evaluations, and professional development.	General and human rights training and education: Actions and measures related to the training and education of workers. Training programs taught by the companies or financed by them.
405 Diversity and equal opportunities (2016)	Addresses issues related to diversity and equal opportunities at work. This index can include percentages of female workers, equal pay, and participation at the highest level of governance.	Pay equity and Gender equality: Measures regarding remuneration above the minimum established by law and any other measure aimed at improving the salary level of workers in general—incorporation of women into the workforce and gender equality in the different areas of the organisation.
406 Non-discrimination (2016)	Addresses the issue of discrimination against workers at work, including harassment and corrective actions taken by the organisation.	Diversity and inclusion, non-discrimination: This indicator analyses actions aimed at preventing discrimination on gender issues, including people with disabilities above the 1% established by law, and raising awareness among workers on these issues.
407 Freedom of association and collective bargaining (2016)	Addresses the issue of freedom of association and collective bargaining.	Unionisation: Actions of companies that promote unionisation and communication between companies and union organisations.
411 Rights of Indigenous people (2016)	Addresses issues related to indigenous peoples and notification requirements regarding them.	Indigenous peoples' rights: Actions of companies that are related to Indigenous communities and native peoples and their rights, relationships, economic support, and education.
412 Human rights assessment (2016)	Addresses human rights evaluation issues and establishes notification requirements on the subject.	This GRI indicator is approached from the perspective of Human Rights education and is incorporated in the criterion: General and human rights training and education
413 Local communities (2016)	Addresses how organisations identify their interest groups, relate to them, and participate in their problems.	Community engagement, Culture and sport, Education and Other local investment and spending: Relationships and communications with the communities, as well as activities and workshops that provide some training or knowledge to the community, dual company training programs for technical education students, investments, donations, or monetary contributions, which benefit the community and

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		that are beyond of what is required by law or the common business activity of the company.
414 Social evaluation of suppliers (2016)	Addresses the evaluation and selection of suppliers according to social criteria and the evaluation of significant or potential negative social impacts in the supply chain.	Control and dealings with suppliers: Actions related to evaluation, registration, and monitoring that ensure the quality of suppliers.
416 Customer health and safety (2016)	Addresses customer health and safety issues, including efforts to address health and safety in the life cycle of products or services.	Customers: Actions focused on customer safety.
417 Marketing and labelling (2016)	Fair marketing communications and information and labelling of products or services, including customer access to correct information about positive and negative economic, environmental, and social impacts of products.	Product labelling: The information delivered to customers through the labels of the products or services.
418 Clients' privacy (2016)	Addresses the issue of customer privacy, including loss of customer data and privacy violations.	This criterion is included in the criterion Customers.

Source: Description of GRI indices and adaptation for the study, extracted from https://www.globalreporting.org/how-to-use-the-gri-standards/gri-standards-spanish-translations/ consulted on 15 November 2022

The indicator employed in the study was aggregated into three main categories: one for community-related criteria (community), one for worker-related criteria (human resources), and the third and final one for product and customer criteria (suppliers, product and customers).

The community category includes the following criteria: Local job creation, Indigenous peoples' rights, Community engagement, Culture and sport, Education and Other local investment and spending. This procedure is repeated for the other two categories, human resources management and Production.

The category of human resources includes the following criteria: General and human rights training and education, Occupational health and safety, Employee relations and work-life balance, Pay equity, Gender equality, Diversity and inclusion, non-discrimination and Unionisation.

The category suppliers, products and customers includes three criteria: Control and dealings with suppliers, Product labelling and Customers.

For each criterion, we analyse if the company expresses concern, explicitly mentions an issue or presents statistical data, and if the company performs actions. We understand there is concern on the company's part whenever there is an action. The concern variable is binary: whether the company shows concern or not. The action variable is a numerical variable that records the number of actions carried out by the company in the indicated area, according to the information published in the company's report. Table 2 illustrates the classification of the community category.

Table 2. Criteria employed for the community category

Company		Local job creation	Indigenous peoples' rights	Community engagement	Culture and sport	Education	Other local investment and spending
Company name	Concern	Yes	Yes	No	Yes	Yes	Yes
	Action No.	0	1	0	1	7	3

Source: Own elaboration based on an adaptation of GRI 400 series criteria.

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4. Results

This research aims to identify the areas of highest business concerns and activity in the social sphere in Chile. We separately analyse the community, human resources, suppliers, and product and customer categories to achieve the objective. Starting with the community category, firstly, we identify the global concerns of companies. Secondly, we compare the concerns of companies that adhere to the GRI standard with those that do not. Thirdly, we analyse if there are differences among production sectors. Then, we analyse if there are differences due to the location of the head of the business category. Once the concerns are examined, the same procedure is applied to analyse the actions implemented by the companies in the social realm. Finally, we investigate the level of concerns expressed and the number of actions performed.

After the community analysis, we will address the other two categories: Human resources, suppliers, and products and customers.

4.1. Community analysis

The analysis conducted for the community category reveals that companies are primarily focused on community engagement. 94% of the companies express concerns regarding this criterion. Similarly, companies are concerned about Education and Other local expenditures, as shown in Figure 1. Conversely, only 16% of the companies show concern regarding the Indigenous people's rights criterion, and only 28% are concerned with Local job creation.

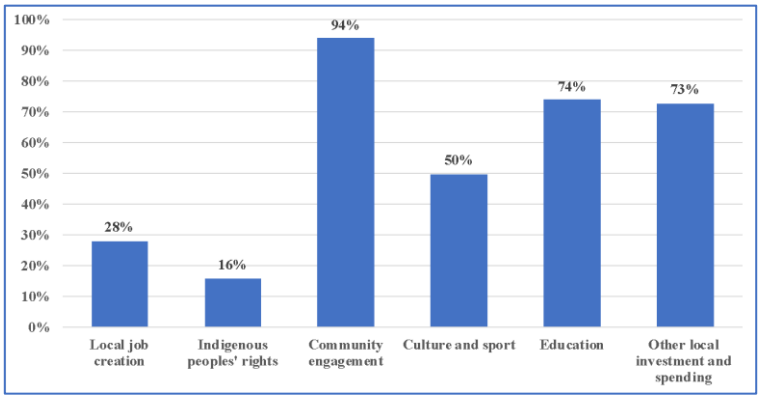

Figure 1. Percentage of companies demonstrating community concern
Source: The authors

Companies which adhere to the GRI standard exhibit more concern across all criteria than those that do not. The most notable difference between Local job creation and Indigenous peoples' rights is that GRI-reporting companies express twice as much concern as non-reporting companies (Figure 2).

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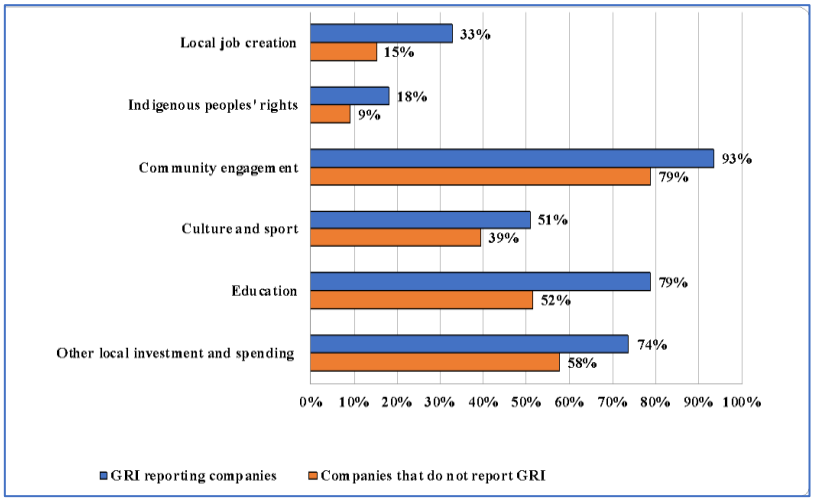

Figure 2. Percentage of companies showing concern for the community, according to whether they report following the GRI standard
Source: The authors

Figure 3 illustrates the concerns of the companies in the different sectors. Across all sectos there are companies expressing concern in the criteria of Community engagement, Culture and sport, Education and Other local investment and spending.

The criteria of Local job creation and Indigenous peoples‘ rights are of least concern to companies, regardless of their sector of activity. In fact, in the Transport, Infrastructure and tourism sector, no company is concerned about these two criteria.

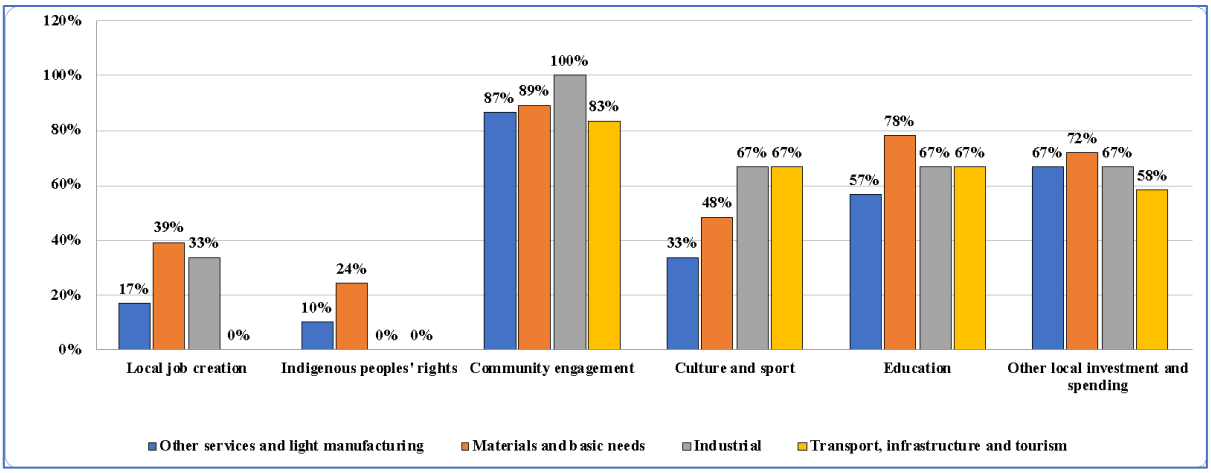

Figure 3. Percentage of companies showing concern for the community by sector of activity
Source: The authors

As for the parent company's location (Figure 4), it is evident that companies with headquarters outside Chile exhibit more significant concern across all community criteria than companies with headquarters in Chile, except Culture and sports.

In relation to the parent company's location (Figure 4), companies headquartered outside Chile demonstrate greater concern across all community criteria, except for Culture and Sports, than those headquartered in Chile. In this regard, the Education criterion shows the most significant difference (27 p.p.) betwen the companies headquartered in Chile those headquatered abroad.

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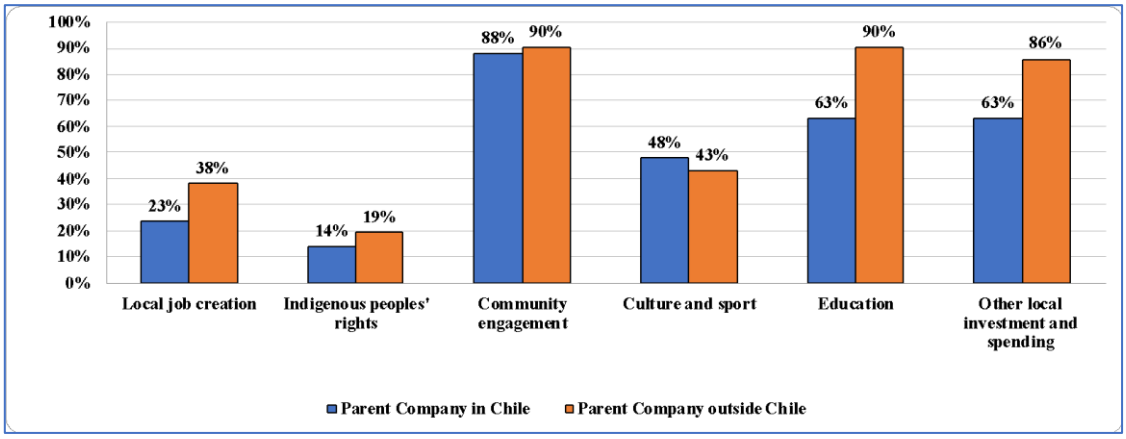

Figure 4. Percentage of companies showing community concern by location of the parent company of the business conglomerate
Source: The authors

Thus far, our analysis has focused on companies' levels of concern. Now, we undertake the same analysis for the number of actions carried out by corporations.

Figure 5 illustrates the average number of companies' actions in the Community category as disclosure in their annual reports. Community engagement is the most prioritised criterion, and Indigenous peoples' rights are the least prioritised.

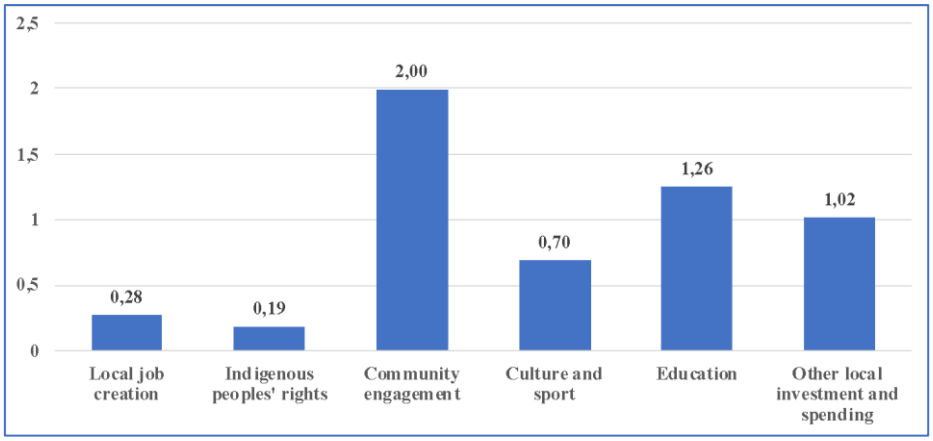

Figure 5. The average number of community actions
Source: The authors

On average, companies applying the GRI standard perform more actions than the others (Figure 6). The most significant difference is observed in the Education criterion, followed by Community engagement.

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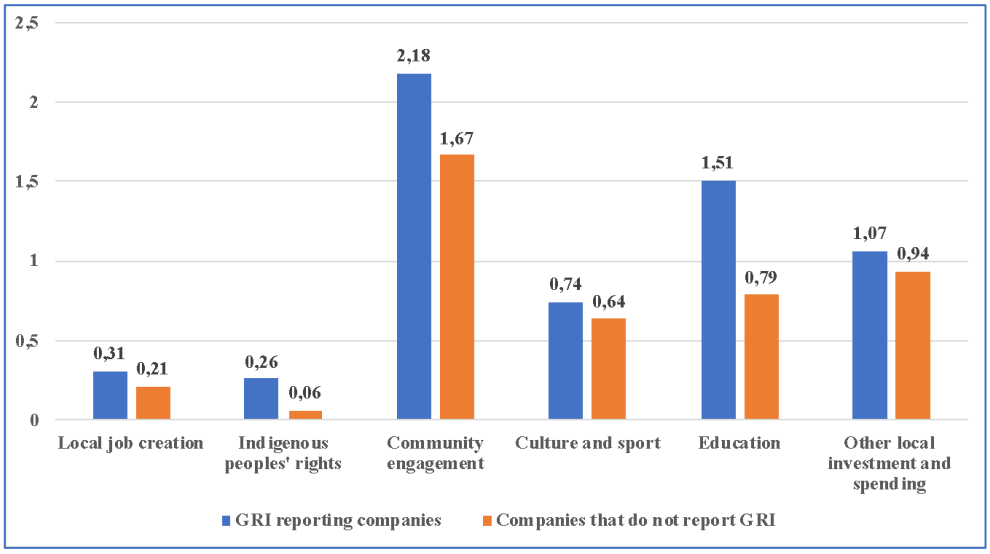

Figure 6. The average number of community actions, according to whether they report following the GRI standard or not
Source: The authors

Figure 7 highlights the prominence of Community engagement, where the Industrial sector performs an average of almost three actions. The other sectors also achieve the highest number of actions in this field. Conversely, companies hardly carry out activities related to Indigenous people's rights and Local job creation. More specifically, companies in the Transport, infrastructure and tourism sectors do not perform any activity in those fields.

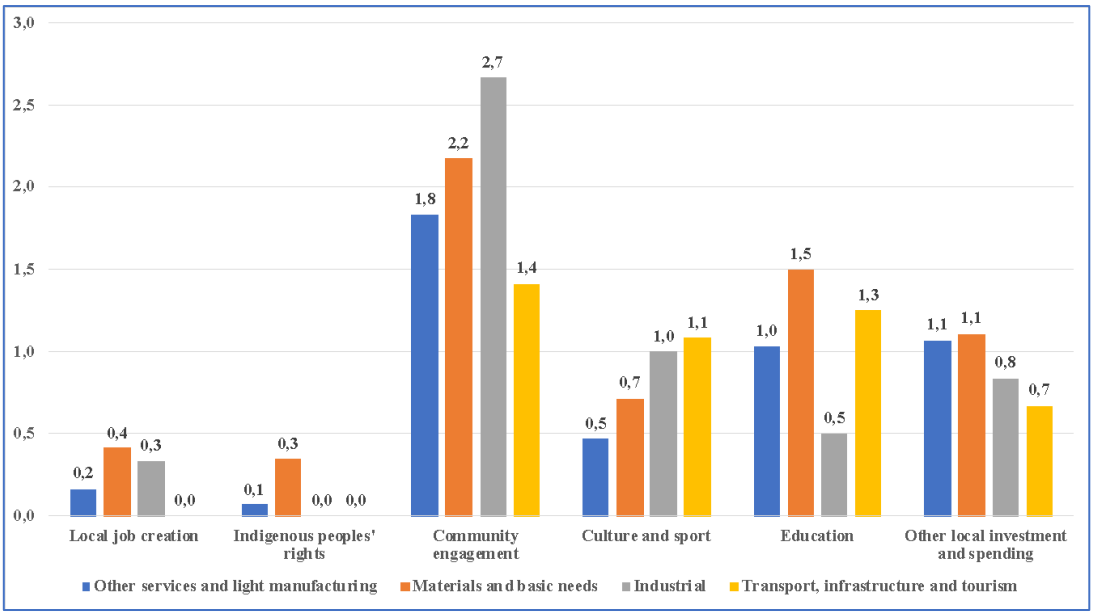

Figure 7. The average number of community actions by sector of activity
Source: The authors

As per the parent company, companies with headquarters located abroad carry out more actions on average than those in Chile. The companies with offices located abroad outperform local companies in four out of six criteria, producing approximately twice as many actions (Figure 8).

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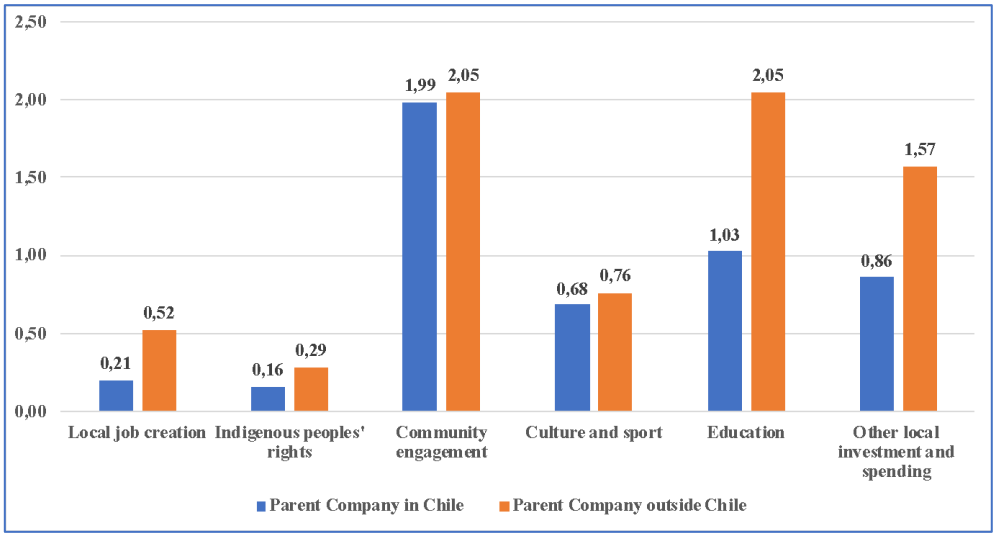

Figure 8. The average number of community actions by location of the parent company of the business conglomerate.
Source: The authors

Once we have analysed the concerns and actions undertaken by the companies in the different areas of the community category, it is relevant to check the degree of coherence shown by the companies. In other words, whether there is concordance between the degree of concern expressed and the actions carried out. The inconsistency could indicate an intention of bluewashing on the part of the companies.

In general, companies perform more actions in those areas where they have expressed greater concern and vice versa. There are no significant changes in this behaviour when considering differences between companies regarding their use of the GRI standard, their sector or the parent company's location. This means that companies will likely refrain from bluewashing in community-related aspects.

4.2. Analysis of concern for Human resources

In contrast to the community category, all criteria in the Human resources category show a level of concern above 60% (Figure 9). It is noteworthy the 31 p.p. of difference between Gender equity and Pay equity.

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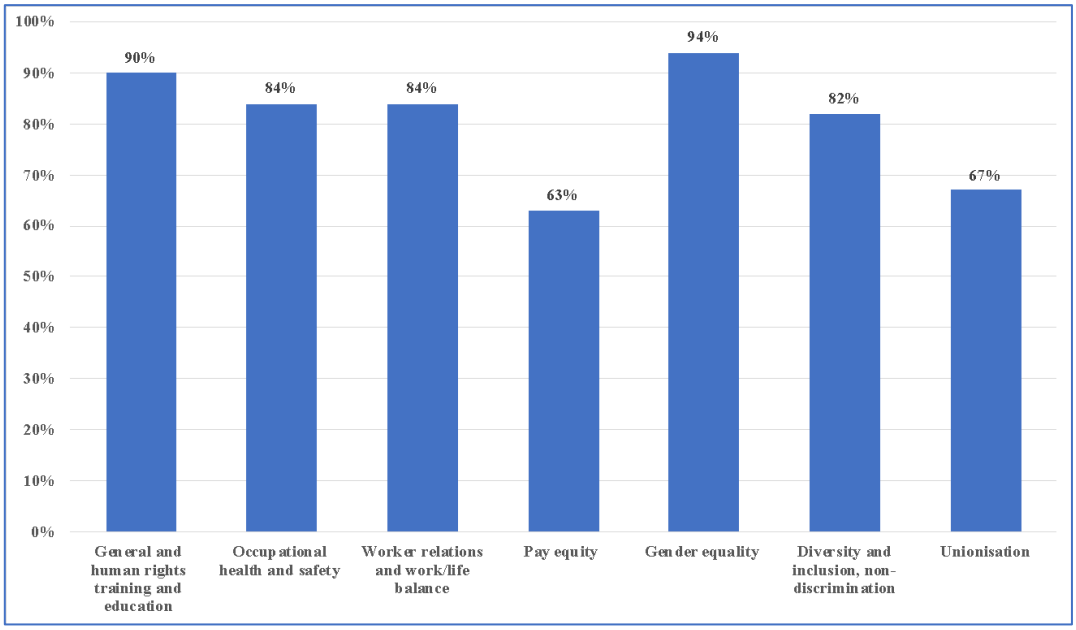

Figure 9. Percentage of companies showing concern for human resources
Source: The authors

Companies reporting applying GRI standards show more concern across all criteria than companies that do not adhere to GRI standards. Among the former, the requirements of least concern are Pay equality at 64% and trade Unionisation at 67%. Companies that do not adhere to GRI standards do not reach 80% concern, except for Gender equality, which is 85% (Figure 10). The largest difference (34 p.p.) is in Unionization.

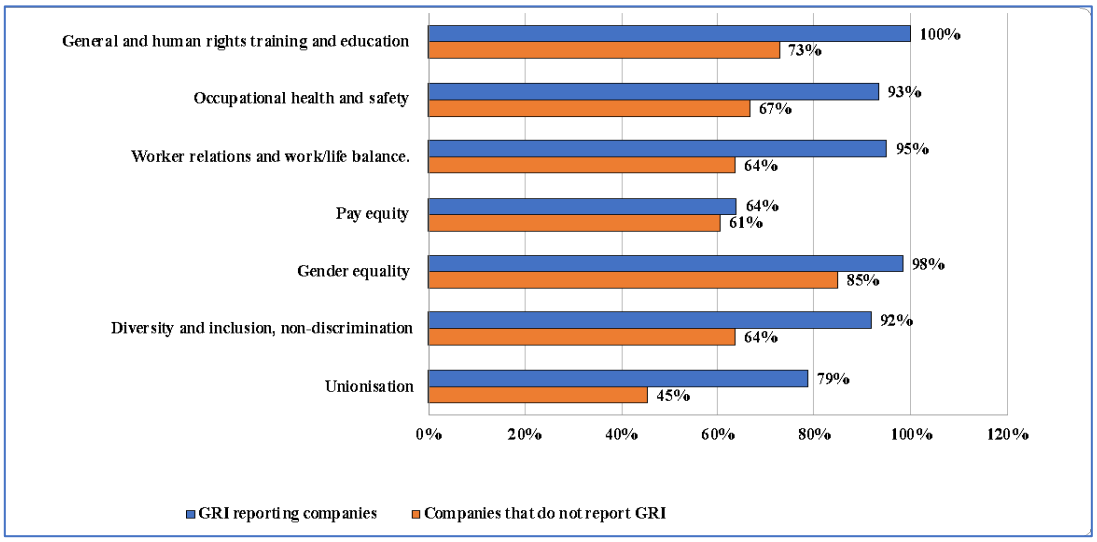

Figure 10. Percentage of companies showing concern for human resources, according to whether they report following the GRI standard or not.
Source: The authors

According to Figure 11, all four sectors show concern for every criterion of the human resources category, and there is no difference in the level of concern across sectors. Diversity and inclusion, non-discrimination, and unionisation show the most significant variations.

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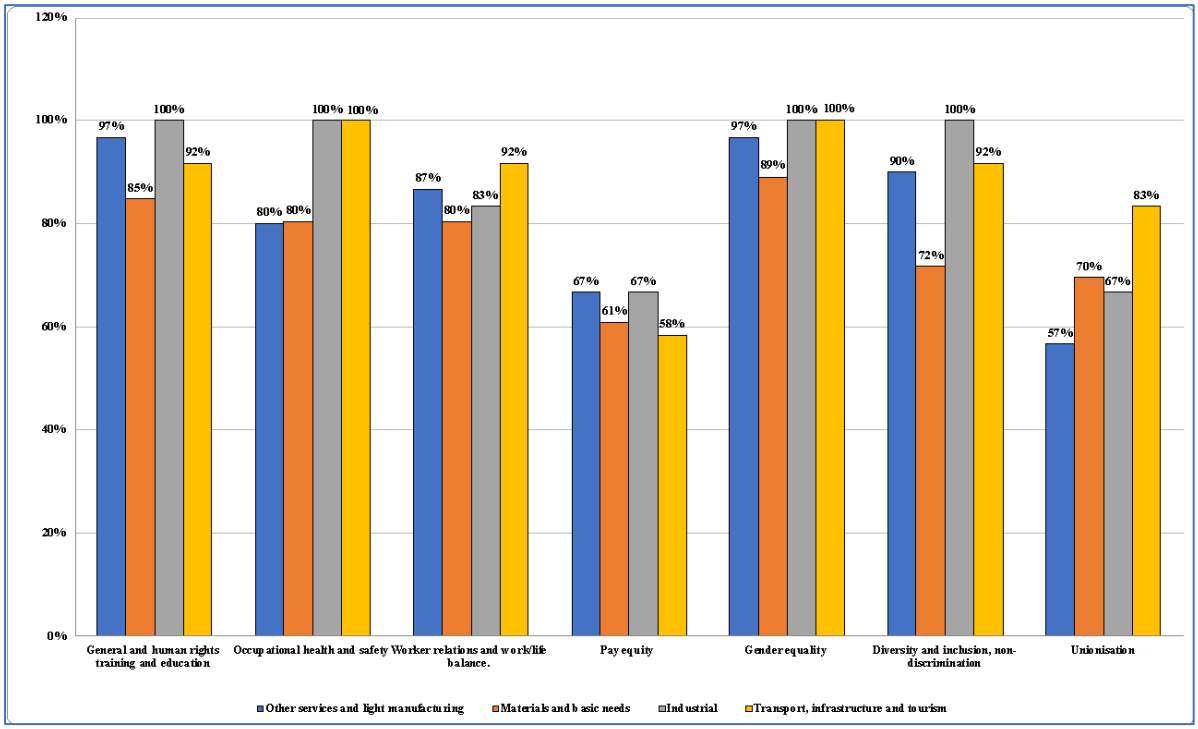

Figure 11. Percentage of companies showing concern for human resources by sector of activity
Source: The authors

Overall, companies headquartered in Chile demonstrate a greater focus on human resources concerns. This is particularly evident with regard to Pay equity, with a significant 38 p.p. difference compared with companies headquartered overseas (Figure 12). While among companies headquartered in Chile, the highest difference in concern is equal to 28 p.p. (observed between Gender equality and unionisation); among companies headquartered outside Chile, the most significant difference in concern is equal to 62 p.p. (observed between Occupational health and safety and Pay equity).

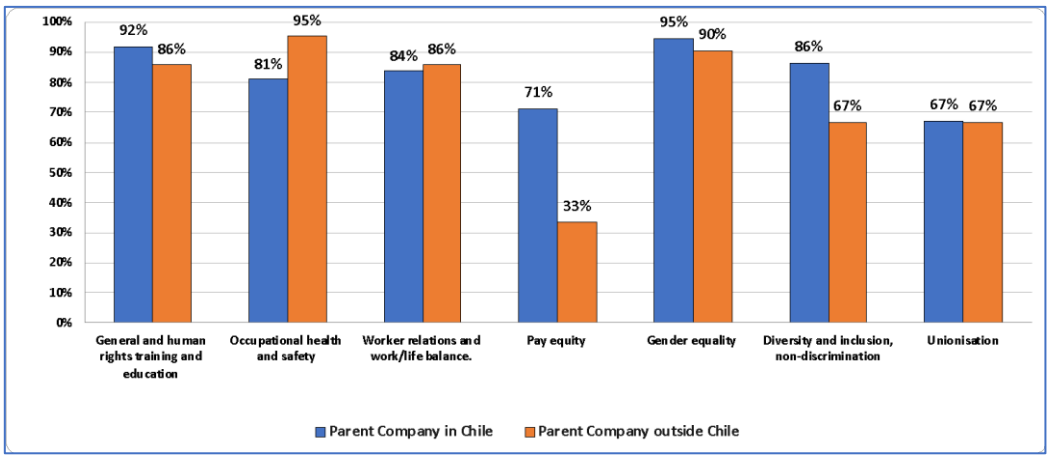

Figure 12. Percentage of companies showing concern for human resources by location of the parent company of the business conglomerate
Source: The authors

Concerning the number of actions carried out by the companies, Gender equity and Pay equity are the criteria where the least actions are observed (Figure 13). General and proper human training and education are the only ones with actions above the average of the other criteria.

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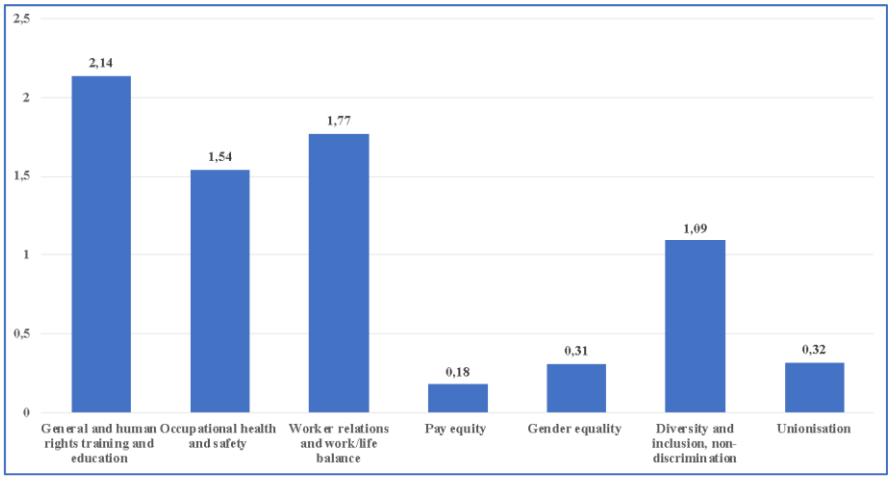

Figure 13. Average number of actions in human resources
Source: The authors

Figure 14 shows companies that adhere to the GRI standard generally duplicate the actions of those that do not report. Companies that do not adhere carry out only a few actions in terms of equity, encompassing both salary and gender.

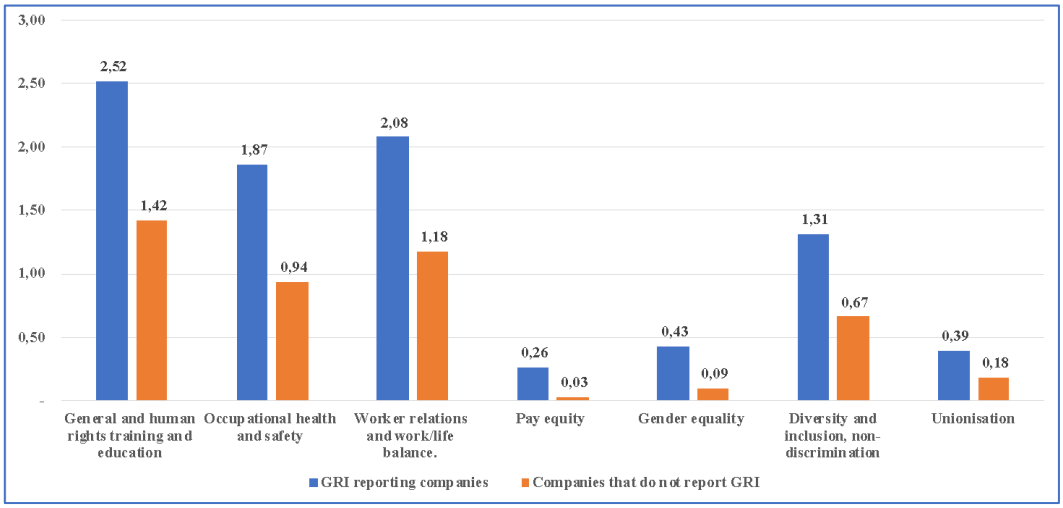

Figure 14. Average number of human resources actions, according to whether they report following the GRI standard or not
Source: The authors

Figure 15 displays the number of actions that companies implement according to their operational sector. The highest number of actions is observed for the Industrial sector in the Occupational Health and Safety criteria. Notably, the sector of Other Services and Light Manufacturing has the highest number of actions for the criteria of Diversity, Inclusion and Non-discrimination, and General and Human Rights, Training and Education, compared to the other sectors.

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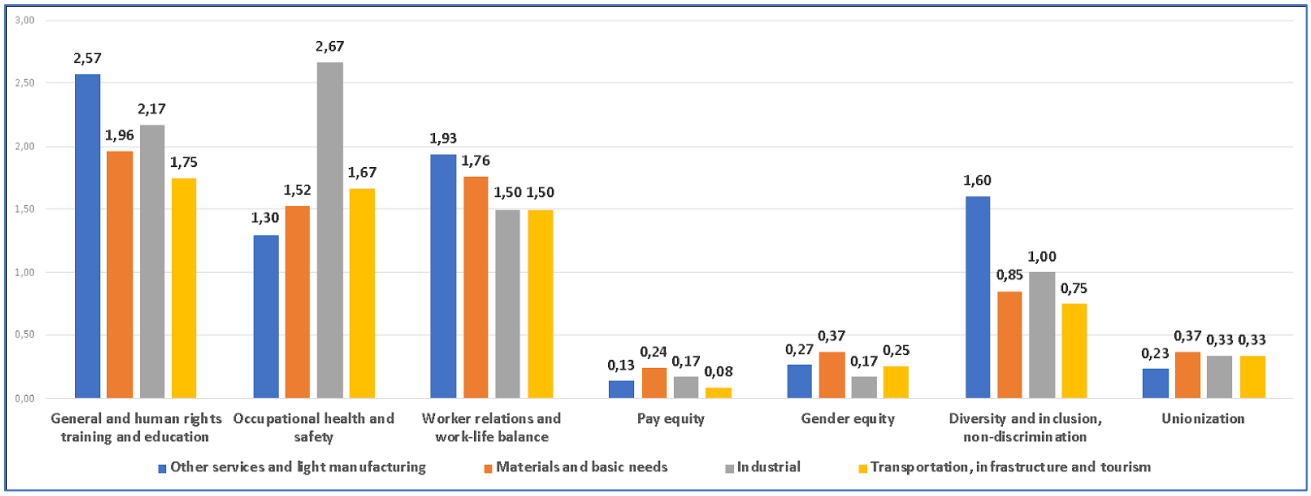

Figure 15. Average number of actions in human resources by sector of activity
Source: The authors

There are no notable variations in the number of actions by companies depending on the location of the head of the business (Figure 16). As in earlier analyses, the areas of Pay equity, Gender equity, and Unionisation represent those with the lowest number of actions taken. The mean number of actions undertaken in these areas is less than 1.

For companies headquartered outside Chile and those headquartered in Chile, the most significant difference is observed between General and human rights training and education as the most concern and Pay equity as the slightest concern.

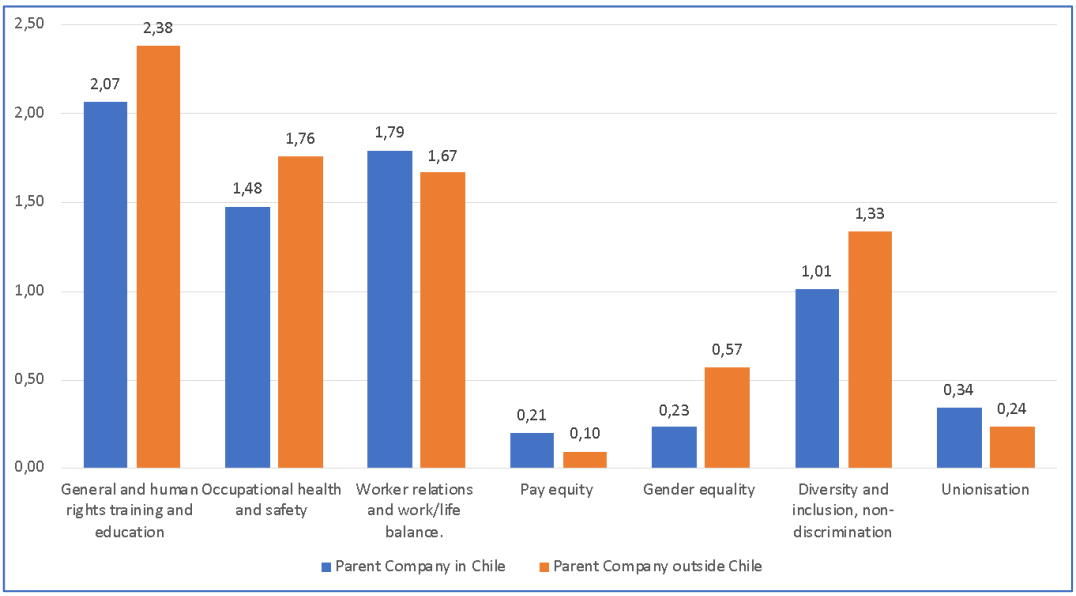

Figure 16. Average number of human resources actions by location of the parent company of the business conglomerate
Source: The authors

Once we have analysed the concerns and actions undertaken by the companies in the different areas of the human resources category, it is relevant to check the degree of coherence shown by the companies.

In general, most companies express concern in all the criteria of the human resource category. However, this is different in terms of the actions carried out. This is evident in the criteria Pay equity, Gender equity and

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unionisation. Notably, 94% of the companies show concern about Gender equality, but only one out of three implement an action.

There are no significant changes in this behaviour when considering differences between companies regarding their use of the GRI standard, their sector or the parent company's location. This could be an indicator that companies are bluewashing in the area of human resources.

4.3. Suppliers, product and customer analysis

In the suppliers, products, and customers analysis, more companies are concerned about controlling and dealing with suppliers (92%). Very few companies are worried about product labelling (Figure 17).

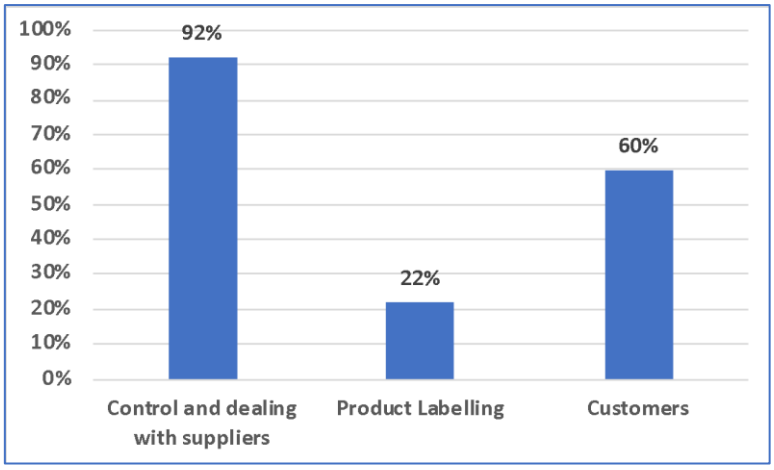

Figure 17. Percentage of companies showing suppliers, product and customer concerns
Source: The authors

The disparities between companies that adhere to the GRI standard and those that do not are significantly more marked within this category than in the community and the human resources categories. The most significant difference exists in Control and dealing with suppliers (Figure 18).

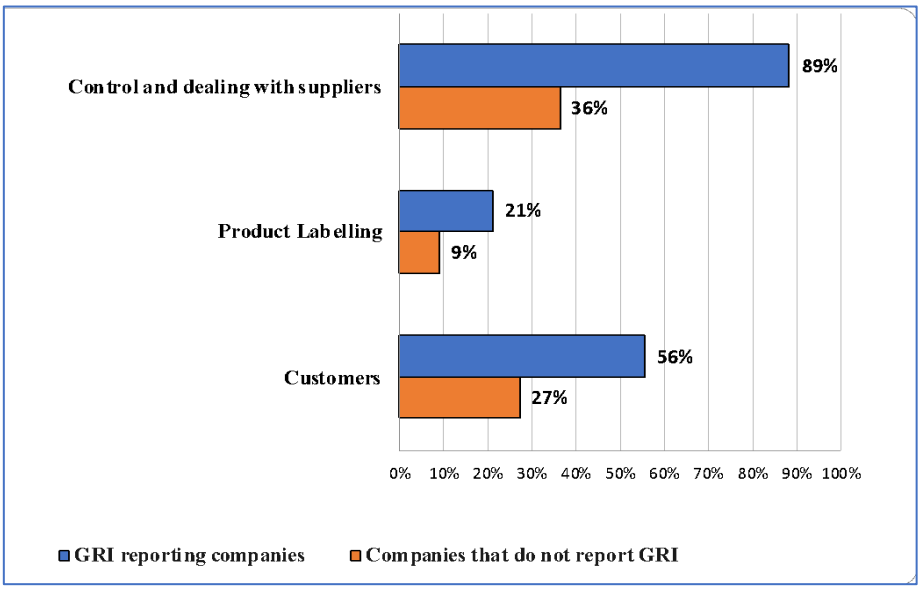

Figure 18. Percentage of companies showing suppliers, products and customers concerns, according to whether they report following the GRI standard.
Source: The authors

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In the analysis by sector of activity, we can observe that many companies from all sectors are concerned about Control and dealing with suppliers. It should be noted that the Industrial sector shows a low level of companies that care about Customers, unlike other sectors (Figure 19).

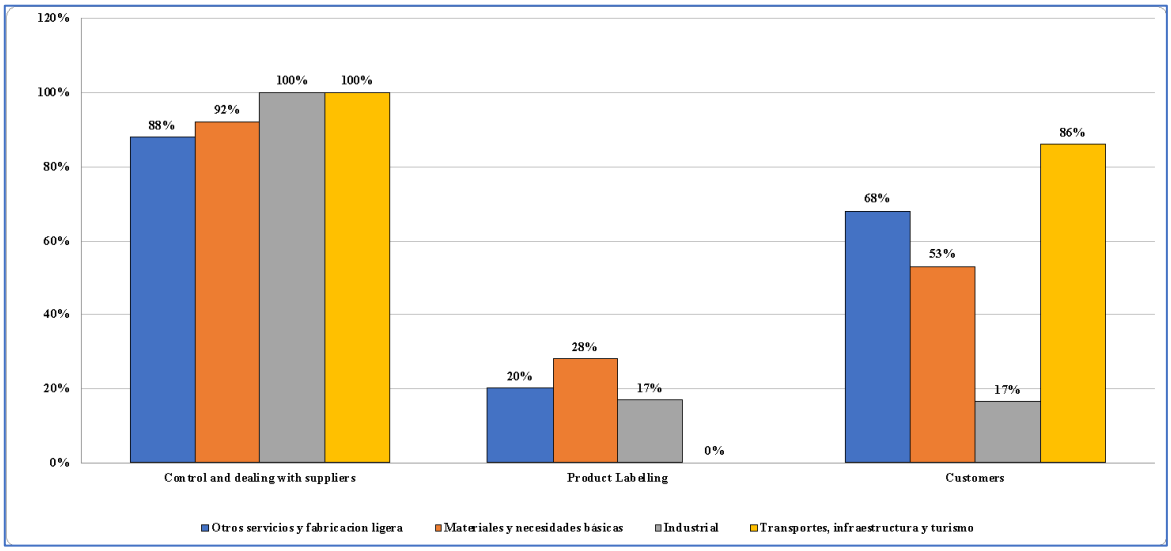

Figure 19. Percentage of companies showing concern for suppliers, products and customers by sector of activity.
Source: The authors

Companies headquartered outside of Chile are much less concerned about Customers than Companies headquartered in Chile (42% and 66%, respectively).

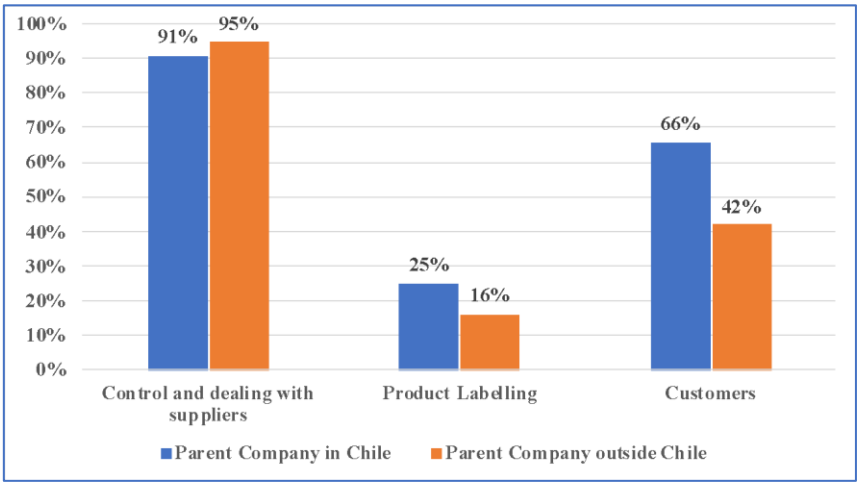

Figure 20. Percentage of companies showing suppliers, product and customer concern by location of the parent company of the business conglomerate
Source: The authors

Regarding the actions of the examined companies for the suppliers, products and customers categories, the average actions do not exceed one action in any of the criteria (Figure 21).

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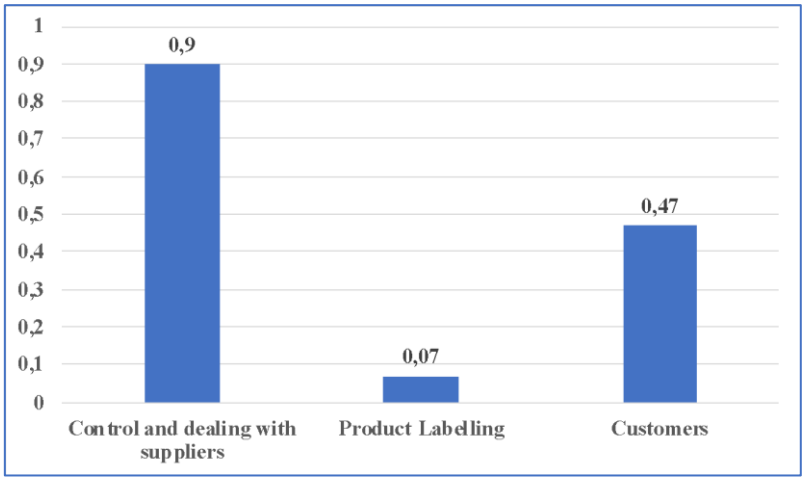

Figure 21. Average actions in suppliers, products and customers
Source: The authors

In the case of companies reporting GRI indicators, a higher average number of actions is performed compared to those that do not report, particularly for Control and dealing with suppliers (Figure 22).

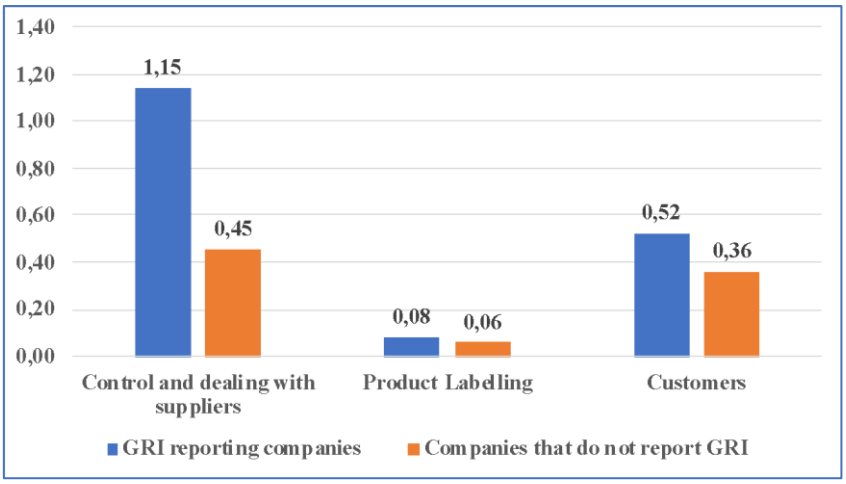

Figure 22. Average number of actions in suppliers, products and customers, according to whether they report following the GRI standard.
Source: The authors

In terms of the activity sector, Figure 23 highlights that Transport, infrastructure, and tourism companies, on average, performed fewer actions than the other sectors. Only on the Control and dealing with suppliers criterion do the four sectors take action.

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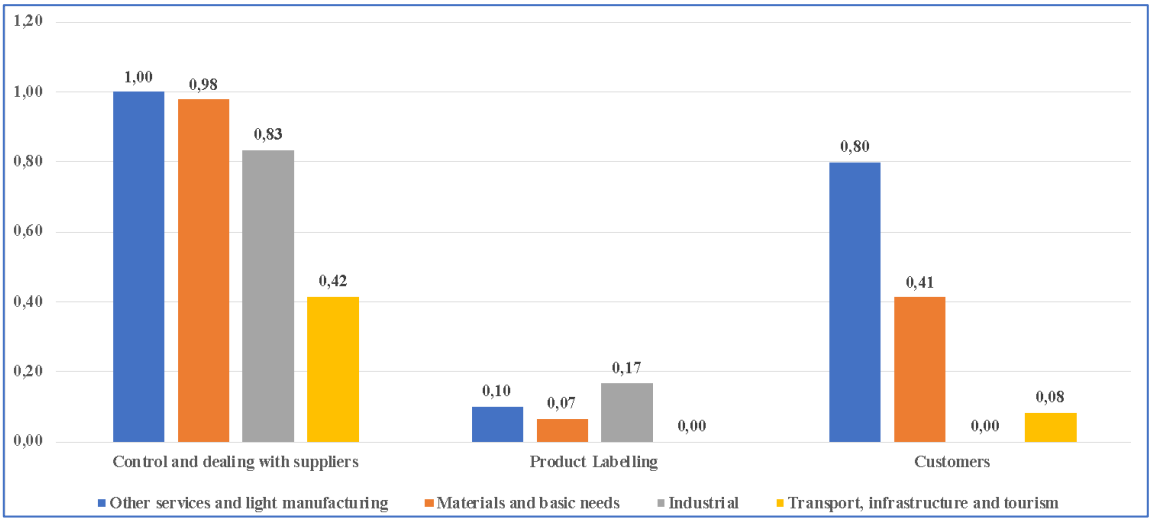

Figure 23. The average number of actions in suppliers, products and customers by sector of activity
Source: The authors

The number of actions performed displays no significant differences based on the parent company's location, as shown in Figure 24.

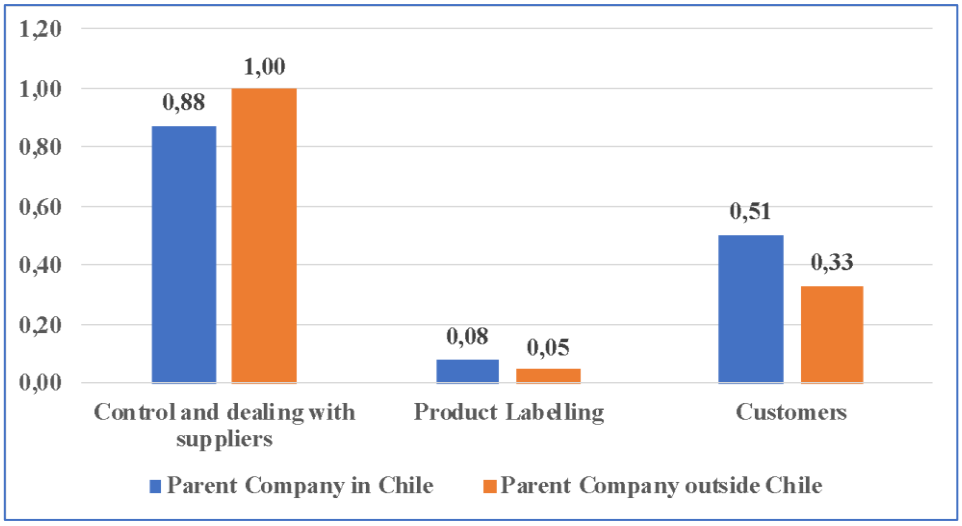

Figure 24. The average number of actions on suppliers, products and customers by location of the parent company of the business conglomerate
Source: The authors

Once we have analysed the concerns and actions undertaken by the companies in the different areas of the suppliers, products and customers category, it is relevant to check the degree of coherence shown by the companies.

In general, companies perform more actions in those areas where they have expressed greater concern and vice versa. There are no significant changes in this behaviour when considering differences between companies in terms of their use of the GRI standard, their sector or the parent company's location. Companies are unlikely to be bluewashing in suppliers, product and customer-related aspects.

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Conclusions

Companies' communication of environmentally and socially responsible activities is crucial for achieving a competitive edge and enhancing stakeholder relationships. It also serves as a pivotal aspect in improving corporate image and reputation; thus, companies should consider it when devising their overall strategy. Some companies have integrated sustainability aspects into their reporting to increase their credibility despite failing to fulfil their sustainability commitments. This is achieved through various communication strategies that enhance the legitimacy of practices. There is a large amount of sustainability research on environmental performance and the impact of communicating environmentally friendly actions, but more research needs to be done regarding social aspects.

This study examines the contrast between what companies claim to be concerned about and their actions in the social realm. This contrast could be used as a proxy to identify bluewashing behaviour by firms. To this end, we analyse the sustainability reports of 94 companies operating in Chile and isolate what companies state they care about and their actions in three social categories: Community, Human resources, Suppliers, products and customers. For each category, different criteria are employed based on the GRI standard.

The companies analysed express concern mainly in the human resources category rather than the community and suppliers, products and customers, with the latter category attracting the slightest interest. Companies that adhere to GRI standards show more concern than those that do not apply GRI standards. Companies belonging to foreign business groups exhibit greater concern than local ones. No significant differences are observed when analysing the behaviour of companies in the different sectors.

When the actions performed by the companies are studied, results indicate that most actions are made in the Human resources category, followed by those in the Community category and, finally, in the Suppliers, product and customers category. This is the same structure as found for the concerns expressed. Again, companies that adhere to the GRI standard carry out more actions than those that do not adhere. Chilean companies carry out fewer actions than foreign companies, although they expressed the least concerns. In the analysis by sector, there is no difference in behaviour in any of the categories.

Regarding bluewashing, most companies express concern about all criteria in the Human resources category. However, the high level of concern is backed by only a few company actions. In some cases (Gender equality and Pay equality), the actions undertaken are relatively scarce. This is indicative of companies' bluewashing. In the Community and Suppliers, product and customers categories, companies take more action in those areas where they have expressed more significant concern and vice versa. Companies will likely avoid bluewashing on community, suppliers, and product and customer aspects. This behaviour is the same when considering differences between companies regarding their use of the GRI standard, their sector or the parent company's location.

Notably, our study reveals that many companies claim that they are deeply concerned regarding community, human resources and suppliers, product and customer issues despite taking limited actions in these fields. This could be identified as bluewashing, a phenomenon in which companies attempt to legitimise themselves in the eyes of their stakeholders

This paper is a pioneer in the study of bluewashing, a topic that has received little attention in academia but deserves more research, in our opinion. This work may serve as an initial step towards developing a standard definition and appropriate methodology for measuring the extent to which companies engage in bluewashing.
The study's limitations are related to the number of sustainability reports accessed, which restricted the database used. In fact, the analisis is restricted to big companies operating in Chile. Studying a larger number of companies from different countries may reveal bluewashing practices that warrant further investigation. Finally, it solely focuses on public information provided by the companies. Future studies should compare what companies disclose in their sustainability reports with the opinions and perceptions of their stakeholders.

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SUSTAINABLE COMMUNICATION AS A MARKETING ELEMENT

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Abstract. Sustainable communication refers to any communication related to corporate social responsibility, considering economic, social, and environmental concerns and the interests of all stakeholders. The fact that media culture has become a dominant force of socialization is discussed in the article. The other point here is that at the beginning of the twentieth century, there were about 3500 manor houses in the territory of present-day Lithuania. Currently, only about 600 of them have survived. The description of the communicative strategies that some of the manors apply, such as by Paliesius manor, can prompt far-reaching conclusions. The general idea of the article is that castles and estates located in priority areas of the country's tourist attraction can be decisive in promoting the nation's heritage, tradition, and culture. The strongest precondition for this influence can be the part of programming that those heritage objects undertake.

Keywords: manor; culture; communication; sustainability; public interaction; territorial marketing; end-product for visitor

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1. Introduction

The manor (curia) was first mentioned in Lithuania in the middle of the 13th century. It was both the residence of Lithuanian ruler Mindaugas and the economic and administrative centre where the tributes of the surrounding settlements were collected. The spread of estates (network) directly expressed the monarch's power and his trustees residing in them. In the 13th century, these estates were likely rarely spread over the territory of the ruler's domain, and their structure (both material and social) still needed to be more robust; the state of Lithuania was forming, and the manor was one of the first signs of the existence of the state. Later sources allow us to talk about Lithuania's denser network of castles and estates. The sources clearly distinguish the castle from the manor. This proves that not every manor could be a castle simultaneously. In the 14th century, the estates of the Lithuanian nobility were described by the term *yard*. The courts of the nobility were less developed than the castles and estates of the Grand Duke. These latter ones were clear reflections of power and status. The manor was served by different groups of people and services scattered around. The courts of the nobility also had a group of subordinate people (captive

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people). The nobleman's court expanded its structure and, over time, "copied" the model of the lord's manor, turning it into a manor, both an administrative and economic, as well as a representative and social structure.

Part of the cultural treasures accumulated in the estates during the mid-17th century, in 1812, during and after World War I and World War II were destroyed, a part of the Russian authorities left after the uprisings of 1830-1831 and 1863-1864, and another part of the movable cultural property was taken by the landlords themselves to Poland and other countries, and the rest were turned into state institutions (museums, archives, libraries). During the liquidation of the estates by the Soviet authorities in 1940–1941, the cultural assets were nationalized. Curretly such objects are protected wordwide (Ortiz & de Madariaga, 2021).

The article's authors will look at the communication techniques that manors (estates) could apply today to spread the word about the manors globally.

2. Literature review

2.1. Communication and culture communication concept analysis

Currently, communication sciences recognize several meanings of communication and have many definitions of communication. All this reveals that the perception of communication is different. Communication is defined as the exchange of informational signs. It is a process whose purpose is to share information, feelings, and thought contents with the exchange of information. Communication is always directed to someone else – to the listener, and it is always an interaction between two – the speaker and the listener. Communication can evoke emotions. Hermawati et al. (2022) mention that business and marketing practices are based solely on rational and emotional considerations. According to Hermawati et al. (2022), if we take finance business at a sensible level, someone is trying to achieve financial gain alone rather than considering whether a company is conducted according to, let us say, religious laws. Marketing is based on the power of logic and scientific concepts. In contrast, at the emotional level, marketing uses human feelings; at this level, empathy, the ability of marketers to understand the emotions and feelings of customers, is essential.

Malik et al. (2021) state that in scientific literature, three aspects measure communication: formality, informality, and willingness to communicate. According to Malik et al. (2021), proper communication includes meetings, document sharing, etc., and barriers between team members still need to eliminate this form of communication. On the other hand, with the help of informal communication, people get to know each other's culture, habits, and skills. Company communication can be divided into two types: internal and external. Internal communication provides an opportunity to carry out and coordinate formal tasks. External communication occurs by forming public opinion, responding to user letters (requests, complaints, claims, etc.), advertising, placing orders, and exchanging information. Thus, effective external communication forms a positive image of an organization.

Țigan et al. (2021) consider that communication can be (1) intrapersonal communication (with self); (2) interpersonal (with others); (3) metacommunication or what is communicated to interlocutors through gestures, facial expressions, and voice intonation, body posture, clothing, etc. According to Țigan et al. (2021), the status in any community is always influenced by an individual's ability to share emotionally. This can be translated into positive outcomes depending on the social, personal, and professional status.

Brinia et al. (2022) argue that communication, as a concept, has attracted the interest of scientists from various fields of science. It can have different interpretations and definitions depending on the approach taken. According to Brinia et al. (2022), communication is a form of interaction where various messages are transmitted or exchanged. Different technical definitions of communication in the literature describe communication as an interactive process between at least two people - the sender and receiver. This interactive process shows that communication is a dynamic and ever-changing process.

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Primožič et al. (2022) mention that communication strategies are a powerful tool to influence people and raise awareness. According to Primožič et al. (2022), when it comes to sustainability, this is especially important because it requires a change in people's perception to achieve the much-needed sustainability-oriented society. Therefore, it is necessary to change human actions and day-to-day operations in all areas.

Modern communication tools help businesses achieve good results. In recent years, technological skills and the need for communication skills have grown the most. Through creativity, the proper channels, specialized content, and a transparent system, modern technologies and communication tools can become tools that create added value for business. Ahokangas et al. (2021) mention that modern communication networks, including 5G, are the basis of the digitization of our entire society. According to Ahokangas et al. (2021), mobile networks are increasingly virtualized and become multifaceted service platforms that facilitate context-, location- and customer-specific communication, offering tailored to the needs and content services to meet diverse and localized end-user and vertical needs. Georgiou (2020) argues that new types of assessment, incorporating multimodal and digital elements, are increasingly being used to assess university students' "soft skills", such as communication and science content knowledge. According to Georgiou (2020), more is needed to know whether and how such products evaluate communicative elements, especially when these elements are so closely related to disciplinary knowledge.

Tjøstheim et al. (2020) state that communication is the transfer of information from the sender to the receiver, whose purpose is to reproduce the message as accurately as possible on the receiver side. As Tjøstheim et al. (2020) understand, successful communication, according to this classical view, is the lossless transmission of information from the sender to the receiver's mind, where the concept of information is derived from semantics and pragmatics - that is, from the meaning of vocabulary words and the way these words are used in the ongoing social interaction of intentional actors.

Munodawafa (2008) mentions that communication requires a complete understanding of the sender and receiver behaviour and potential obstacles that may exist. According to Munodawafa (2008), there are challenges in developing the source of what needs to be communicated because it is a prerequisite for program success. Communications (i.e., messages) often come from professionals or the government and are ignored by intended beneficiaries.

Dincer et al. (2022) argue that the term “sustainable communication” refers to any communication related to corporate social responsibility, considering economic, social and, on the one hand, environmental concerns and the interests of all stakeholders. According to Dincer et al. (2022), the abundance of definitions and confusing names of this type highlighted three common meanings of sustainable communication in practice, "responsible communication", "ecological design of communication products", and "communication about sustainable development".

According to van Ruler (2018), mass communication theories focus on communication as a one-way process in which a sender does something to one or more receivers. However, the identity of this subject remains a matter of debate. Some theories have considered communication as a diffusion process, a flow of information in which the sender spreads the message to the receivers, revealing its meaning in this message.

Sharma (2017) states that communication is the art of creating and sharing ideas, and the richness of those ideas makes the communication process efficient. It is a communication process that enables us to communicate with others; we wouldn't do it without him being able to share knowledge or experience with other people. It is the verbal and non-verbal communication of information and understanding between the sender and receiver.

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Kirtiklis (2008) thinks that communication theory seeks to accumulate and structure knowledge about communication and, based on it, to explain and predict specific cases of communication, while the philosophy of communication aims to understand the role of communication in the social life of individuals, to determine general communication principles and general communication research guidelines, to solve the emerging methodological problems of communication science.

Marketing communications provide tools that influence the user's decision a little more. Nowadays, you must stand out if you want to have a user. Otherwise, you will be overshadowed by other, more noticeable alternatives. Therefore, it is essential to attract users. So, attracting him becomes the primary goal. It is necessary to take a purposeful action plan and make thoughtful and rational decisions that would be effective and lead to the desired goal. Integrated marketing communication is one of the ways to reach the consumer's attention and thus attract the buyer to use the relevant product or service.

Pruskus (2015) assumes that communication and knowledge management, the main functions of marketing, are closely related to information. On the other hand, communication and news management can also be used to persuade citizens. These two elements – informing and persuading – belong to the public relations activity.

Černevičiūtė et al. (2009) notice that the communicative potential of culture has grown and formed together with the processes of globalization: networks of global culture include the concepts of worldwide society and the world order, models, and methods of organizing social life, etc. According to Černevičiūtė et al. (2009), today, we can observe that there is an emerging media culture that is replacing "high culture", and the attention to the art provided by a famous cultural centre affects many more people. Media culture becomes a dominant force of socialization, creating new patterns of identification, resonance style, fashion, and behaviour images.

Juzefovič (2011) examines how other concepts of beauty and creative communication are formed and why this issue is still relevant for today's aesthetics and communication theory, highlighting the reception of ideas developed in ancient philosophy reflected by current phenomenological philosophy.

As Gudonienė (2013) considers, culture includes certain distinctive human activities. Although different theories provide different definitions of culture, they have a feature which is in common for everybody – the recognition that culture includes knowledge, faith (religion), arts, morals, law, customs, and other abilities, which a person acquires as a member of a specific society in one particular historical period.

Rudokas (2013) suggests that since the 1960s, knowledge has been one of the growing paradigms of society; this happened due to postmodernity, which influenced the situation that public relations are no longer a department of any organization instead – public relations are carried out in a networked structure that public (self) organizes their communication instead of the organization's activities.

Chen et al. (2023) say that trade in cultural products within international cultural communication effectively weakens cultural distance. According to Chen et al. (2023), cultural exchange can strengthen cultural identity, build bilateral trust, and create a trade effect. Still, on the other hand, bilateral cultural differences in the expansion of trade markets force the strengthening of international cultural communication and further reduce barriers dealing with the impact of cultural differences on export trade.

Janavičienė (2009) argues the role of cultural events in the most popular cultural communication measures. According to Janavičienė (2009), within real-time events, direct contact is established between the communicators of cultural values and the consumers of culture, whilst information is directly exchanged, and cultural perception is formed or corrected instantly. What form of the traditional or non-traditional event would be presented to the public

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is not particularly relevant. The event must transmit the message (information) to be received favourably, and meet the needs of those receiving that message, which would be understandably conveyed.

Charapan (2018) reveals how cultural communication creates various visiting scenarios for ethnographic museums. Concepts of the open air as a cultural heritage site, natural park and recreational site are trendy in modernity. Research findings can be relevant for cultural strategy developers and communication specialists forming open-air ethnographic museums as communicators and cultural, recreational and educational policy builders.

2.2. Dissemination of knowledge of the heritage of manors

Spreading knowledge of national heritage, it is essential to undertake the preservation and revitalization of family manors as a part of territorial marketing. The state supports specific projects from the state budget, provided they have historical value. The rules for the partial financing of the projects disseminating and revitalizing the immovable cultural heritage with state budget funds are regulated by the procedure for the organization of the tender for partial financing provided by the Department of Cultural Heritage under the Ministry of Culture, including the principles of project evaluation, applications for partial financing of these projects with funds from the state budget procedure for submitting, considering, allocating state budget funds and accounting for their use.

According to the rules for the partial financing of projects of immovable cultural heritage with state budget funds, partial financing can be awarded to (Minister of Culture of the Republic of Lithuania, 2023):
1. Events, artistic and cultural activities, audio, video, information tools, and online projects (except for creating websites) promote tangible cultural heritage protection, revitalization, knowledge, and dissemination.
2. International cooperation and exchange projects: regional cooperation, European cultural routes of the Council of Europe, initiatives of the European Commission's European Heritage Label.
3. Projects that actualize Lithuanian immovable cultural heritage values are included in the UNESCO World Heritage List and contribute to capacity building, competence development, and implementation of volunteering programs in the areas of immovable cultural heritage.
4. Disseminate information about the immovable cultural heritage of Lithuania, including dissemination using information technologies.
5. Publishing: educational, cognitive-informative, scientific-informative, comprehensive publications, scientific studies, monographs, unique professional literature with a volume of at least three pages, 120,000 printing characters (including spaces);
6. Certified “Lithuanian cultural road” projects.
In 2023, 90 applications were submitted for the competition for dissemination and revitalization (publishing) of knowledge of immovable cultural heritage, out of which three applications did not meet the requirements of administrative verification and were not considered, whereas 54 projects were partially financed, the amount of 197,000 euros was allocated for the implementation of knowledge and dissemination projects.

2.3. Manor culture communication as a part of territorial marketing

The promotion of tourist destinations is an essential part of territorial marketing. The main task of promotion is to interest consumers in a tourist area before visiting it directly. Currently, this area of research is of increased interest not only among theorists but also among practitioners. The tendency to study the features of the promotion of regional tourism products is primarily a consequence of changes in the tourism industry. According to the authors, among the main ones, the following can be identified:

- An increase in the number of tourist destinations and, consequently, an increase in competition between them.
- The rapid development of media carriers and information dissemination channels has increased information saturation within the tourism industry.

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- The emergence of several new tourist destinations (the so-called sending countries), whose representatives actively travel.

The reasons listed above for the increased interest in the topic of tourism promotion territories give rise not only to strengthening competition in the tourism industry but also new opportunities in disseminating information about the regional tourism product, attracting the interest of travellers, and, in ultimately making more profit due to increased tourist flow.
The key ones, according to the authors, are the following features as
- the nature of the very product (of tourism).
- the multicomponent nature of a tourist destination and the resulting features of financing marketing activities.
- features of each specific region.

Thus, the authors set the following goal-based strategies based on existing concepts and features of the tourist destination to form a program for promoting the destination (manor).

The cornerstone for the strategies is set in the working papers of the World Tourism Organization. "UNWTO: marketing and promotion plan" aims to strategically position the country as a tourist destination and identify tourist models and priority sources, markets, and segments. The algorithm of actions posted on the official website assumes the formation of a detailed marketing and advertising plan for the tourism industry considering the quality and quantity of tourist products, diversity of domestic, regional, and international source markets, image and positioning, branding, quality, and distribution of advertising materials (including e-marketing) and institutional marketing mechanisms added by promotion, including public-private partnerships.

Presented by the World Tourism Organization, the methodology includes several points:
- Review and evaluate the current quality and standards of the country's tourism product, such as existing and potential, from the point of view of its diversity (natural, cultural, or recreational).
- Analyze past and present tourism development scenarios in the country, conduct several visitor surveys in crucial locations, and assess the country's current domestic, regional, and international image as a tourist destination.
- Develop profiles of short-term, medium-term, and long-term perspective destination markets (tourist supply markets) and segments of these markets that can be attracted to the country.
- Determine quality and estimate the cost of current marketing and advertising programs in the country, including promotional materials produced, distribution channels, and electronic marketing methods.
- Review the existing institutional structure for country marketing as a tourist destination and identify and recommend organizational changes necessary to implement effective marketing strategy involving a robust public-private partnership.
- Prepare a medium- and long-term marketing strategy, including recommendations for branding at destinations and identification of financial and technical resources necessary for implementation strategies. The General Marketing Strategy includes a detailed short-term marketing and advertising program for the first five years, indicating activities, goals, and cost estimates on an annual basis.

The plan proposed by the WTO provides a detailed marketing concept. This algorithm of actions includes the study of not only the regional tourism product and past and current marketing programs but also an institutional base, profile and goal setting of clients and the current image of the territory. However, sometimes, the significant determining aspect of the strategy becomes the location's macro- and microenvironment.

2. 4. On the protection of manor homesteads

On October 24, 2023, The Manor Forum was held at the Presidency of the Republic of Lithuania, during which the main parties responsible for the situation of Lithuanian estates met incorporated representatives of state institutions and municipalities, heritage protection specialists and the owners and managers of the estates (see vkpk.lt). The

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participants analyzed both the most urgent emerging problems and future opportunities. The hope has been expressed that such an event would stimulate the necessary changes, fundamentally improving the condition of all Lithuanian estates. The proposals of the Heritage Commission were systematized on December 16 2022, and the decision “On the protection of manor homesteads" was made.

There are 484 manor homesteads in the Register of Cultural Values and about 70 homesteads where buildings no longer exist. Solitary since 2014, 46 objects under legal protection have been cancelled.

There needs to be more systematic scientific research on the need for differentiated protection of manor houses. There is an underestimation of the importance of information accumulation, preservation and archiving, the suspension of projects that are significant for the dissemination of the heritage of manor houses, such as the Lithuanian manor database and the Lithuanian manor house atlas.

Estate managers and owners often lack legal and managerial knowledge. Since the heritage objects often depend on grants, the administration needs to be well-trained in public policy to avoid political manipulations and bureaucracy.

The susceptible problem of the integrity of manor homestead complexes when the homestead belongs to several owners – as many as 74 per cent of all manor homesteads in Lithuania – was touched upon. The order and legal regulation of the sale and rental processes are unfavourable for the protection of manor homesteads; the lack of competencies and professional training of specialists in cultural heritage institutions, which are already lacking, so the problem will become even more acute in the future, were discussed. The problem of objects of exceptional cultural value or those on the verge of extinction in 2005 was accentuated. Another sensitive problem was the inefficiency of the list of homesteads of non-privatized estates.

2.5. The existing research on the issue

How to organize communication in manors properly? What are the strengths and weaknesses in the current communicative tools promoting manors? What factors can play a vital act in promoting a nation's heritage, tradition, and culture?

1. To monitor how the heritage property is responding to the public needs and expectations of its local community”,
2. To examine the impact of immovable memory on regional development.
3. To envision the opportunities, issues, and threats and inactivate the image as an object of the cultural heritage.
4. To undertake qualitative research, supported by field research on the topic, and produce the research records.
5. To publicize the outcomes of the study while developing prospects for future decisions (Ščiglienė, Kuizinienė et al., 2017).

The most critical issue in modern communication of the estates is their role in territorial tourism.
The paper offers several recommendations on how to redevelop the communicative message of the estates:
-Event congruence (annual events)
-continuity of the calendar
-site-specific heritage services: culinary heritage, crafts and other services
-a high-level amusement
-state-of-the-art housing and catering services
- excursions and other interactive means
- a good rapport with the media

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3. Research methodology

The authors' research investigates the methods and peculiarities of studying manor culture communication as a marketing element.
Objectives of the research:
- to describe the concept, benefits, and role of communication and culture of manors and estates.
- to summarize the dissemination of knowledge on the heritage of manors and manor culture communication as a part of territorial marketing.
- to apply the case study method relating it to the manors of M.K. Oginsky "Northern Athens" in Byelorussia to the well-preserved and animated manor of Paliesius in Lithuania.

The article uses theoretical analysis and case study analysis methods. Cultural case studies are used as a reliable research strategy while looking for successful marketing solutions.

Article structure: The article consists of an introduction, theoretical part, research part, discussion, and conclusions. The introduction describes the topic's relevance, problem, purpose, research, tasks, methods, and methodology. The theoretical part (2) describes the communication and culture communication concept, summarizing the dissemination of knowledge of the heritage of manors and manor culture communication as a part of territorial marketing. Part 3 of the article analyzes research methodology. Part 4 analyses the case study method relating it to the Byelorussian M.K. Oginsky manor "Northern Athens - the estate of the famous creator of the Polonaises and the Paliesius manor in Lithuania."

The input to this study is to develop theoretical and empirical arguments about the case study method, relating it to the manors acting as specific cultural hubs in the area.

4. Case studies' analysis

4.1. Case study of the M.K. Oginsky manor

One of the attractive ways to draw public attention to the tourist site is a celebrity. This type of manor is dedicated to a real persona who lived on the site. The village of Zalesye, incomparable to any other, in the Smorgon district of the Grodno region (Byelorussia), owes its name to the estate of Michal Kleofas Oginsky, a great diplomat of the three neighbouring countries.

According to the famous historian of the 19th century, Czesław Jankowski – the peasant settlement on the site of today's village of Zalesye was then called Derby (from the word "to tear"), which means "cleared place". Near Derby, M.K. Oginsky founded another village named "Amélina" in honour of his eldest daughter.

The land ownership of the Oginskys around Zalesye was a whole "key" of surrounding lands with serf villages. In the first half of the 18th century, this large landholding was acquired from the previous owner by Michal Kleofas's great-grandfather, Vitebsk voivode Marcian Michal Oginski (1672-1750). According to his will, Zalesye went to his fourth wife, Tekla Anna Lyarska, after his death. After the death of Lyarska (1765), the owner of Zalesye became Tadeusz Oginski (1712-1783), son of Marcian Michal from his first marriage, castellan, and later voivode Troksky (of Trakai), a grandfather of Michal Kleofas. Uncle Franciszek Xavier intended to bequeath all his property to his nephew, Michal Kleofas Oginsky. However, it happened so that Michal Kleofas had the chance to become his heir only 12 years later, having lived all these years as the guardian of his elderly uncle.

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On April 28, 1802, M.K. Oginsky, having received the imperial decision of Alexander I to become the guardian of the elderly Franciszek Xavier, returned from St. Petersburg to Lithuania and settled in one of his uncle's estates – Zalesye near Smorgon.

The estate of Frantiszek Xavier was a wooden manor house built in the first half of the 18th century, added by a farmyard, a wooden mill, a brewery, a garden, and a vegetable bed. A pond was dug behind the house. The Zalesye estate also included a transport facility on the Viliya River, three taverns, meadows in the floodplains, the Olenets forest and a brick factory on the Belaya River. Not far from the estate was an ancient wooden Orthodox Church of St. George the Victorious, as no church was nearby.

Almost immediately after arriving in Zalesye, Mikhail Kleofas began the construction of a new stone palace next to the old one. He accepted the architectural project of Vilna University architecture professor Michal Schulz for implementation. The construction was carried out under the supervision of the Vilnius architect Jozef Pousse. The palace of Michal Kleofas received a look previously unseen in the construction of aristocratic residences: it consisted of two one-story wings elongated at right angles, between which and at the ends of which there were two-story pavilions. The primary wing, with columns, was 50 m long, and the side wing and the greenhouse were 160 m long. This elongated wing was presented in the famous engraving "Zalesye in Lithuania. 1822" by Oginsky's young secretary Leonard Khodko.

The construction of the palace was completed by 1815. The architectural style in which the palace was built corresponded to the canons of Classicism. In addition, the entire building was erected almost without a foundation. The central part of the palace was marked by a portico of four Tuscan columns and was crowned with a small turret in which a striking clock was placed, with dials and arrows on all four sides. A ball was attached above the tower, and a unique bell chimed the time.

Further, the historian Jankowski describes in detail all the manor and park buildings, their beauty, and admiration for the nature of Zalesye, allowing us to visually imagine the view of 'Northern Athens', the estate of the famous creator of the Polonaises.

The Zalesye estate received the sublime name 'Northern Athens' from his contemporaries because it is a centre of social and political affairs discussed here, new musical and literary works listened to, and live musical festivals organized.

Along with the outbreak of World War II and the annexation of Western Byelarus to the BSSR, all owners of the Zalesye estate left it. In 1939-1941, in the Oginski palace, there was a spa for the residents of Minsk. After the end of the war, the spa resumed its activities. In 1961, it was converted into a nursing home. In 1977, the territory of the estate and the palace were transferred to the balance of the Smorgon silicate plant, which meant nationalization, planning to create a sanatorium here for its employees. At this time, the plant even ordered the restoration of the estate and its adaptation to a dispensary. Still, the project was not implemented due to a lack of financial resources.

The successful revival of the Zalesye estate can only be imagined with the daily detailed work of the leadership of the Smorgon district organizations. Without exception, they all pay significant attention to preserving Zalesye's historical heritage. Thanks to them, reviving the estate and historical memory became a priority, and a constant search has been carried out for the most successful solutions and close cooperation with the relevant state and cultural institutions.

Since 2014, the state historical and cultural institution "Museum-Estate of M.K. Oginsky" has been in the composer's palace, and since September 2015, there has been a permanent museum exhibition. The article's author

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had visited the estate and, with her students, staged a performance in Vilnius Academy of Arts, dedicated to Oginsky's (1765 – 1833) 250th anniversary.

In 1996, the estate of M.K. Oginsky became a branch of the State Museum of the History of Belarusian Literature. On September 25, 2014, the official opening of the museum estate of M.K. Oginsky took place, and a year later, on the composer's 250th anniversary, the current museum exhibition opened.
Contents and Programming

The museum offers the following items on display:
-The exposition of the museum estate of M. K. Oginski is represented by 13 halls, in which its visitors can get acquainted with the life and work of the talented composer and statesman Michal Kleofas Oginski and become imbued with the spirit of 'Northern Athens'.
-The "Music of Oginsky" hall might interest guests of the estate with musical instruments of the 19th century and allow them to plunge into the harmonious atmosphere that reigned in this estate during Oginsky's life.
-In the "Fireplace Hall", visitors could see a gallery of portraits of the Oginsky family, and the exhibition "The Bureau of M. K. Oginsky" tells the story of the state activities of the famous politician and diplomat Oginsky.
-Exposition of the hall "Greenhouse. Temporary exhibitions" demonstrates the variety of exotic plants of the tropics and subtropics that grew on the Oginsky estate in the 19th century and introduces visitors to artists' works.
-The Coffee House is the composer's famous summer dining room, where he often received guests. Now, there is a coffee shop in this greenhouse

Among the foremost collections of the museum, the following items are in the funds:
-Old printed editions (Memoirs of M. K. Oginsky)
-Musical instruments (zither, 19th century violin)
-Printed publications (19th-century books by Oginski's secretary Leonard Khodko)
-Items from the history of technology (barometer, floor clock, mantel clock of the 19th century)

The main directions of scientific research in the museum are:
The museum-estate of M.K. Oginsky conducts scientific research on the topics: "Descendants of M.K. Oginsky", "Traditions of education in the Oginsky family", "Northern Athens - the centre of culture", "Oginsky - politician and statesman", "Architectural heritage of the family of princes Oginsky", "Patron Michal Kleofas Oginsky", etc. The international scientific and practical conference "M. K. Oginsky in the culture of three nations" is held here. The Oginsky Estate Museum actively participates in regional and local seminars dedicated to the theme of the famous composer's heritage.

Services for visitors:

- Sightseeing tours of the museum and park
- Theatrical excursions
- Museum classes and lectures
- Organization of classical music concerts
- Holding balls (for adults and children)
- Solemn registration of marriage ceremonies
- Hotel and coffee shop services
- Traditional holidays: the festival "Zalesye Invites Friends" on the first weekend of August (timed to coincide with the name day of M.K. Oginsky's wife, Maria Neri), "Visiting Michal" (September 25 - ceremonial events on the composer's birthday). The estate museum is ready to accept excursion groups (up to 25 people).

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4.2. Case study of the Paliesius Manor

The best example of what has been said earlier is the Paliesius mansion in Lithuania. Paliesius manor dates back to the 17th century, when Count Tyzenhaus bought a manor here, and there was a sauna and tavern at the Kanchiogina stream. With its unique landscape and mysterious diversity, nature itself whispered the name of the area: those near the forest, "in the woods" (the word comes from Slavic languages). This is how the Paliesius area was born, and Paliesius manor became its centre. In 1671, historical documents mentioned the owners of the Paliesius manor, the Tyzenhauses (see Paliesius manor, n.d).

Over the years, as the owners of the manor changed, so did the manor itself. The 19th century is considered a period of prosperity for the manor. Since 1736, the manor belonged to the Kublicki family of Livonian government officials (Livonian cupbearers Justina and Kazimieras Petras Kublicki), who were related to the Soltan nobles of the LDK. During the reign of the Kublickis in the 19th century, a residential house with stables, now called the manager's (econom's) house, was built. An unusual semi-circular barn was built next to it, connected to the residential house by a closed yard. Only later, an unsophisticated brick-plastered residential building - a palace - was erected, to which the owners moved.

There was a chapel, a freezer house (ice room), and a representative courtyard park near this building. The fact that there was no rush to build a residential building indicates that the Kublickis cared more about the farm than expected. This is also confirmed by the letters of the painter Vincent Smakauskas, written to his wife Emilija Kublickaite, in which they mention that the Kublicki brother's farm in a modern way, has the latest equipment, the farm is large and tidy, and the manor library is rich. Also, in 1779, the Kublicki funded the construction of the Mielagėnai church. Paliesius Manor was even more important than the town of Mielagėnai and was a major centre of the prosperity of the Lithuanian economy and the spread of culture; just at that time, the entire ensemble of Paliesius Manor was formed. Besides, the brothers Stanislovas and Adolfas Kublickis were active in 1831. Organizers and participants of the uprising in the Užneris County were forced to leave for Prussia after the rebellion.

Vincentas Smakauskas, who painted the famous “Steponas Batoras Founding the University of Vilnius”, also lived in the estate. The Mielagėnai church is decorated with magnificent paintings painted by him “St. Mathew the Evangelist”, “St. Mark the Evangelist”, “St. Luke the Evangelist”, “St. John the Evangelist”, the high altar is decorated with his painting “St. John the Baptist”, in the presbytery – “Jesus Christ Crucified”. In 1838, he created the magnificent St. Peter and St. Paul's stucco sculptures and a memorial plaque in the presbytery - Kublicki's busts.

During the mid-19th century and mid-20th century, the estate survived the fall. In 1887 Paliesius manor was bought from auctions by Lyubimov, around 1900. Mrs. Povarova took over the manor after becoming its administrator. The latter sold the estate to Major General von Ekse, after whose death Maria Dmitrievna von Ekse's widow sold the estate's lands, and what remained was pledged to the Vilnius Land Bank. In 1921, Romualdas Bržezinskis became the manor's owner, but before World War II, when this part of Lithuania entered the territory of Belarus, the manor was nationalized. From 1940, after nationalization, the manor went to the Cirkliškis collective farm. During the Soviet years, the water mill and other manor buildings were destroyed, and the property was looted. It should be noted that in 1956, the manor house, although in poor condition, was still standing. In 1974, by the collective farm's decision, permission was given to demolish it.

When the manor reconstruction began, one main goal was creating health improvement and complex tourism services. So now, on the foundations found at the northern entrance to the manor, a wooden building has been built, which houses the Paliesius cardiac and exercise therapy clinic. Only here, where the magical nature of Paliesius itself invites you to return to it and heal, did it become possible to establish an exclusive clinic whose primary treatment method was bodily work.

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The treatment is based on the specialized and evidence-based experience of treating patients with this method at the Mayo Clinic in the United States. It has also been proven that the best therapeutic effect is achieved when clinical practice is used in a holistic environment. Therefore, Paliesius applies specialized clinical practice and a holistic principle connecting body treatment, life education and positive emotions. The sound of chamber music stimulates positive emotions, nature and history-remembering walls invite you to learn to live, and the body is treated with individualized clinical programs. In 2019, Paliesius Manor won the "Most Attractive European Health Tourism Destinations 2019" award in Lithuania.

In 2015, The Restorers' Union of the Republic of Lithuania awarded Paliesius Manor with the competition's winner diploma for the best restoration works - for implementing new methodological solutions in the management functions and the complexity and innovativeness of the restoration. The revival of the economist's house, which has become luxurious, will pleasantly surprise those staying here for the night. Instead of the former barn, a real object of cultural attraction appeared - the horseshoe-shaped concert hall, which was appreciated by representatives of the world classical Olympus, who chose this space for their recordings due to the sensations when you can feel every emotion of the performers, as well as the uniquely created acoustics was reborn. There are legends that because of the acoustics of the hall, classical music celebrities bypass even the halls of the capital city Vilnius and, on purpose, come to perform concerts only at the Paliesius Manor.

There is a shop in 'Ledaune' where you can find various rare products and goods. And when you go down, the wine cellar awaits you with 200 types of selected French wines - public and private tastings are held here. Instead of former barns, the plinth floor of the economist building now houses a restaurant and a mini spa with restored columns. They grow a garden next to it with flowers and herbs used to decorate and flavour their meals. Bread, buns, and cakes are baked in the bakery according to authentic recipes.

The territory is surrounded by an original outdoor boulder fence - not made of brick but uniquely put together. At the entrance to the manor, an oval parterre has been restored, and pedestrian paths, outdoor lighting, and a parking lot have been installed. The cellars in the former house of the estate owner Mr. Kublicki, built in the 19th century, have finally been opened. The outdoor terrace invites guests to enjoy a rest, a cup of tea or coffee in the summer.

In the park of the old manor, there are maples, ash trees, poplars, and linden trees that are several hundred years old. The decoration of the park is the protected botanical natural heritage object, the 25 m high Paliesius oak. Also, a fountain of naturally gushing waters, the sculpture of which was created by the Finnish sculptor Jari Mannisto, stands here. Constantly gurgling water like a picture frames a living work of nature - Paliesius Manor Park.

The park invites you to walk with its comfortable surface for walking paths - reminiscent of a natural forest path, designed to make movement extremely easy. The walking paths are of different lengths so everyone can choose a distance according to their strength. The total length of the walking paths in the park is about 1,250 meters. When you are tired, you can rest in the park's rest areas.

In the forest near the manor, there are also wellness trails of various distances (2.3 km, 5 km, and 8 km) with signs. You must choose the desired route and overcome it according to the directions or the orientation map. In winter, these trails turn into excellent ski tracks.

Paliesius Manor, faithfully guarding the old secrets within its masonry walls, now offers visitors a wonderful sense of peace, inviting them to take a breather from work, immerse themselves in the world of music and art, escape from civilization, and choose friendship with nature.
The twists and turns of history have changed the life of the manor. Still, now the Paliesius manor, which has preserved the spirit of centuries and has been reborn for another life, emerges again in all its grandeur and reborn history, becoming the centre of a broad-spectrum attraction again. Symbols will accompany you everywhere, be it

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the stones of the buildings that protect the secrets of the centuries, the song of the bird, the dewy grass rustling in the morning, or the cinnamon-scented buns just taken out of the oven, or the music playing. The services offered here are the concert hall "Pasaga" (Horseshoe), accommodation services, restaurant and bakery, recreational services, shop, spaces for leisure, studio, clinic, etc. They say that even world-famous performers may refuse the most prestigious halls of Lithuania in favour of Paliesius Manor for its acoustics and intimacy.

Conclusions

Nowadays, a mansion often is part of the local culture. Social needs define the importance of the manor as a cultural heritage. It also serves as a representative unit presenting a country's historical development, culture, customs, and traditions. The restoration and use of the manor for tourism purposes is strategically beneficial both for the local community and at the national level, as it attracts foreign visitors. Reserving the manor is one of the most sensitive cultural safety issues today. This article examines the integration of tourism into manor life. The influence of communication of the estate as an element of the marketing complex has yet to be widely studied. However, individual publications on the impact of communication have yet to be published. Each manor was influenced by the local environment and created according to a particular purpose or the owners' vision. Although the culture and management of a specific manor differed little from other manors, in principle, all manors are different and require separate research.

The Association of Lithuanian Castles and Estates (2023) mention that thanks to the project "Increasing the awareness of Lithuanian castles and estates using electronic marketing" carried out by the Association, castles and estates located in priority areas of tourist attraction are widely presented as exceptional values, places of interest, protected as cultural heritage in 2019-2020. Castles and mansions of Lithuania are offered in a new and attractive way on the new website, as well as professional visual information and communication in social network spaces. Anyone interested can easily and conveniently access information about the heritage objects to be visited, their uniqueness and their value. To promote Lithuanian heritage and indorse tourism, advertising should be carried out for domestic markets and foreign visitors.

Recommendations

1. Modern means of communication help modern businesses achieve good results. The need for communication skills has grown everywhere during the most recent years. Through creativity, the proper channels, specialized content, and a clear framework, modern technology and communication tools can become instruments that create added value for the hospitality business.
2. The results of the study show that the increased interest in the topic of territorial tourism promotion leads not only to the strengthening of competitiveness in the tourism industry but also to new opportunities to spread information about the tourism product of the region, attract the interest of travellers and finally get more profit thanks to the increased flow of tourists.
3. Complexity of the services offered, including environmental sustainability, stakeholder involvement, attractivity to end-users, adequate socialization and skilful entrepreneurship.
4. The recommendations of previous researchers suggest the following:
- I) the congruent strategy of services and more excellent annual events,
- II) Fill in the calendar so the year can offer activities.
- III) Local and regional culinary heritage, crafts, and other services should be provided.
-VI) A state-of-the-art entertainment is organized.
-V) Quality housing and catering services should be guaranteed,
- VI) excursions and other interactive means should complement the permanent collections; and finally,
-VII) an excellent relationship to the communication channels set up and maintained.

The authors complement the list by the following suggestions:
5. New media should be used (3D, AI, and other techniques) while creating new content.
6. Calendars and maps should become a ready-made product of a manor.
7. A merchandise corner would create more possibilities to distribute knowledge about the site.
8. The local excursions should include Trivia games, competitions, and treasure hunts.
9. Hospitable housing and cuisine should add extra value to the place.
10. Artistic programmes should be the ultimate tool for successful communication.

As Ashworth et al. (2027, p. 207-212) once focused on the 'enduring and complex interrelationships' between heritage, identity and place, the article supports the idea that a place continues to be important in the world and that by promoting manors, we can learn not only how to organize entertainment but also how to reach plurality in the world. Only a complex offer package can become a win-win solution towards sustainable communication of the manors and estates.

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STREAMING AHEAD: TECHNOLOGICAL INNOVATIONS REDEFINING NEW PRODUCT DEVELOPMENT IN THE ENTERTAINMENT INDUSTRY

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Abstract. This article delves into the dynamic intersection of technology and innovation within the streaming industry, offering a comprehensive analysis of the evolving landscape of content creation, delivery, and consumption. By scrutinizing the integration of cutting-edge technologies such as artificial intelligence, augmented and virtual reality, and blockchain, the article elucidates how these innovations are revolutionizing the viewer experience. Additionally, exploring emerging trends, including metaverse integration and the increasing demand for live and interactive content, provides critical insights for industry practitioners. As the industry grapples with content overload and the intricacies of revenue models, this article propounds strategic considerations for navigating the evolving streaming landscape. Ultimately, this comprehensive examination illuminates the future trajectory of the streaming industry and underscores the imperative for innovative adaptation.

Keywords: streaming technology; innovation; content personalization; metaverse integration; monetization models

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1. Introduction

The contemporary landscape of the entertainment industry is in the throes of a profound metamorphosis, propelled by the inexorable convergence of technological prowess and an insatiable consumer appetite for on-demand content developed in recent years (Lambrinos & Demetriou, 2010; Bampis & Bovik, 2018; Sliwa et al., 2021). Central to this paradigm shift is the ascendant dominion of streaming platforms, which have swiftly ascended to the vanguard of content consumption preferences and are leading the entertainment industry (Nguyen et al., 2023). Within this dynamic milieu, the perspective of transformation resides in the rapid evolution of streaming technologies, fundamentally redefining the contours of new product development strategies within the entertainment sector.

The present article thoroughly explores the intricate interplay between technological innovation and the genesis of novel products and services within the streaming industry. As the digital realm extends its pervasive influence, the previous boundaries delineating content dissemination are becoming a subject of history. In their stead, an array of state-of-the-art technologies are heralding an era marked by unparalleled ingenuity,

accessibility, and customization, while the expectations are that the growth projections are even more accentuated (da Silva & Lima, 2022; Tugui et al., 2022).

In seeking to explore this phenomenon, we endeavour to address pivotal ideas about the nature of these technological advancements and their impacts across the strategic landscape of industry stakeholders. What configurations do emergent technologies assume in shaping the expanse of content provisioning, and what ramifications do they portend for the trajectory of new offerings? What sagacity can be gathered from exemplary case studies wherein innovation has propelled streaming platforms to pinnacles of audience engagement (McKenzie et al., 2022; Shon et al., 2021)?

To address these epistemological imperatives, we comprehensively analyse the latest trends in streaming technology. Through a synthesis of knowledge encapsulated in academic treatises, industry dossiers, and exemplar manifestations, we elucidate the transformative potential encapsulated within these technological forays. The streaming technology has been extended on a global scale, with immersive experiences woven by augmented reality and prescient algorithms orchestrating content delivery, the arsenal at the disposal of content creators and disseminators standing as an assemblage of unprecedented diversity and potency (Awa et al., 2013, Wilbert, 2019).

Furthermore, as we navigate this digital frontier, the necessity to apprehend the stratagems imperative to this technological renaissance becomes manifest. How many enterprises efficaciously harness these innovations to not only sustain relevance but also to assume a pole position in steering the course of future entertainment paradigms? This article purports to proffer vital insights and prescriptive counsel for industry practitioners, constituting a compass for navigating this rapidly changing environment and implementing innovative solutions to the market needs (Greenwald, 2014).

In so doing, we underscore the importance of comprehending and leveraging the symbiotic interplay between technology and content creation. By foretelling this synergy, we forge a trajectory toward not merely adaptability, but mastery of the multifaceted landscape wherein the destiny of entertainment is irrevocably inscribed.

2. Literature Review

The contemporary entertainment landscape has undergone a radical transformation, primarily catalyzed by the development of streaming platforms as the dominant medium for content consumption and as the top preference for entertainment (Frade et al., 2021; Wilbert, 2019). In this dynamic milieu, the nexus of innovation, technology, and the development of new products assumes essential significance.

The evolution of technology has indelibly intertwined with shifts in content delivery mechanisms. The high-speed internet and the proliferation of mobile devices have catapulted streaming platforms to the forefront, fundamentally altering the dynamics of content accessibility (Farhand & Tsechpenakis, 2023; Wilbert, 2019). This paradigmatic shift, characterized by democratized access and changed consumer expectations, has dismantled erstwhile barriers to entry, contributing to the expansion of the industry (Darwich et al., 2020; Maia et al., 2015).

The fusion of diverse technological domains has engendered a proliferation of immersive experiences within the streaming ecosystem. In particular, augmented and virtual reality (AR/VR) technologies have emerged as transformative tools, enabling unprecedented levels of viewer engagement (Tingley et al., 2022; Jeon et al., 2020). Simultaneously, the integration of artificial intelligence (AI) and machine learning algorithms has ushered in an era of hyper-personalization, wherein content recommendations are tailored with precision to individual preferences (Mariani et al., 2023; Bahoo et al., 2023; Suárez-Cetrulo et al., 2023).

At the heart of contemporary streaming services lie sophisticated recommendation algorithms underpinned by machine learning and data analytics. These systems play a pivotal role in enhancing user satisfaction and retention, facilitating the promotion of content catalogues that resonate with individual tastes, thereby

augmenting user engagement and allowing users to create their preference lists (Shahraki et al., 2022; Aguiar et al., 2021).

Moreover, the evolution of monetization strategies within the streaming industry has been spurred by technological innovation. Subscription models, advertising-supported platforms, and hybrid approaches have proliferated, reflecting a nuanced response to market dynamics and constantly changing consumer preferences (Wu & Chiu, 2023; Haslam & Forster, 2022). This diversification of models has engendered a complex ecosystem, necessitating astute strategic insight from industry stakeholders.

However, the proliferation of technological innovations is accompanied by challenges and ethical considerations. Issues about data privacy, content moderation, and the ethical deployment of AI algorithms have garnered increasing scrutiny (Mariani et al., 2023; Bahoo et al., 2023). Navigating these ethical quandaries presents a formidable imperative for industry practitioners.

In synthesizing extant literature, it becomes evident that the nexus of innovation, technology, and new product development stands as the pivot upon which the future trajectory of the streaming industry develops. The advent of a digital frontier ushers forth an era not merely of adaptability but of mastery, wherein the destiny of entertainment is irrevocably inscribed.

The streaming area of the entertainment industry is an innovative way of transforming an existing industry. Due to the novelty of the domain, scientific literature finds itself in an initial stage, where the consistency of dedicated materials like articles, conferences or publications is not quite extensive. The industry has recently attracted the interest of business and technology professionals, investors, and academics. Moreover, another gap noticed is that the existent literature is mainly centred on the historical results obtained by the companies within the industry and on the state of the art of the technology; the present article aims to focus on the perspectives for the future and in which direction it will continue to develop.

3. Methodology

The paper aims to delve into the dynamic interplay of technological innovation and new product development within the streaming industry by contouring the perspective of scientific advancements. The main questions to be answered are related to the state-of-the-art technological developments, the innovations that are transforming the industry, and the implications for professionals and industry practitioners, with a focus on the importance of technological evolution and future tendencies.

This study employs a comprehensive mixed-methods approach, combining qualitative and quantitative methodologies to delve into the dynamic interplay of technological innovation and new product development within the streaming industry.

To garner deep-seated insights into the strategies and technologies underpinning new product development, a select group of prominent streaming platforms was purposively chosen for in-depth case study analysis. The criteria for selection encompassed market influence, innovative adoption, and content diversity. In tandem, an extensive archival analysis of company documents, press releases, and user feedback was undertaken to enrich and cross-verify the qualitative findings.

While this study endeavours to provide a comprehensive analysis, it is not devoid of potential limitations. Its focus primarily on English-language streaming platforms may need to be revised to capture the entire expanse of global innovations within the industry. Additionally, findings may be contingent on the specifics of the consumer habits and preferences, circumscribing their universal applicability within the broader streaming landscape.

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4. Technological Innovations Shaping the Streaming Industry

The landscape of the streaming industry has been dynamically moulded by a continuous influx of technological innovations, revolutionizing content delivery and consumption paradigms. These advancements redefine the mode of entertainment dissemination and transmute the essence of modern entertainment itself (Blichfeldt & Faullant, 2021) while investments in technology offer a high return to their stakeholders (Brown et al., 2008).

Augmented Reality (AR) and Virtual Reality (VR) technologies exemplify this transformative wave. AR superimposes digital elements onto the physical world, while VR plunges users into entirely virtual environments. Within the realm of streaming, this translates into epochal experiences where users interact with content in unprecedented fashions. Noteworthy applications include AR-enhanced live sports broadcasts, furnishing real-time statistics and overlays, and VR-driven immersive storytelling experiences that immerse viewers within the narrative world (Felice et al., 2023; Liu & Wang, 2017).

Artificial Intelligence (AI) and Machine Learning (ML) have emerged as pivotal constituents of content recommendation systems. These technologies scrutinize user behaviour, preferences, and viewing history to furnish personalized content suggestions. The ramifications are profound, as viewers are presented with a curated selection aligned with their unique preferences, culminating in heightened engagement and satisfaction. Moreover, AI-driven algorithms optimize video quality and streaming efficiency, ensuring an uninterrupted viewing experience, even under fluctuating network conditions (Liang, 2023; Sutandijoa & Qomariyah, 2023; Shahraki et al., 2022).

The advent of 5G technology marks a monumental step forward in streaming capabilities. Endowed with ultra-high-speed data transmission, reduced latency, and augmented capacity, 5G unleashes many possibilities. Live streaming, for instance, achieves unparalleled interactivity and quality, while the potential for augmented reality experiences undergoes exponential expansion. This shift portends limiting the demarcations between physical and digital domains, announcing a new epoch of immersive entertainment (Fan, 2023; Taleb et al., 2023).

Blockchain technology surfaces as another disruptive force permeating the streaming industry. By furnishing transparent, decentralized ledger systems, blockchain holds the potential to revolutionize content distribution and copyright management. Smart contracts, underpinned by blockchain, might empower content creators to monetize their work directly, increasing flexibility and circumventing traditional intermediaries (Tapscott & Tapscott, 2018).

Additionally, voice and natural language processing loom large on the horizon, poised to redefine the user interface for streaming platforms. Voice-activated controls, synergistically integrated with AI, present an intuitive and seamless means for users to navigate content libraries and explore offerings (Sarmiento-Calisaya & Leite, 2024; Aydogmus et al., 2023).

In summation, the streaming industry stands on the cusp of a technological renaissance, where innovations in AR, VR, AI, 5G, blockchain, and voice technology are redefining the contours of entertainment consumption and interaction.

5. Case Studies

To gain deeper insights into the integration of technological innovations in new product development within the streaming industry, a selection of prominent leading platforms was chosen for detailed case studies. Each platform represents a unique approach to leveraging technology to enhance user experience and expand its content offerings.

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Netflix: AI-Driven Content Recommendations

Netflix, a global leader in the streaming industry, has attached the power of artificial intelligence (AI) to revolutionize the way viewers discover and engage with content. Through a sophisticated machine learning algorithm, Netflix analyzes an extensive array of data points including viewing history, genre preferences, time of day, and user ratings (Netflix, 2023). This data-driven approach enables the platform to deliver highly personalized content recommendations tailored to each subscriber. The algorithm refines its suggestions, continuously adapting to changing viewing habits and preferences.

The core of Netflix's recommendation system lies in its collaborative filtering approach, which compares a user's behaviour and preferences with those of other viewers (Netflix, 2023). By identifying users with similar viewing patterns, the algorithm can recommend titles that align with the individual's taste. Additionally, Netflix incorporates content-based filtering, which analyzes the attributes of shows and movies (such as genre, cast, and director) to make suggestions based on thematic similarities (Fig. 1).

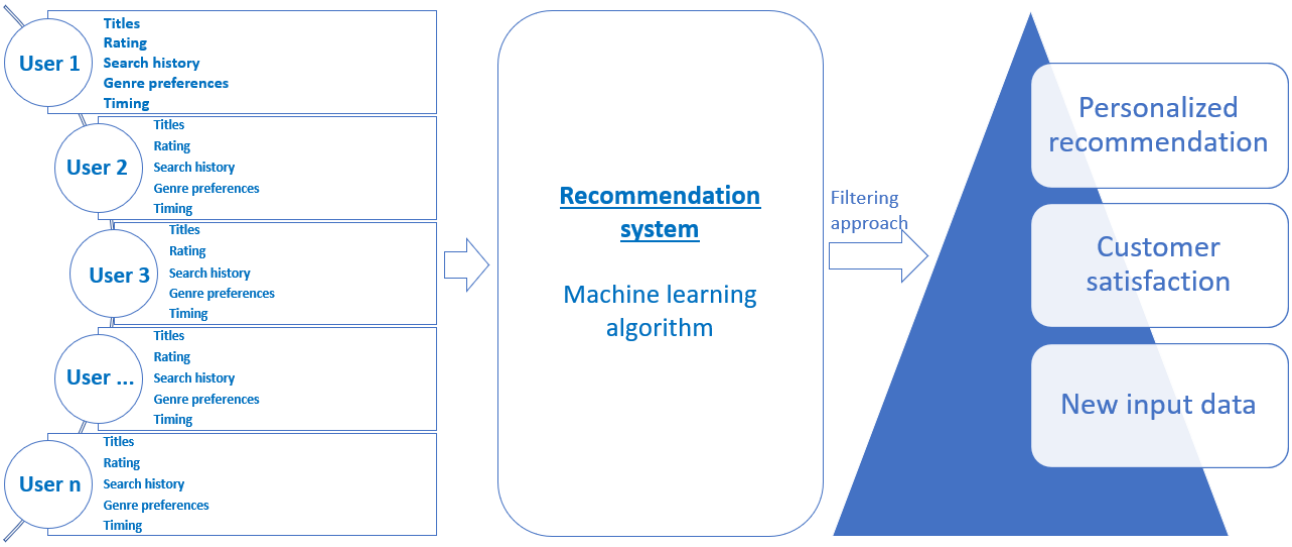

Fig. 1. User recommendations system

This AI-driven recommendation system has proven to be a pivotal factor in user engagement and satisfaction. Studies have shown that a significant portion of content consumed on Netflix results from these personalized recommendations. By tailoring content suggestions to each subscriber, Netflix enhances user experience and contributes to increased engagement (Netflix, 2023). Moreover, this data-driven approach has contributed to Netflix's status as a trendsetter in the industry, setting the standard for how streaming platforms curate and deliver content to their audiences.

In essence, Netflix's AI-driven content recommendation system exemplifies the power of data analytics and machine learning in shaping the future of entertainment consumption. By understanding the unique preferences of each subscriber, Netflix creates a more immersive and satisfying viewing experience, solidifying its position as a frontrunner in the global streaming landscape.

ESPN+: Augmented Reality Integration

ESPN+, a leading sports-centric streaming platform, has distinguished itself by seamlessly integrating augmented reality (AR) technology into its service. A dedicated mobile application gives users access to an enriched sports-watching experience (ESPN, 2023). During live sports events, ESPN+ overlays real-time statistics, player profiles, and interactive elements directly onto the screen. This integration of AR technology transcends traditional sports broadcasts, providing viewers with a wealth of additional information and interactivity.

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The AR integration on ESPN+ enhances the viewing experience and redefines how sports enthusiasts engage with live events. Viewers gain a deeper understanding of the game, player performance, and crucial moments by overlaying statistics and additional insights. This technology caters to avid sports fans and acts as an educational tool, offering a more immersive and informative experience for both casual viewers and dedicated sports enthusiasts.

Furthermore, the integration of AR on ESPN+ sets a new standard for sports streaming platforms, demonstrating the potential for technology to augment how audiences engage with live events (ESPN, 2023). ESPN+ has created a more dynamic and interactive sports-watching experience by providing real-time, contextually relevant information.

In conclusion, ESPN+'s integration of augmented reality technology exemplifies the platform's commitment to providing innovative and immersive sports content. By leveraging AR, ESPN+ enhances viewer engagement, providing a more interactive and informative experience for sports enthusiasts across the globe.

Oculus TV: Virtual Reality Storytelling

Oculus TV, a leading platform specializing in virtual reality (VR) content, has redefined storytelling by immersing subscribers in fully realized virtual worlds. Leveraging VR headsets, users are transported into narrative experiences that transcend conventional viewing (Verhulst, 2021). This groundbreaking approach revolutionizes the way stories are consumed, offering an unparalleled level of immersion and interactivity. Through Oculus TV, subscribers can actively participate in the narrative, influencing the story's direction and creating a profoundly personalized viewing experience.

The innovative VR technology employed by Oculus TV allows for a level of immersion that was previously unimaginable in traditional media formats. Subscribers are not merely passive observers but active participants in the storytelling process. By providing users with agency within the virtual environment, Oculus TV blurs the boundaries between fiction and reality, offering an entirely new form of entertainment (Oculus, 2023). This transformative approach can potentially reshape the future of narrative content, heralding a new era of interactive storytelling.

Oculus TV's pioneering foray into VR-enhanced storytelling has garnered attention not only for its technical prowess but also for its potential to revolutionize the entertainment industry. By offering subscribers the opportunity to step into the narrative, Oculus TV has created a unique and immersive form of entertainment that pushes the boundaries of conventional storytelling (Oculus, 2023). As VR technology advances, Oculus TV stands at the forefront, paving the way for a new generation of interactive and personalized content experiences.

Audius: Blockchain-Powered Content Monetization

Audius, an innovative player in the streaming industry, has harnessed the potential of blockchain technology to revolutionize content distribution and monetization. By integrating smart contracts, Audius empowers content creators to monetize their work directly, sidestepping traditional intermediaries. This transformative approach ensures fair compensation for creators and establishes a transparent and secure ecosystem (Chalmers et al., 2021).

The utilization of blockchain in Audius' platform has far-reaching implications for content creators and the streaming industry as a whole. Audius empowers a new generation of creators to retain greater control over their content and earnings by providing a direct channel for artists to monetise their work. The transparency and security afforded by blockchain technology engender trust between creators and consumers, creating a more equitable and artist-centric streaming platform.

Audius' foray into blockchain-powered content monetization marks a significant advancement in the streaming industry. By embracing the decentralized nature of blockchain, Audius is at the forefront of reshaping how content is distributed and creators are compensated. This innovative approach not only disrupts existing models but also holds the potential to create a more sustainable and inclusive ecosystem for artists and content consumers alike.

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Amazon Alexa-Natural Language Processing Interface
Amazon Alexa, a pioneering voice-activated virtual assistant, has revolutionized human-computer interaction by seamlessly integrating natural language processing (NLP) into its interface. This innovation marks a watershed moment in the evolution of user-friendly technology interfaces. By enabling users to interact with devices and content using voice commands, Amazon Alexa has transcended traditional modes of interaction (Amazon, 2023). Incorporating advanced NLP algorithms empowers Alexa to recognize and interpret user commands and comprehend context, tone, and intent, creating a deeply immersive and intuitive experience.

One of the transformative aspects of Amazon Alexa's NLP interface lies in its ability to understand and respond to natural language commands in real time. Users can engage with their devices conversationally, making the interaction more organic and dynamic. This shift towards natural language interaction has profound implications for accessibility, making technology more inclusive for individuals with limited experience with traditional interfaces. This inclusivity extends to individuals with disabilities, as voice-activated commands can be a game-changer for those with mobility challenges.

Furthermore, integrating NLP into Amazon Alexa has unlocked a new realm of possibilities for automation and personalization. Users can issue complex commands, ask questions, and even engage in multi-step interactions, creating a highly customized experience. The system's ability to learn and adapt to individual preferences and behaviours enhances the user experience, creating a more symbiotic relationship between humans and technology (Amazon, 2023). This personalisation level is convenient and sets the stage for a future where technology seamlessly integrates into our daily lives.

In addition to enhancing accessibility and personalization, the NLP interface in Amazon Alexa has implications for the broader ecosystem of smart homes and Internet of Things (IoT) devices. As more devices become interconnected, the ability to control and interact with them using natural language commands becomes increasingly valuable. This integration facilitates a more cohesive and connected living environment, where devices work in concert to anticipate and fulfil the needs and desires of users (Amazon, 2023). This seamless integration of technology into our living spaces represents a glimpse into the future of smart homes.

In conclusion, Amazon Alexa's NLP interface is a testament to the transformative potential of natural language processing in human-computer interaction. By enabling users to interact with technology conversationally and intuitively, Amazon Alexa has ushered in a new era of accessibility, personalization, and interconnectedness. This innovation augments the user experience and sets the stage for a future where technology seamlessly integrates into every facet of our lives.

6. Implications for Industry Practitioners

Integrating cutting-edge technologies in streaming platforms has far-reaching implications for industry practitioners across various domains. Here, we delineate vital insights and actionable takeaways for professionals in the streaming industry.

Professionals involved in content curation and recommendation systems should closely monitor AI and machine learning advancements. These technologies are instrumental in understanding viewer preferences and behaviour, ultimately leading to more accurate and personalized content recommendations. Embracing AI-driven algorithms can significantly enhance user engagement and satisfaction.

For those responsible for user experience (UX) and interaction design, prioritizing the integration of emerging technologies like AR, VR, and NLP is crucial. These innovations can potentially revolutionize how viewers interact with content, offering immersive and intuitive experiences. Designing interfaces seamlessly incorporating these technologies will be essential in staying at the forefront of user engagement.

Content creators and producers should consider the expanding landscape of VR-enhanced storytelling. Platforms like Oculus TV exemplify the potential for immersive experiences. Exploring narrative techniques

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that leverage VR technology can open new avenues for storytelling, allowing creators to craft content that transcends traditional boundaries and captivates audiences in novel ways.

Professionals involved in monetization and copyright management should closely follow developments in blockchain technology. Platforms like Audius are pioneering the use of blockchain for fairer compensation and transparent copyright management. Understanding and adopting blockchain solutions can revolutionize how creators are compensated and how content rights are managed.

Focusing on scalable and adaptable infrastructures is imperative for those responsible for the technological backbone of streaming platforms. This includes investing in robust backend systems capable of handling the increasing demands of high-quality content delivery. Moreover, ensuring seamless integration of various technologies, from AI algorithms to AR interfaces, is imperative to provide a cohesive and cutting-edge user experience.

These implications underscore the dynamic nature of the streaming industry and the imperative for industry practitioners to remain agile and forward-thinking. Embracing these technological advancements enhances the user experience and positions professionals at the vanguard of an ever-evolving landscape, ultimately driving innovation and shaping the future of streaming entertainment.

7. Future Trends and Challenges

Many pivotal trends are significantly shaping the trajectory of the streaming industry, each exerting its influence on the future landscape. Concurrently, the industry grapples with substantial challenges that necessitate innovative strategies and a fast and dynamic approach to adaptation. The development of the metaverse, an immersive virtual universe, is gaining traction. Streaming platforms are expected to play a pivotal role in developing and applying the metaverse for content consumption, potentially giving rise to novel forms of interactive and social viewing experiences that blur the boundaries between virtual and physical reality.

The demand for live streaming and interactive content is surging. Viewers are increasingly drawn to real-time experiences, from live sports events to interactive gaming streams. Platforms that seamlessly incorporate interactive features, such as live chats, polls, and viewer engagement, are poised to capture a larger market share.

The advancement of AI-driven personalization is set to continue, allowing platforms to fine-tune content curation with greater precision. This encompasses recommendations and the personalization of user interfaces, advertising, and content creation tools.

The widespread adoption of 5G technology will profoundly impact streaming. The higher data speeds and lower latency offered by 5G will facilitate the seamless delivery of high-definition and immersive content, ushering in new possibilities for AR, VR, and other data-intensive experiences.

As streaming platforms expand their global reach, an increased emphasis on content localization is anticipated. This involves not only the translation of content but also a deep understanding of cultural nuances and preferences to deliver a truly immersive experience for viewers worldwide.

The immense volume of available content challenges viewers regarding content discovery. Platforms must continually refine their recommendation algorithms, and user interfaces to ensure viewers can easily locate content that aligns with their preferences.

Striking the right balance between ad-supported, subscription-based, and hybrid revenue models remains an ongoing challenge. Ensuring that creators receive fair compensation while providing a seamless viewing experience for users necessitates continual innovation and adaptation in revenue strategies.

Conclusions

The landscape of the streaming industry is poised for dynamic transformation, driven by a convergence of technological innovations and evolving viewer preferences. As the industry continues to evolve, several vital takeaways emerge:

Firstly, integrating advanced technologies such as AI, AR, VR, and blockchain is reshaping how content is created, curated, and consumed. These innovations have unlocked new dimensions of immersion, personalization, and monetization.

Secondly, the metaverse concept represents a potential paradigm shift in content consumption. Streaming platforms are at the forefront of this evolution, poised to redefine the boundaries between physical and virtual experiences.

Moreover, the rising demand for live streaming and interactive content underscores the importance of real-time engagement. Platforms that effectively integrate interactive features stand to capture a significant market share.

AI-driven personalization is poised to reach new heights, enabling platforms to offer tailored experiences that transcend mere content recommendations. This has profound implications for user satisfaction and retention.
The expansion of 5G technology promises to revolutionize content delivery, offering higher quality and more immersive experiences. This technological leap opens up new opportunities for AR, VR, and other data-intensive applications.

Content localization and cultural adaptation will be increasingly vital as streaming platforms seek to reach global audiences. Understanding regional preferences and sensibilities is paramount to creating truly immersive experiences.

The article's novelty is given by the focus on the disruptive industry of streaming entertainment and the inclusion of the most performant modern technologies. The study's limitations are related to the need for a historical behaviour motivated by the recent appearance of the activity, the focus on English language-related platforms and the specificity of consumer habits. However, the study provides both a retrospective viewpoint and a future-oriented perspective, the practical value of the results benefiting academics by extending the knowledge base and professionals responsible for recommendation systems, user experiences and customer satisfaction, together with business and technology development.

In conclusion, the streaming industry is continually evolving, driven by technological innovation and dynamic shifts in viewer behaviour. Adapting to these trends while navigating various challenges, such as content overload and revenue models, will be critical to the sustained success of streaming platforms. By embracing innovation and understanding the evolving needs of viewers, the industry is on its way to shaping the future of entertainment consumption on a global scale.

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ENTERPRISES' INNOVATIVE ACTIVITY MANAGEMENT ORIENTED TO THEIR MARKET VALUE INCREASE*

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Abstract. The article proposes general approaches to the identification and reliable assessment of costs and intangible assets that arise in the enterprise during the commercialization of innovative implementations. It is proven that the investment attractiveness and market value of the enterprise depends on the correct assessment of the assets and costs of the enterprise of the innovative type of development. In order to assess the influence of the cost structure, which reflects the efficiency of innovative activity, on the resulting indicator of the growth rate of equity capital, the activities of 20 industrial enterprises of Ukraine for 2017-2021 were studied. The correlation analysis of the close relationship between these indicators (correlation coefficient 0.22) allowed to conclude that operating leverage does not have a significant impact on the rate of growth of the enterprise's capital. In turn, this indicates insufficient efficiency of the innovative cost management system of the selected enterprises. Another reason is the failure to take into account the amount of intellectual capital when evaluating the total capital, which reflects the formation of internally generated goodwill that appears during the innovative activity of business units. In order to improve the management of innovative activities of enterprises, it is proposed to differentiate innovations by stages of capitalization, which clarifies their identification as objects of managerial influence in the management system. It is concluded that it is necessary to take into account the chain effects from the introduction of a certain type of innovation on all indicators of the business entity's activity.

Keywords: innovative activity; innovation index; types of innovations; cost management of innovative activity; capital growth rate; operating leverage; market value of enterprise

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1. Introduction

The transformation of the world economy and its transition to the information paradigm is characterized by the decisive of innovative activity to ensure the competitiveness of enterprises. The capital investment in innovative technologies that define the fourth stage of the industrial revolution (Industry 4.0), such as additive manufacturing, artificial intelligence, large databases, cloud technologies, and the "internet of things" (Ibarra et

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al., 2018; Dalenogare et al., 2018; Bai et al., 2020; Yermachenko et al., 2023; Hrab & Minculete, 2023) could enable the growth of competitiveness and sustainable development of economic systems in general, both at the countries level, as well as sustainable business growth at the level of individual companies (Müller et al., 2021; Chen, 2022; Tugui et al, 2022).

Thus, the development of modern economic systems of any hierarchical level is based on the constant desire of business entities to obtain competitive advantages for the realization of the chosen strategic goal. The basis of such advantages is the organization of a permanent system process of innovative activity on the enterprise, as the core source of obtaining additional profit, due to the possession of a unique innovative product. Such an organization approach increases both the competitiveness of enterprises and their market value. A certain correlation between the index of innovative activity and the competitiveness of national economies is observed (using the example of countries of the V 4 group) (Ivanová & Žárská, 2023).

We should agree with the opinion of (Kabát et al., 2020) that the globalization of the world space, on the one hand, is the driving force for increasing the innovative level of national economies and creating a favourable environment for expanding technological cooperation between countries, and on the other hand, it poses a threat to the flow of qualified labour to countries with higher wages. Such trends have a negative impact on the innovative potential and innovative capabilities of labour donor countries, which subsequently negatively affects the level of competitiveness of market entities. At the same time, thanks to the direct cash flows from labour migrants to their own families, labour migration provides a revitalization of the business environment in donor countries.

An interesting experience in reducing the consequences of labour migration from the countries of the V4 group after unification of the labour market in the EU countries was the transfer of direct financial compensation to the mother countries. The volume of such compensation amounted to more than 70 billion US dollars in 2017 (Kabát et al., 2020).

In any form, receiving additional financial flows by the mother countries has a direct positive effect on GDP growth and improvement of the main economic indicators of development.

Sustainable growth of the economies of Eastern European countries, including the Slovak Republic, Ukraine and other countries, is impossible without an effective state investment policy that provides support for both public and private financing of innovatively active enterprises.

Of particular importance for determining the directions and objects of investment is the approach to understanding the "locomotive" innovative ability of the industry and the range of connections of the investment object with other economic entities. Analysing the economy of Ukraine, it should be noted the prospects for the development of the construction industry and the electric power industry, which are one of the key sectors of the post-war period of revival of the country's economy (Labunska et al., 2023). In Slovakia, such industries may include the automotive, electrical, mechanical and chemical industries (Stefko et al., 2019).

Note that the basis for determining the feasibility of investing in innovative transformations at both the micro- and meso-level is the implementation of organizational transformations of business entities and the involvement of enterprises in integration interaction (Pilipenko & Litvinenko, 2017; Labunska et al., 2022).

Nowadays, innovative activity is the basis of increasing the efficiency of the enterprise management system, a guarantee of its competitive advantages and sustainable development Pysmak et al. (2021). It is the innovative ability, together with the general indicators of the book value of assets and expected operating profit in the long term, that is the basis for assessing the market value of a business entity. Therefore, the market value of the enterprise can be considered as an integral indicator of its economic capabilities, which takes into account all the resources available to the subject of entrepreneurial activity and certifies the prospects of its development.

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The results of the study by Binh et al. (2020) showed that intangible assets of enterprises, which are the basis and at the same time the result of innovative activities of companies, have a positive impact on increasing the efficiency of enterprises and increasing their market value. At the same time, there is no general approach to assessing the value of intangible resources as objects of management influence, especially those that cannot be accurately identified in the accounting and financial statements of a business entity as intangible assets.

Methodological aspects of identifying and assessing intangible resources are the subject of many studies (Hellman, 2022; Ievdokymov et al., 2020; Arianpoor, 2021).

One should agree with the opinion Timotius (2023) that the rapidly changing business climate and increasing competition require companies to elaborate the right strategy for growing and maintaining their business. This also applies to the organization and effective functioning of the cost management system's innovation activity.

Koilo (2022) noted that in the conditions of globalization, the process of creating value, including the value of the results of innovative activities, becomes more complex and causes huge risks for companies, partners, and customers. Therefore, the identification and evaluation of innovations as a product of innovative activity needs clarification, because it is the basis of the creation of an effective system of managing innovative activity.

2. Theoretical background

Due to the modern conditions of the growing importance of innovativeness of development, the priority role in the process of enterprise activity has shifted from material to immaterial factors of production. At the highest level of abstraction, innovation is a dual phenomenon, the elimination of the existing and the creation of something new. Due to this, innovation (I) brings to life the phenomenon of economic growth (ER) through the mechanism of competition (K). Schematically, such a movement can be represented as follows:

$$I \Rightarrow K \Rightarrow EP \tag{1}$$

Innovative changes create the internal energy of economic growth in the economic system. At the same time, such changes disrupt the achieved balance and equilibrium, but they create the basis for economic growth and the transition of the system to a new qualitative state. In this sense, the generalized task of effective management of innovative activities is to ensure the balance of the new state of the economic system.

Achieving a bifurcation point in the development of the enterprise's economic system becomes the basis for reaching a new level of competitiveness and generates an additional increase in the value of the enterprise's assets over their recognized valuation. All this leads to an increase in the market value of the enterprise as a business unit. Thus, effective management of innovation activities involves influencing the internal factors of the enterprise and indirectly the external environment in order to ensure dynamic development and increase the investment attractiveness of the enterprise by achieving an increase in its value. Thus, the increase in the market value of an enterprise is the most important criterion for the effectiveness of a management system at any level.

The methodological aspects of assessing the market value of enterprises and the importance of factors in the forming process are discussed in the research of Boiarko et al. (2023), Habib (2022), Aouadi & Marsat (2023), Palomino-Tamayo et al. (2020).

To carry out a comparative analysis of the innovativeness of the national economies of Slovakia and Ukraine in 2021 (before the war in Ukraine), Figure 1 visualizes the results of the comparison of indicators according to the following ratings:

- The Global Innovation Index (GII) WIPO, 2022), formed by the World Intellectual Property Organization, is an annual assessment of the innovation climate of countries based on 80 indicators, divided into 7 groups;
- The Global Competitiveness Index (GCI), which is formed based on research by the World Bank (2022]) shows the general level of competitiveness of the countries. This index is calculated based on 98 indicators, divided into 12 groups of factors, one of which is the evaluation of innovative capacity;
- Bloomberg Innovation Index (Bloomberg Innovation Index, VII? 2021)– an assessment of the level of innovative development of 60 countries based on indicators grouped into 7 groups: research and

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development, productivity, the added value of production, the concentration of high-tech companies, the concentration of researchers, efficiency of higher education and patent activity;

- The Summary Innovation Index (SII) is an indicator of the level of innovative development of European countries, which is formed within the framework of the European Innovation Scoreboard project (2022]) and includes four categories of indicators (Framework conditions, Investments, Innovative activity, and Impact), within 3 groups of allocated indicators. (32 in total);
- The Global Talent Competitiveness Index (GTCI) (2022), is a ranking of the European Institute of Business Management INSEAD, which assesses the prospects for the formation of a high intellectual level of employees in the country due to a quality system of only 6 main groups of criteria: opportunities, talent attraction, talent development, index talent retention, global knowledge, technical skills.

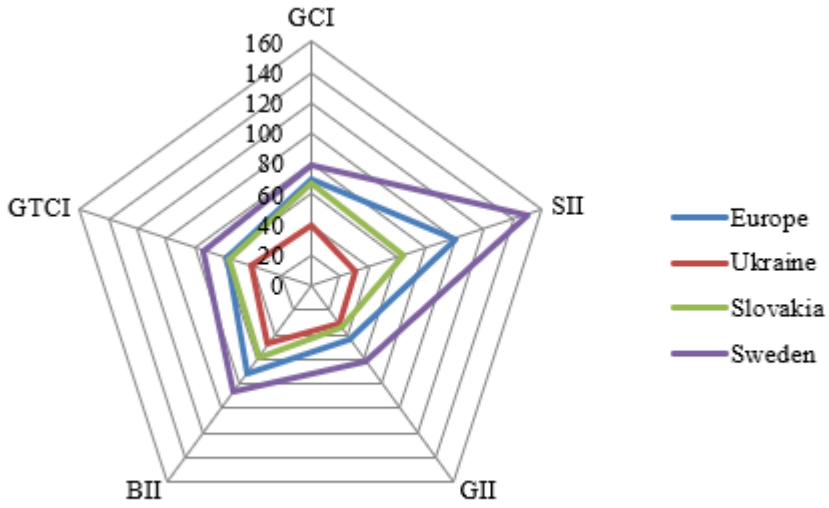

Figure 1. Comparison of the level of innovative capacity of Ukraine, Slovakia, and European countries accordingly that the main world indexes of innovativeness of national economies
Source: own processing based he the database of The Bloomberg innovation index (2021), The Global Talent Competitiveness Index (2022), The Word Bank (2022), European innovation scoreboard (2022), Global Innovation Index (2022)

Comparing the rating indicators of innovativeness of the national economies of the Slovak Republic and Ukraine, it should be noted that Ukraine lags in most rating indices. This is due to the backwardness of the Ukrainian economy at the level of enterprises implementing various types of innovative transformations, Figure 2 and Figure 3.

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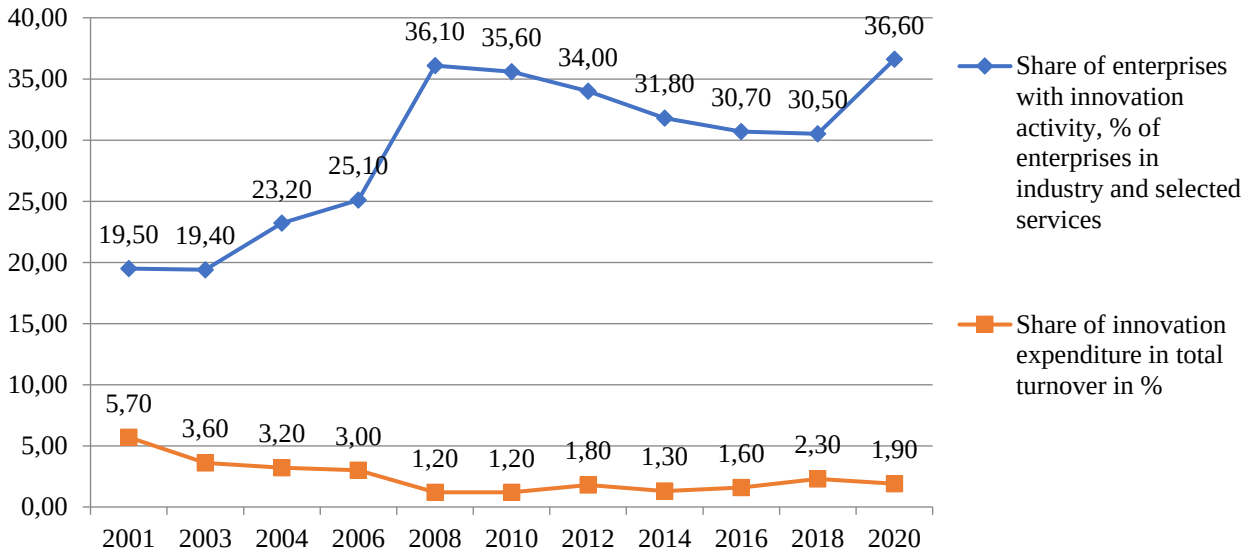

Figure 2. Main indicators of innovative activity in Slovakia
Source: own processing based on the database Statistical Office of the Slovak Republic (2021)

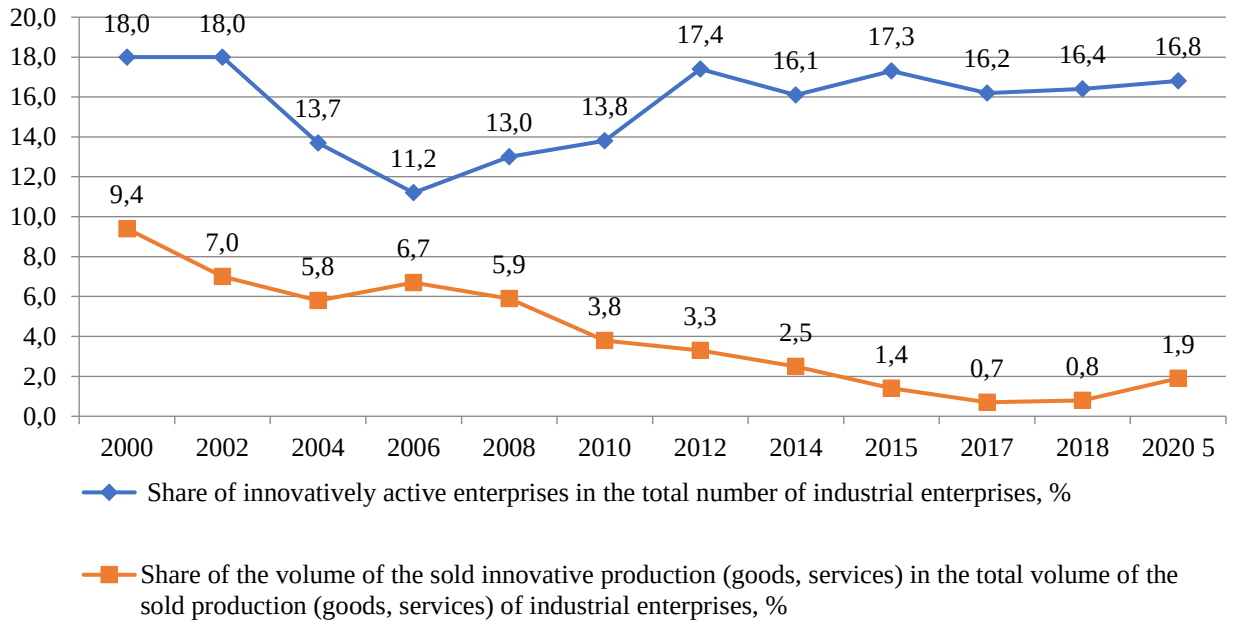

Figure 3. Main indicators of innovative activity in Ukraine
Source: own processing based on the database of the State Statistics Service of Ukraine (2021)

Thus, the level of innovative activity of economic entities forms the overall growth of the competitiveness of the national economic system and directly affects the investment attractiveness of individual enterprises in the country.

The analysis of trends in the sources of financing innovative activities of Ukrainian enterprises in recent years (2000-2019) allows us to conclude that the company's funds remain the main source of financing their innovative activities, Figure 4. Therefore, the effectiveness of cost management aimed at ensuring innovative activities in the general management system of the enterprise economic activity is the primary task of the business entity.

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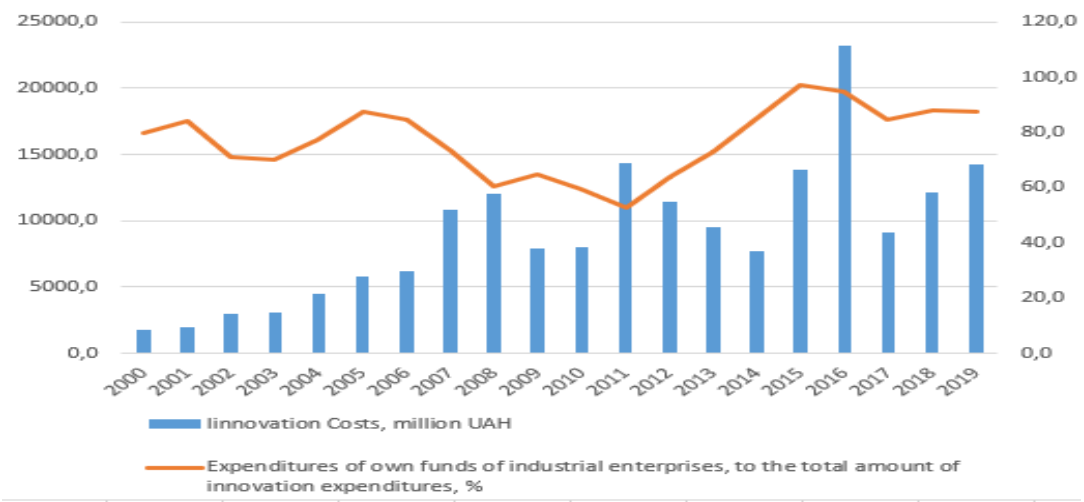

Figure 4. The main directions of investment in the innovative activities of Ukrainian industrial enterprises (2000-2019) *
Source: own processing based on the database of the State Statistics Service of Ukraine (The latest publicly available data in Ukraine due that martial law)

Thus, the main attention should be focused on the cost management system used to generate innovative resources and create an innovative product, taking into account the characteristics of costs at each stage of production innovation.The cost management for innovative products must be carried out in strict accordance with the innovation life cycle, which includes the following stages: 1) idea (stage of production of the latest knowledge and development of " ideological innovation") - not a product form; 2) idea (stage of research work - product form); 3) product (scientific and production cycle, development and implementation) - product form.

That is, if an enterprise generates innovations on its own, it usually go from one to three stages during its implementation.In order to identify the results of innovative transformations and improve the efficiency of cost management for their implementation, it is proposed to highlight the following types of innovations:

- ideological innovation - in the form of an information intangible component, which can expressed more precisely through the use of the enterprise's intellectual capital in the presence of intellectual potential and resources for its implementation. The intangibility lies in the fact that the idea cannot yet be sold and does not have an unambiguous value estimate - specialists only have primary information, which suggests the possibility of an innovation in a particular area of the enterprise. At this stage, it is even impossible to predict its success or failure;
- investments in innovative developments, which are included in the composition of costs - the company believes that the idea, already expressed in the form of a new approach, product, development, method, etc., is worth trying to implement, and calculates its cost. At this stage, the innovation can already be attributed to a certain classification group;
- capitalized innovation in the form of assets – expenses incurred at the previous stage brought profit (income) to the enterprise, or increased the value of other assets. The innovation has been successfully implemented and is now included in the company's assets (tangible or intangible) and can be reflected as an accounting object.

Schematically, the production process of development and implementation of innovations, with a distinction between their product and non-product forms, is presented in Figure 5.

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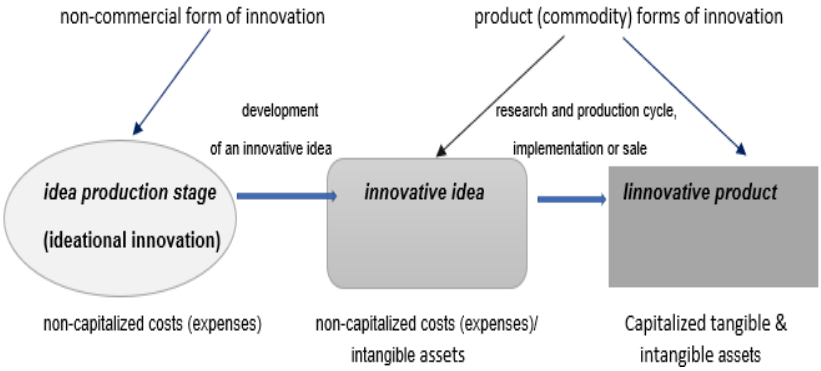

Figure 5. The process of development and capitalization of innovations
Source: developed by the authors

The enterprise can reject the innovation in the second stage if its implementation becomes economically inefficient. The process of identifying an innovation with a particular type of asset is not so critical, meaning that an unambigious decision on its adoption on the balance sheet of the enterprise is more dependent on the convenience of accounting. In practice, it is possible to forecast such an option, when a recognized innovation is used, and brings income, but is not allocated to a separate type of asset. Then the costs of its implementation are distributed among other articles, and formally it seems to not exist, being between the I and II stages.

According to the authors " ideological innovation" is not an asset of the enterprise, since it is not yet presented in material form (it does not have a clear argumentation and expression), but the enterprise already bears the costs associated with its development. In the future, the "ideological innovation" may be assigned to a group of assets or expenses, depending on the effectiveness of its practical implementation, or may not be singled out at all (in case that its predicted efficiency is too low).

This approach means that the enterprise has already begun to spend tangible and/or intangible resources on the research (theory, strategy, individual event, etc.), without yet obtaining a clear result, but the failure of this innovation is already becoming clear, and a decision is made to abandon such an idea. The money and efforts spent, without any benefit, actually saved the enterprise from even greater losses in the future - in case the wrong model of behavior was accepted.

3. Aim and methodology

The main goal of the study was to determine the cost structure impacting level on the business unit's market attractiveness and to justify approaches to the creation of an effective cost management system of innovatively active enterprises based on the decoupling of the costs of innovative activity on the assets and costs and further improvement of their identification and evaluation methods.

The conceptual study basis of the impact of the efficiency of the asset management system of innovatively active enterprises on the rate of capital growth exists in the hypothesis that there is a certain relationship between the indicator that characterizes the structure of costs and the rate of growth of total capital. At the same time, the authors believe that it is the operating leverage, (2) indicator that determines the level of compliance of the organizational structure of an enterprise with the innovative needs and demands of the market:

$$OL = \frac{MR}{OP} \tag{2}$$

where OL – operating leverage;
MR– marginal revenue ;
OP – operating profit.

This position regarding the proposed indicator comes from the fact that the operating leverage reflects the elasticity of changes in profit, in case of expansion or reduction of the scope of the enterprise's activity and is

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formed as a result of certain managerial decisions in the management system regarding the organization of the production process taking into account the market positions and competitiveness of the business entity. The increase in the value of the operating leverage, which indicates the growth of conditionally constant costs in the general cost structure of the enterprise, is justified only in the case of the expansion of the sales market, which indicates the growth of the enterprise's competitiveness. In the case of a decrease in market control, the operating leverage reflects a multiplicative decrease in profit and a possible entry of the business unit into the loss zone. Thus, this indicator is a signal of mutual agreement of all management subsystems of the enterprise.

Limitations in such indicators implementation are, first of all, the need to take into account a part of the resource of the enterprise, which cannot be recognized as an asset in the financial accounting and reporting of the enterprise, because it cannot be clearly and reliably evaluated in a monetary measure and are not assets of the enterprise or recognized expenses.

When determining the rate of capital growth, the study takes into account the authorized capital, all types of additional capital and retained earnings (uncovered loss) of the enterprise for the corresponding period.

According to the author's understanding, the indicator of the retained profit (uncovered loss) should be adjusted by the number of opportunities lost by the company under the influence of "refusing" the investment in other types of innovative transformations, (3). It can be formed as a balance sheet profit, reduced by the "cost of capital investment in innovative activity". The "cost of capital investment" is proposed to be the sum of capital investment multiplied by the profitability of an individual economic entity.

$$AC = TC - (I * ROE) \tag{3}$$

where *AC* - adjusted capital;
TC – total capital;
I – investments.

During the research, the following methods of analysis and synthesis were used to solve the scientific problem: comparative analysis, rating, and correlation analysis. Results are visualized using charts and graphs.

4. Results and discussion

Given the significant differences in the organization of corporate governance and the mechanism of decision-making on the management of innovative processes, the set of researched Ukrainian enterprises is formed from enterprises that are public and private joint-stock companies by organizational and legal form. Financial, statistical, and internal management reporting became the information sources of the research for the selected enterprises in 2017-2021 years, which are published on the official websites of enterprises. (Appendix A, Table 1 A, Table 1).

An array of data to be included in the model for assessing the relationship between the rate of capital growth (RCG) of enterprises (Y) and the measure of operational leverage (OL)- (X) is given in Table 1.

Table1. Input data for regression modeling

the rate of capital growth RCG	operational leverage OL	the rate of capital growth RCG	operational leverage OL	the rate of capital growth RCG	operational leverage OL	the rate of capital growth RCG	operational leverage OL	the rate of capital growth RCG	operational leverage OL
15.03	0.00	63.31	0.00	7.05	0.00	4.58	18.33	14.81	2.48
-7.29	0.00	25,32	3.37	-1.11	0.00	-3.81	1.41	-40.31	0.00
20.52	11.92	10.92	5.57	-10.45	4.01	88.47	yf2.82	-47.73	0.00
-54.08	0.00	3.09	7.81	13.65	2.15	47.15	4.53	0.43	0.00
-14.97	8.79	10.62	6.92	59.90	1.82	-69.56	0.00	-57.48	0.00
23.52	0.00	1.46	9.41	3.99	1.71	-15.61	0.00	80.98	2.60
-11.34	0.00	13,16	3.85	-4.01	2.80	-47.61	0.00	-24.08	0.00

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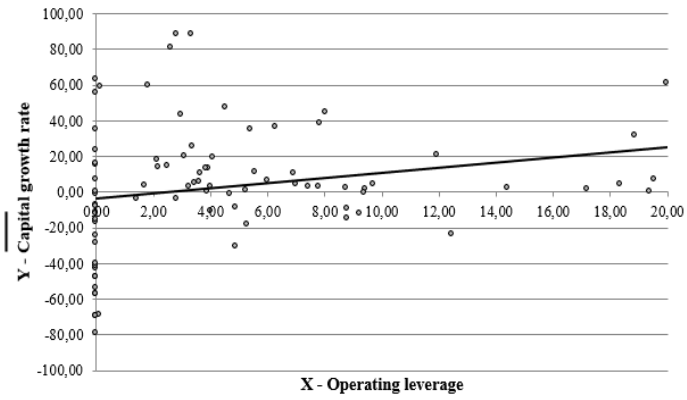
-35,26	0.00	4.29	9.72	2.99	7.42	-28.46	0.00	-69.72	0.00
59.06	0.13	0.59	19.39	-23.32	12.43	-69.06	0.11	-88.15	0.00
10.58	3.67	1.98	17,19	60.96	19.99	-1.06	4.68	3.03	4.02
-42.74	0.00	2.63	14.41	-7.83	0.00	3.27	3.25	-12.18	9.21
43.17	2.99	7,12	19.54	88.77	3.32	4.75	3.44	-0.15	9.38
-9.52	8.79	-16.76	0.00	-8.50	4.90	17.91	2.12	0.65	5.23
4.67	7.00	38.85	7.81	-18.52	5.26	0.11	3.87	-30.73	4.87
36.68	6.26	-57.06	0.00	6.14	6.01	20.42	3.10	6.02	3.61
-41.37	0.00	31.48	18.85	44.96	8.03	19,13	4.08	-11.83	0.00
13.39	3.92	35,27	5.40	2.51	8.76	15.69	0.00	55.79	0.00

The results of the regression analysis are presented in Figure 6

RESULTS

Regression statistics	
R	0,223
R-square	0,050
Normalized R-square	0,038
Standard error	34,055
Observations	85,000



Dispersion analysis

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	5016,630	5016,630	4,326	0,041
Residual	83	96260,364	1159,763		
Total	84	101276,994			

	Coefficients	*Standard error*	*t-statistics*	*P-value*	*bottom 95%*	*top 95%*
Y-intercept	-3,691	4,874	-0,757	0,451	-13,386	6,003
X	1,462	0,703	2,080	0,041	0,064	2,861

Figure 6. The results of the correlation analysis of the influence of the indicator of operating leverage on the rate of growth of capital of enterprises
Source: own calculations

The obtained results testify to the existing, but very low coefficient of influence of operating leverage on the rate of growth of the enterprise's capital. (R=0.223)

$$Y = 1{,}462 * X - 3{,}691$$

The obtained negative results of the analysis, in the opinion of the author, have multiple causal origins.

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Firstly, the operating leverage that developed in the previous period characterizes the ratio of marginal income and net profit. The average value of the calculated indicator by industries was: 5.9251 (mechanical engineering), 1.6699 (metallurgy), and 2.6278 (chemical industry). The cost structure that has been developed in the enterprise has a significant impact on the operational leverage; the absolute majority of analyzed enterprises are characterized by the prevailing variable costs: according to management reporting data, only 13.58% of enterprises have a share of variable costs in the structure of cost of sold products less than 75%. This means an insufficient investment in the production of the non-cash assets, and focusing on spending on product marketing and organizational innovations, which are weaker in adding market value to the entity.

Secondly, operational leverage is significant, but not decisive in the characteristics of innovative business opportunities of the enterprise Labunska et al. (2023).

Thirdly, in order to clarify the evaluation of the results of innovative activity, it is necessary to take into account the intangible component that shapes the intellectual capital of the enterprise depending on the type and stage of capitalization of innovations carried out by the enterprise.

The innovative activity of the enterprise produces intangible resources, which are either an independent result of innovative transformations or a concomitant product of the material form of the results of innovations. The formation of any type of intangible resources, including intellectual resources, which determines the effectiveness of the management system in accordance with the strategic goals of the enterprise, leads to the growth of the competitive position of the enterprise and generates internal goodwill.

Identification and assessment of such intangible resources when developing approaches to determining managerial influence is difficult due to the impossibility of reliably defining them in accounting and including them in full as assets.

In most studies, three main approaches to the valuation of intangible assets are distinguished: cost, income and market approaches (Binh et al. 2020; Pastor et al., 2017; Salamudin et al., 2010).

In order to form an effective cost management system of innovative activities, depending on the type of innovative changes, the cost approach was chosen in the study. The authors take the position that the most grounded on a strategic and operational management level is a cost-generated factors model, the main developers of which are Scherer & Ross (1990), Cooper & Kaplan (1999). This model allows a rough assessment of the set of costs that are aimed at ensuring the functional and structural manifestations of the general system of cost management and its subsystem of cost management of innovative activities.

The structural component of costs in both strategic and operational management should play a decisive role since it highlights the dependence of current and future costs of the enterprise on the effectiveness of their previous (or planned for the future) usage, reflected by their structural component. In addition, the considered approach makes it possible to take into account the conceptual principles of building a system of cost management of innovative activities by structurally distinguishing costs according to the determined priority functional manifestations of the system. At the same time, the total costs in system functioning should be equal to the total costs of the structural subsystems accumulated by the cost centers.

Within this approach, the direction of cost evaluation and recognition should be singled out, which is based on the generalization of all types of costs, including alternative ones. It takes into account both the losses of the enterprise from unused opportunities and the formation of costs based on an alternative, and not valid, accounting system-recognized, assessment of consumed resources. The usage of this approach is considered quite reasonable; specifically, in the system of cost management of innovative activity within the framework of decision-making regarding the implementation of an innovative project at the enterprise, first of all at the stages of the life cycle of innovation, which are determined by development and stabilization. Meanwhile, it was noted that the processes of information diffusion which define innovation itself, accelerate the dynamic changes in

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the internal environment of the enterprise. On the other hand, such processes themselves are a product of accelerating dynamic changes in the external environment, formed under the influence of an increase in the volume of information flow about a certain innovation in the middle of the macro system.

The approach to determining costs, taking into account the actual market value of the resource spent adjusted by the lost chances variable, makes it possible to estimate the real amount of profit from the commercialization of the selected innovative project. However, in the case when the actual (accounting) value exceeds the market value of the consumed resource, we believe that it is appropriate from the point of view of the company to use the actual value formed in the financial accounting system. This value is a reflection of the actual cost of the resource due to its untimely use, or a wrong decision on the size of the safety stock in the enterprise management system.

Another acute problem arises when determining the corrective factor in the case of the reasonable existence of a significant (longer than the term of the total capital turnover of the enterprise) term of capitalization of the assets of the enterprise. Such a correction factor must reflect:

- firstly, the impact of inflationary depreciation of the actual value of assets ;
- secondly, the increase in the price of resources, which is associated with the costs of storage, insurance, losses due to natural damage ;
- thirdly, take into account the rate of total return on capital of the enterprise or the average annual deposit rate of capital placement, in case the indicated indicators exceed the average planned rate of return on expenses of the period.

Thus, the total costs in the system should be determined by the formula (4):

$$B_t = \left\{ B_f ; \sum_{i=1}^{n} K_i \cdot R_i \right\} , \qquad (4)$$

where B_t - costs estimated in the cost management system for the purpose of exercising managerial influence in a certain period;
K_i - adjustment factor for the clarification of the actual value of the capitalized resource used in the period;
R_i - the accounting value of the consumed resource;
In_f - the actual costs of the enterprise reflected in the accounting system for a certain period.

The proposed approach to the refined determination of the actual cost of the period based on the distinction between actual (accounting) and actual (economic) costs makes it possible to make reasonable decisions in the system of management of enterprise costs.

Should be noted that to shape a managerial impact, the innovations of the enterprise are determined according to the following characteristics:

- the sensitivity to the conditions of the external environment and the level of influence on the external environment;
- the reaction of the internal enterprise environment to the changes;
- the purpose, form, and significance of implementation;
- the method and process of implementation.

Understanding the classification characteristics of certain innovative changes determines a unique set of tools for its implementation in each enterprise.

Based on the cost analysis that precedes the real implementation of innovations, it is proposed to distinguish the following classification groups:

1. By the type of innovation for the market (by the level of novelty, by the depth of the introduced changes).

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2. According to the life cycle (by the level of diffusivity, the degree of renewal of the final product, the stage of commercialization).

3. According to the level of security requirements (the need to protect a new idea).

This determination makes it possible to develop a multi-vector representation of the array of innovation features x1, 2, ..., n . The combination of three classification feature is considered the most reasonable (Fig. 7,). The form of elements x_{xyz} will appear in the following way:

axis 0X ("Oslo Guide"): 1 – product, 2 – process, 3 – marketing, 4 – organizational innovation;

axis 0 Y (by stage of capitalization): 1 – ideological innovation, 2 – capitalized innovation in the form of expenses, 3 – capitalized innovation in the form of assets;

axis 0 Z (by factors of origin): 1 – endogenous, 2 – exogenous innovation.

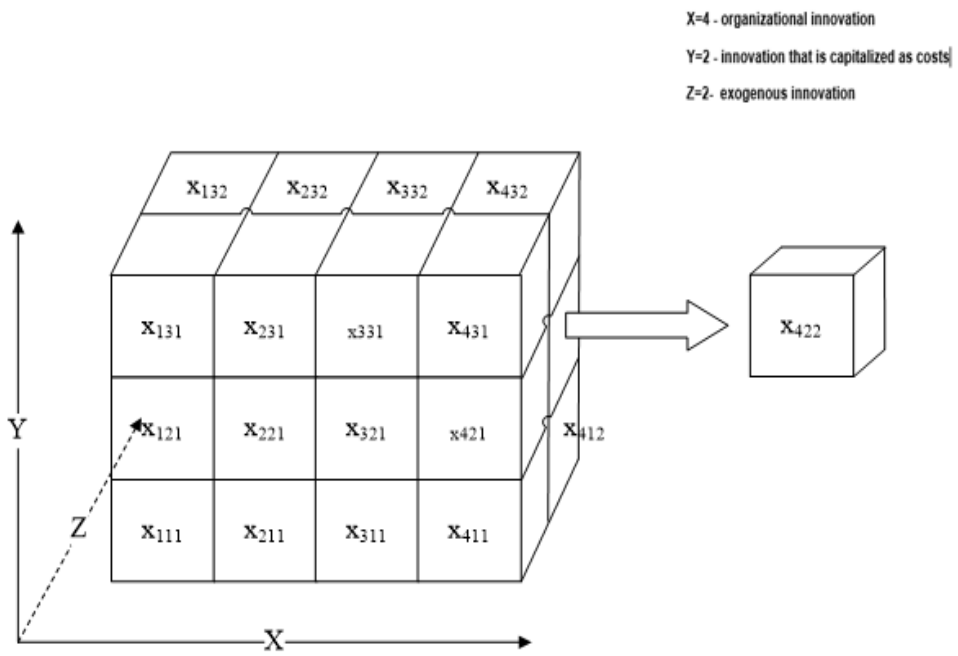

Figure 7. Classification of innovations by groups of features in order to clarify the costs of their implementation
Source: developed by the authors

The proposed form of presentation of classification features has a significant limitation - the investigated object (innovation) cannot acquire more than one feature within the group. For example, a certain organizational innovation, capitalized in the form of costs, is exogenous, that is, environmental factors had a significant influence on its emergence (z = 2), although it is quite possible that there were also internal factors, but they did not turn out to be as important as external ones, and therefore are not taken into account. However, if the enterprise implements several innovations, another innovation (the next object of classification) can be endogenous organizational, capitalized in the form of costs.

The developed approach to the classification of innovations will allow not only to distinguish diverse groups of features but also to align them to the requirements of building a unique and effective system of cost management of innovative activities of the enterprise. The introduction of a new kind - "ideological innovation" - can expand the list of objects for accounting of the innovative costs, in turn, will contribute to a more reliable assessment of the innovation potential in order to determine the prospects for changing its competitiveness.

5. Conclusions

The obtained research results made it possible to draw the following conclusions.

1) The method of recognizing and evaluating the results of innovative activities should be improved to determine the final impact of innovative transformations on the enterprise market value Such clarification can be achieved by adding internally generated goodwill to capitalized intangible assets and accounting for the amount of intellectual capital arising as a result of the innovative activity of business entities as part of total capital.

2) The cost management system of the innovative activity of the enterprise must be built based on determining the characteristics of innovative transformations and taking into account the stages of capitalization of the results of innovative activities.

3) To build an effective management system of innovative activity, it is necessary to consider not only its cyclic nature but also the chain effects that are inherent in the process of introducing innovations. The chain effect is explained by the fact that the separate innovation provokes and causes innovations in other parts of the economic system.

4) In the case of systematic and consistent implementation of innovations, the economic efficiency of innovative activities is multiplied, and vice versa - the implementation of innovative processes on an episodic basis eliminates the positive effect of innovations and has a destructive effect on the managed subsystem of the enterprise's innovative activity management system.

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Appendix A

Table 1 A. Indicators of companies' performance for regression modeling, 2017-2021, UAH

No	Year	Total capital (TC)	Net profit	ROE	Investments (I)	Adjusted capital (AC)	Income
Company 1	2017-2020	data not available					
	2021	5 316 479	-486 412	-0,09	648 009	5 375 766	8 225 588
Company 2	2017	545 712	-62 460	-0,11	62 394	552 853	872 153
	2018	668 688	36 537	0,05	43 249	666 325	1 132 614
	2019	231 942	-479 950	-2,07	35 764	305 947	1 341 269
	2020	262 811	28 418	0,11	24 673	260 143	1 214 610
	2021	317 521	-68 241	-0,21	17 661	321 317	1 283 066
Company 3	2017	-3 340 489	-287 748	0,09	14 023	-3 341 697	434 617
	2018	-2 255 298	1 068 125	-0,47	193 873	-2 163 478	231 191
	2019	1 172 586	333 514	0,28	195 824	1 116 889	137 583
	2020	1 235 167	58 552	0,05	2 006	1 235 072	669 448
	2021	data not available					
Company 4	2017	74 232	-72 347	-0,97	15 940	89 767	611 030
	2018	134 544	59 240	0,44	13 682	128 520	638 958
	2019	113 337	-20 425	-0,18	16 354	116 284	966 871
	2020	123 645	10 828	0,09	22 058	121 713	980 198
	2021	data not available					
Company 5	2017	678 018	203 061	0,30	5 060	676 503	713 342
	2018	396 017	-81 380	-0,21	3 136	396 661	623 612
	2019	465 190	71 798	0,15	99 979	449 759	770 259
	2020	750 429	191 826	0,26	62 267	734 512	431 986
	2021	data not available					
Company 6	2017	409 223	95 769	0,23	21 675	404 150	894 583
	2018	453 600	64 883	0,14	37 198	448 279	1 074 933
	2019	462 859	29 765	0,06	10 973	462 153	970 004
	2020	513 200	69 136	0,13	14 694	511 220	1 086 774
	2021	518 797	29 517	0,06	2 076	518 679	1 224 175
Company 7	2017	398 575	50 955	0,13	62 464	390 589	519 383
	2018	409 148	10 633	0,03	69 309	407 347	571 227
	2019	409 825	728	0,00	33 166	409 766	504 941
	2020	418 292	8 487	0,02	20 669	417 873	512 690
	2021	431 712	13 445	0,03	91 993	428 847	654 237
Company 8	2017	61 447	2 149	0,03	188	61 440	211 067
	2018	51 060	-11 354	-0,22	363	51 141	272 866
	2019	71 040	19 980	0,28	119	71 007	359 055
	2020	30 453	-40 587	-1,33	30	30 493	156 939
	2021	40 093	-18 708	-0,47	0	40 093	171 084
Company 9	2017	117 790	22 842	0,19	30 346	111 905	421 811
	2018	119 938	481	0,00	36 946	119 790	327 538
	2019	118 517	168	0,00	39 873	118 460	215 433
	2020	106 275	1 907	0,02	10 694	106 083	147 746

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	2021	130 467	31 758	0,24	40 683	120 564	173 113
Company 10	2017	5 371 560	710 420	0,13	23 842	5 368 407	2 377 533
	2018	5 586 863	764 275	0,14	32 560	5 582 409	2 615 427
	2019	5 361 073	314 065	0,06	39 681	5 358 748	2 822 845
	2020	5 519 647	276 294	0,05	16 132	5 518 839	1 465 531
	2021	data not available					
Company 11	2017	17 374	-3 139	-0,18	1 230	17 596	200 377
	2018	29 683	12 680	0,43	3 184	28 323	325 905
	2019	19 296	-26 499	-1,37	4 958	26 105	353 048
	2020	49 229	-470	-0,01	5 255	49 279	429 733
	2021	48 324	23 051	0,48	6 778	45 091	716 438
Company 12	2017	34 880	10 406	0,30	429	34 752	164 767
	2018	43 830	10 161	0,23	29 958	36 885	186 037
	2019	54 104	10 274	0,19	3 355	53 467	289 177
	2020	54 845	741	0,01	2 697	54 809	111 670
	2021	57 469	2 624	0,05	3 263	57 320	174 872
Company 13	2017	81 870	-8 371	-0,10	4 184	82 298	199 074
	2018	158 254	28 009	0,18	17 798	155 104	382 184
	2019	233 420	79 605	0,34	15 182	228 242	752 937
	2020	56 863	-89 807	-1,58	7 983	69 471	179 263
	2021	data not available					
Company 14	2017	128 066	-24 973	-0,20	1 769	128 411	156 124
	2018	66 044	-62 548	-0,95	1 305	67 280	163 741
	2019	40 815	-25 701	-0,63	11 619	48 131	140 861
	2020	14 871	-31 481	-2,12	10	14 892	5 854
	2021	data not available					
Company 15	2017	4 983 341	395 446	0,08	149 346	4 971 490	4 396 033
	2018	5 174 326	637 950	0,12	328 583	5 133 815	5 668 691
	2019	5 402 964	670 516	0,12	205 772	5 377 427	6 655 129
	2020	6 394 389	1 438 061	0,22	239 933	6 340 429	6 475 932
	2021	6 355 380	407 827	0,06	124 238	6 347 408	4 719 198
Company 16	2017	120 227	6 605	0,05	1 342	120 153	134 114
	2018	143 177	5 660	0,04	1 038	143 136	130 377
	2019	165 578	-3 899	-0,02	583	165 592	105 556
	2020	190 229	13 821	0,07	1 545	190 117	110 184
	2021	data not available					
Company 17	2017	-4 390 912	-1 116 083	0,25	0	-4 390912	905 322
	2018	-6 481 701	-2 157 985	0,33	14 765	-6 486617	759 815
	2019	-6 458 973	165 353	-0,03	14 457	-6 458603	851 381
	2020	-10 169 684	-3 709 503	0,36	4 460	-10171311	874 404
	2021	data not available					
Company 18	2017	14 583	10 254	0,70	57	14 543	50 520
	2018	11 014	-4 262	-0,39	70	11 041	25 354
	2019	456	-10 531	-23,09	125	3 343	33 235
	2020	396	-100	-0,25	0	396	40 139
	2021	data not available					
Company 19	2017	287 333	21 951	0,08	0	287 333	687 392
	2018	249 949	-21 881	-0,09	27 216	252 332	614 609
	2019	251 356	-26 226	-0,10	5 832	251 964	350 876
	2020	253 663	2 308	0,01	5 832	253 610	222 306
	2021	data not available					
Company 20	2017	-1 087 972	-196 553	0,18	28 635	-1093145	582 182
	2018	-1 029 829	61 600	-0,06	40 901	-1027382	705 437
	2019	-1 145 919	-99 337	0,09	35 096	-1148961	417 480
	2020	-510 829	53 880	-0,11	27 141	-507 966	259 809
	2021	data not available					

Source: Dates, which are published on the official websites of enterprises

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Table 2 A. Indicators of companies' performance for regression modeling, 2017-2021

No	Year	Variable costs,UAH	Marginal revenue, UAH	Operating profit,UAH	Operating leverage (coefficient)	Capital growth rate (coefficient)	Adjusted OL (coefficient)
Company 1	2017-2020	data not available					
	2021	5 682 400	2 543 188	-237 307	-10,72	15,03	0,00
Company 2	2017	547 230	324 923	-11 136	-29,18	-7,29	0,00
	2018	638 066	494 548	41 498	11,92	20,52	11,92
	2019	747 016	594 254	-423 953	-1,40	-54,08	0,00
	2020	710 649	503 961	57 327	8,79	-14,97	8,79
	2021	831 188	451 878	-144 979	-3,12	23,52	0,00
Company 3	2017	297 137	137 480	-188 517	-0,73	-11,34	0,00
	2018	135 901	95 290	-58 915	-1,62	-35,26	0,00
	2019	94 956	42 627	333 375	0,13	59,06	0,13
	2020	454 852	214 596	58 552	3,67	10,58	3,67
	2021	data not available					
Company 4	2017	420 080	190 950	-54 767	-3,49	-42,74	0,00
	2018	406 841	232 117	77 680	2,99	43,17	2,99
	2019	569 213	397 658	45 223	8,79	-9,52	8,79
	2020	565 870	414 329	59 166	7,00	4,67	7,00
	2021	data not available					
Company 5	2017	413 546	299 796	47 916	6,26	36,68	6,26
	2018	407 307	216 305	-6 924	-31,24	-41,37	0,00
	2019	443 353	326 906	83 413	3,92	13,39	3,92
	2020	293 130	138 856	-40 932	-3,39	63,31	0,00
	2021	data not available					
Company 6	2017	505 144	389 439	115 506	3,37	25,32	3,37
	2018	641 383	433 550	77 896	5,57	10,92	5,57
	2019	592 827	377 177	48 309	7,81	3,09	7,81
	2020	666 381	420 393	60 734	6,92	10,62	6,92
	2021	761 284	462 891	49 190	9,41	1,46	9,41
Company 7	2017	312 307	207 076	53 833	3,85	13,16	3,85
	2018	348 429	222 799	22 921	9,72	4,29	9,72
	2019	320 759	184 182	9 499	19,39	0,59	19,39
	2020	319 504	193 186	11 238	17,19	1,98	17,19
	2021	421 990	232 247	16 117	14,41	2,63	14,41
Company 8	2017	115 527	95 540	2 688	35,54	7,12	19,54
	2018	157 126	115 740	-9 936	-11,65	-16,76	0,00
	2019	193 329	165 726	21 211	7,81	38,85	7,81
	2020	85 043	71 896	-36 696	-1,96	-57,06	0,00
	2021	79 610	91 474	3 835	23,85	31,48	18,85
Company 9	2017	205 484	216 327	40 025	5,40	35,27	5,40
	2018	195 442	132 096	-27 721	-4,77	7,05	0,00
	2019	173 065	42 369	-97 176	-0,44	-1,11	0,00
	2020	69 155	78 591	19 608	4,01	-10,45	4,01
	2021	49 658	123 455	57 361	2,15	13,65	2,15
Company 10	2017	756 683	1 620 851	892 942	1,82	59,90	1,82
	2018	1 035 046	1 580 381	922 884	1,71	3,99	1,71
	2019	1 326 889	1 495 956	534 376	2,80	-4,01	2,80
	2020	854 581	610 950	82 324	7,42	2,99	7,42
	2021	data not available					
Company 11	2017	122 318	78 059	6 278	12,43	-23,32	12,43
	2018	222 862	103 043	2 577	39,99	60,96	19,99
	2019	207 330	145 718	-5 344	-27,27	-7,83	0,00
	2020	227 082	202 651	60 990	3,32	88,77	3,32
	2021	431 287	285 151	58 249	4,90	-8,50	4,90
Company 12	2017	98 404	66 363	12 614	5,26	-18,52	5,26
	2018	111 341	74 696	12 421	6,01	6,14	6,01
	2019	184 791	104 386	12 999	8,03	44,96	8,03
	2020	70 720	40 950	72	568,76	2,51	8,76
	2021	112 866	62 006	3 383	18,33	4,58	18,33
Company 13	2017	108 171	90 903	64 611	1,41	-3,81	1,41
	2018	196 532	185 652	65 839	2,82	88,47	2,82
	2019	450 562	302 375	66 813	4,53	47,15	4,53
	2020	178 267	996	-134 987	-0,01	-69,56	0,00
	2021	data not available					
Company 14	2017	97 498	58 626	-19 375	-3,03	-15,61	0,00

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	2018	109 322	54 419	-57 659	-0,94	-47,61	0,00
	2019	89 377	51 484	-31 789	-1,62	-28,46	0,00
	2020	8 782	-2 928	-26 933	0,11	-69,06	0,11
	2021	data not available					
Company 15	2017	2 156 410	2 239 623	478 334	4,68	-1,06	4,68
	2018	2 837 910	2 830 781	872 329	3,25	3,27	3,25
	2019	3 246 780	3 408 349	991 151	3,44	4,75	3,44
	2020	2 937 213	3 538 719	1 668 607	2,12	17,91	2,12
	2021	2 273 464	2 445 735	632 041	3,87	0,11	3,87
Company 16	2017	82 375	51 739	16 712	3,10	20,42	3,10
	2018	86 125	44 253	10 858	4,08	19,13	4,08
	2019	74 278	31 278	-3 944	-7,93	15,69	0,00
	2020	76 462	33 722	13 575	2,48	14,81	2,48
	2021	data not available					
Company 17	2017	789 514	115 808	-308 603	-0,38	-40,31	0,00
	2018	646 660	113 155	-1 557 137	-0,07	-47,73	0,00
	2019	684 479	166 902	-184 030	-0,91	0,43	0,00
	2020	612 588	261 816	-1 803 601	-0,15	-57,48	0,00
	2021	data not available					
Company 18	2017	23 155	27 365	10 540	2,60	80,98	2,60
	2018	14 830	10 524	-6 134	-1,72	-24,08	0,00
	2019	21 533	11 702	-7 060	-1,66	-69,72	0,00
	2020	26 132	14 007	-2 243	-6,24	-88,15	0,00
	2021	data not available					
Company 19	2017	407 957	279 436	69 578	4,02	3,03	4,02
	2018	378 562	236 047	25 625	9,21	-12,18	9,21
	2019	214 950	135 926	14 496	9,38	-0,15	9,38
	2020	140 320	81 986	15 676	5,23	0,65	5,23
	2021	data not available					
Company 20	2017	317 363	264 820	54 392	4,87	-30,73	4,87
	2018	399 817	305 620	84 675	3,61	6,02	3,61
	2019	273 081	144 400	-116 563	-1,24	-11,83	0,00
	2020	179 218	80 591	-140 135	-0,58	55,79	0,00
	2021	data not available					

Source: Management reporting data and the authors' own calculations

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INDICATORS FOR DETERMINING THE EFFECTIVE LEVEL OF DIGITALIZATION IN HIGHER EDUCATION*

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Abstract. With the rapid advent of the new information and communication technologies, including fast development of the Artificial Intelligence, the digitalization process could be considered as a basic key element of the transition process, securing the sustainability of an organization. This is also relevant for the Higher Education Institutions that have very significant and at the same time responsible role to prepare well the next generation for the challenges of the labor market. Therefore, the effectiveness of the digitalization at the universities is critical for two major aspects: to secure proper education based on the cutting-edge technologies and to provide good quality of all accompanying administrative services. This article presents the potential indicators determining the effective level of digitalization in higher education institutions. These indicators are developed based on the empirical study among 360 universities students in Master and Bachelor degrees in leading Bulgarian universities. Our findings indicate that students generally positively evaluate the efforts of universities to digitize the educational process. At the same time, some aspects of the educational process - such as the assessment in a digital environment, or the provision of administrative services - such as the application for dorm accommodation, which should be improved, are outlined. However, the need to make constant efforts to protect personal data and provide quality educational digital content is considered. We propose 9 complex indicators for assessment the effectiveness of digitalization in university.

Keywords: digitalization; higher education institutions; digital educational resources; digital education

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1. Introduction

One of the most important objectives in front of every Higher Education Institution (HEI) is to provide quality education in order to prepare well next talented young people for the challenges of the labor market. At the same time, this educational service must be consistent on the one hand with the requirements of the business, and on the other - with the educational standards and the maintenance of high-quality education. In the era of information and communication technologies (ICT) and the extremely strong development of Artificial Intelligence (AI), it is impossible to provide quality education if a high level of digitization is not sufficiently ensured. The process of digitalization in HEIs has to be considered as multifactorial and complex and respectively the determination of indicators for its effectiveness is the main object of the current study.

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From the very first universities to our days, it can be said that they are not just institutions of education where some people try to transfer their knowledge and skills to other people. Universities create an entire environment, worldview, form critical thinking, encourage their students to discover and develop their potential and opportunities. In this sense, every single university can be seen precisely as an opportunity for young people - to prove themselves that they know, that they can, and that they are ready for the challenges of tomorrow – equipped with knowledge skills and abilities required by business organizations.

For any serious university nowadays, digitization and the digitization process are a key to guaranteeing a quality education recognized by academy community, young people and businesses. Of course, digitization can be found in everything - from a quality university website that is easy to navigate, search for information and provide access to any educational platforms, through online application, inclusion in certain courses and access to digital educational resources to, for example, submitting documents for student accommodation.

The key understanding of digitalization, shared by the authors of the current article, should be sought not in the exact reproduction of the traditional process in a digital environment and their implementation with digital tools, which simply copy the currently existing traditional process, but in the way to improve its efficiency - less time, less resources, more options, etc. Therefore, just having a digitized process is not enough prerequisite to ensure efficiency of organization - it is necessary to consider these processes in their complexity and systems and in the opportunities for improvement. The present article defines namely the indicators for securing effectiveness of the digitalization in HEIs. The proposed indicators are identified on the base of the empirical survey among 360 students in leading Bulgarian universities.

2. Theoretical background

Digitization, digital services and their applicability in all aspects of our modern life are in the top focus of the scientific discussion and interest for the last few years. This interest is logical and easily explicable due to the fact that digitization and the provision of digital services can bring the development of any organization to a completely new level. The business organizations are the most adaptable and flexible to the rapidly changing demands of the external environment, but the public authorities and organizations from other social systems have also changed following the digital trends, albeit at a slower pace.

The interaction between universities and industries in terms of digital transformation and digitization is one of the most vivid scientific discussions at the moment. For some researchers this collaboration is considered as a driver needed both for industries and universities for achieving sustainable transition to the new economic development. Evans, Miklosik and Du (2023) consider that the advantages of the partnership between businesses and universities encompass gaining valuable resources, validating work, facilitating learning and teaching opportunities, financial gains, enhancing reputation, and advancing career prospects. Albats, Alexander and Cunningham claim that intermediaries in relations universities and industries are shifting from physical to virtual and digital formats. Some interesting researches in the relation line between industry and universities but in more general context are explored by different scholars: Meissner et al. (2022) focus on the role of the labs, created as a result of partnership between industry and universities; Roncancio-Marin et al. (2022) consider the social impact of this collaboration; Alpkan and Gemici (2023) examine the synergy effect from this partnership for the product innovations; Zhang et al. (2021) explore the role of this collaboration for the creation of new technology companies. Silva et al. (2021) made comprehensive research to identify the milestones of successful collaboration and propose a model for sustainable partnership.

Based on a comprehensive research and data analysis, Ma and Li (2022) revealed an interesting correlation between the level of digitalization and from the other side – relations between enterprises and universities. They concluded that the digitization process facilitates the transfer of knowledge from universities to businesses and identified indicators to assess digitalization in different dimensions. The scholars selected indicators covering 5 different aspects of digitalization which are: digital facilities, digital carriers, digital communications, digital applications, and digital finance (ibid).

The possibilities of digital learning, as well as its limitations, is also one of the main topics when it comes to digitization in education system, especially after COVID-19 pandemic. Liu et al. (2023) made an interesting research on the digital capability of university students, and concluded that for students, attributes such as innovative capability, the application of big data, and employability skills are crucial factors connecting digital capability with sustainable behavior. Similar research was made by Reinhold et al. (2021) whose major conclusion is that positive attitude of students towards e-learning is the key element for success in digital education. Different aspects of e-learning coming from different countries around the world and its impact on both on students and teaching staff is explored by Zaharia et al. (2022), Weerarathna et al. (2023), Liu (2023), Stoykov and Petrova (2023); Angelova (2020), Salahshouri et al. (2022), Manjeese (2022), Al-Okaily et al. (2020) etc.

Tautz, Sprenger and Schwaninger (2021) focus their scientific interest on the digital tools that could improve digital learning such as Virtual reality, question tools, classroom response system, lecture recording etc., in order to understand their impact for the active learning of students. Their main finding is that the students are willing to use digital tools in learning and consider this as a form of diversity (something new), which enrich the lecture (ibid).

Liu, Lee and Huang (2023) explore the possibility how could be boosting creative confidence, motivation for learning, and the collaborative creative performance of university students in design thinking through the utilization of a digital visual collaborative environment. Elnadi and Gheith (2023) on the other side pay attention on the role of individual characteristics of students for their digital entrepreneurial skills and intention to do digital business. They found out that digital competence as well as passion and curiosity are key factors for digital business intention. In this line comes the research of Demsash, Emanu and Walle (2023) who explores the digital technology and its level of exploration from university students. Scholars made empirical research among university students for their digital skills and usage of technologies and outlined several factors for good level of digital exploration such as: previous computer experience, favorable attitudes, good internet access (ibid). Almost the same subject is explored by Alferaih (2022), who also study the intentions of the university students for doing digital entrepreneurship. Scholar admit that factors such as attitude, subjective norm, perceived feasibility, perceived desirability, propensity to act, digital entrepreneurial education, and innovativeness play a substantial role in influencing entrepreneurial intentions. Additionally, perceived behavioral control and self-efficacy significantly impact actual entrepreneurial behavior (ibid).

Chan, Krishnamurthy and Sadreddin (2022) investigate the ways in which digital tools, particularly technologies encompassing social, mobile, analytics, and cloud (SMAC), enable both internal and external interactions within university incubators and various participants in the entrepreneurial innovation ecosystem.

Some of researchers explore the specific digital services provided by universities. For instance, Litoussi et al. (2022) consider the practice of universities for providing digital certifications (such as official academic transcript, registration certificate, diploma) and propose a model for decentralization of digital certification using blockchain technology. Ahmad and Rafiq (2022) assess the level of digitalization readiness of the university libraries and secure the digital preservation of the available literature. The results of their research reveal that libraries demonstrated a high level of readiness only in terms of having sufficient funds for acquiring technological infrastructure, while lack of adequate policy and procedure for digital preservation, training opportunities and skilled human resources are pointed out as insufficient (ibid).

Zeqiri et al (2023) admit that students' satisfaction nowadays is a complex magnitude, but on the other side, the quality e-services provided by university, including trough web-site and intranet pages of the universities are one of the factors that are directly connected and impact the students' satisfaction.

Guerrero, Heaton and Urbano (2021) explore the real possibility of new level of development of universities through the Massive Open Online Courses (MOOCs) which they consider as a chance for university to regain competitive advantage in digital era and digital economy. The main benefit that MOOCs provided, identified by Ogunyemi, Quaicoe and Bauters (2022) is the huge potential for massive audience which is geographically dispersed and absolutely heterogenous in its basic characteristics. On the other side, Dang, Khanra and Kagzi

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(2022) study the limitation in front of the MOOCs and reveal the following major groups – usage barriers, value barriers (including poor content quality etc.), tradition barriers and image barriers (including accent of the lecturer etc.). Interesting researches for different aspects of MOOCs are developed by Wong, Baars, de Koning and Paas (2021), Aparicio et al. (2019), Weinhardt and Sitzmann (2019), Janelli and Lipnevich (2021) and others.

On the other hand, McLean, Maalsen and Lake (2022) pay attention to something very important – how university can secure the digital sustainability in long terms period. They conducted a study at the University of Sydney and one of the conclusions they reached was that digital sustainability is not yet at the center of strategic sustainability planning efforts.

In summary, the process of digitization in universities represents a transformative journey that extends beyond mere technological integration. Embracing digitization opens avenues for enhanced learning experiences, improved collaboration, and increased access to information. The benefits extend to both students and educators, fostering a dynamic and interactive educational environment. Additionally, digitization enables universities to streamline administrative processes, optimize resource utilization, and stay abreast of evolving educational trends.

3. Methodology of the research

Our main objective of the current study is to identify workable indicators for determining the effective level of digitalization in the higher education institutions, considering the two major aspects in any university: the core educational process itself (with all levels and forms) and all accompanied services – including different administrative services and securing access digital record and online educational platforms and resources. This study is a part of the entire scientific project title, financed by Bulgarian Science Fund.

In order to achieve the above-described objective, we implemented the followed methodological steps, presented in Table 1.

Table 1. Methodology, used for the achieving the main objective of the research

METHODOLOGY OF THE RESEARCH	
1.	Discussion and determination of the most thorough and effective way to achieve the research objective
2.	Preparation of questions for semi-structured interviews and task allocation between authors
3.	Identification of the major target groups and their concrete representatives for the interviews
4.	Collecting initial information through semi-structured interviews
5.	Developing an initial set of questions to be used in the questionnaire
6.	Pilot testing the quality of questions and their order in the questionnaire
7.	Finetuning of the questionnaire according to the result of the pilot test
8.	Distribution the questionnaire
9.	Conducting the empirical study – collect responses
10.	Analysis of the collected information
11.	Identification of workable indicators for the assessment of the effective level of digitalization in HEIs

Our first step was to discuss and agree on the most appropriate and effective approach for the overall methodology of the research. In order to obtain initial information about the process of digitalization in university, we decided to conduct several semi-structured interviews (21 in total) with different representatives of our major target groups - academic staff, management body, administration and students. Although different groups can be presented in more comprehensively, for the purposes of our study we have identified the above four groups, with their main roles in the digitization process of a university shown in Table 2.

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Table 2. Major target groups, their role and characteristics in the digitalization process of a university

Main target groups	Role	Characteristics
Management Body	Decision makers	They lead the entire process of digitizing the university, including making decisions about the different systems to be used, ways to ensure connectivity and security. They are also the people who make decisions about the overall strategic development of digitization in the university.
Academic Staff	Users with different level for access and activities	Regarding the different platforms used for distance learning, the academic staff should have more rights than the average user - including managing different groups, being able to create groups, assign tasks and monitor deadlines for their completion, etc. At the same time, in purely administrative aspect, academic staff has access to the systems for entering and signing grades - i.e. to student files etc.
Administration	Service and maintenance	Administration representatives at each university are responsible for maintaining systems and providing administrative services, from different documents to applying for scholarships. At the same time, the administration works on a daily level with these systems, enters information and their opinion is very important in relation to the overall digitalization approach of the university.
Students	Users	The most important target group, as universities are devoted to create communities of active, intelligent young people. In the sense of digitalization, they are the main users of university systems, especially in terms of access to platforms with educational materials and platforms on which distance online learning takes place. At the same time, however, students are also users of all accompanying administrative services, provided by universities. All this means that the final evaluation of the effectiveness of the level of digitization should be done precisely by this target group, since they are also the final beneficiaries.

The information collected as a result of these interviews we considered as very important for proper understanding of the overall digitalization of one university and not only the point of view of some of the stakeholders. However, even at this early stage of the research, differences in the focus of our target groups emerged. For example, for the representatives of the management structures, the emphasis was placed on ensuring the security of data and personal information of students and staff, for the representatives of the administration themselves, the most important thing was the easy maintenance and service of the various systems, as well as their connectivity, so as not to be required repeatedly or several times entering the same information into different systems. At the same time, academic staff emphasizes the preservation of the quality of the educational process and the need to keep the attention of students in a digital environment, including by using various digital new tools for this purpose. In turn, for students, one of the most important advantages is the possibility of easy access to educational resources and the possibility of a facilitated / distance educational process.

Based on the information, collected and analyzed from the semi-structured interviews, we developed an initial set of questions to be used in the questionnaire of our main research. Given the depth of the research, the initial version of the questionnaire was pilot-tested among students (as focus group), who were asked to say whether they understood the questions, whether there were questions with pre-formulated answers that did not fully exhaust the possible range of answers, whether they thought the questions themselves were correctly asked, lack of Ambiguity, etc. In general, the questions were relatively well developed, but it was necessary to reformulate three questions in order to achieve greater clarity.

After finetuning of the questionnaire, we distributed the information for survey among students in different universities. As a result of our efforts, we received 360 answers from university students both in Bachelor and Master degree.

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4. Survey Results and Discussion

First section of the questionnaire collects information for the students' profile (Table 3). The profile of our responders indicates serious predominance or representatives coming from the public university (91,1%), while the responders of the private universities remain modest (8,9%). This situation is easily explicable considering the fact that there are 52 universities in Bulgaria in total and the majority of them are public. According to data from the National Statistical Institute, approximately 12% of the university students in Bulgaria are in private universities. On the other hand, the administrative fee of the private universities could be considered as some kind of barrier in front of all young people who desired to study. Therefore, the number of students in private universities is in general smaller than the number of students in public universities, which fact is visible in our collected data.

Table 3. Combined data for the responders' profile (in %)

Combined data for responders profile		
Status of the university	**Public**	**Private**
	91,1	8,9
Form of Education	**Regular**	**Distance Learning**
	91,4	8,6
Type of Educational Degree	**Bachelor**	**Master**
	95,6	4,4

In terms of form of education, the majority of our responders are in regular form (91,4%) and only 8,6% are students in Distance Learning form. This result does not really represent the correct proportion between students in the different forms of education. It is clear that our questionnaire was taken more seriously and more responsibly by the students in a regular form of education, while it did not arouse any interest at all in terms of students in distance learning. This can also be explained by the fact that distance learning students usually choose this because they work and study at the same time, which also explains their less commitment to a voluntary university study.

The vast majority of respondents are studying at a bachelor's degree, which is also understandable considering that a bachelor's degree is four years long, while a master's degree is between 1 and 2 years.

The second part of the questionnaire contains the questions on the assessment of the different aspect of digitalization in university, starting with those concerning education process. The next two questions are focused on the assessment of the learning process in digital environment. On the question "Did you like that the study was flexible – you could study from different places and at different times?" the accumulated results show that a large part of the responders rated positively the flexibility of the digital learning. A convincing 70,3% of responders declare their positive attitude to the flexibility which is one of the leading strengths of the digital learning process, versus only 25% whose assessment is negative. This question collects also almost 5% of hesitant students, who find some aspects of digital learning as positive and some – as negative ones (Fig. 1).

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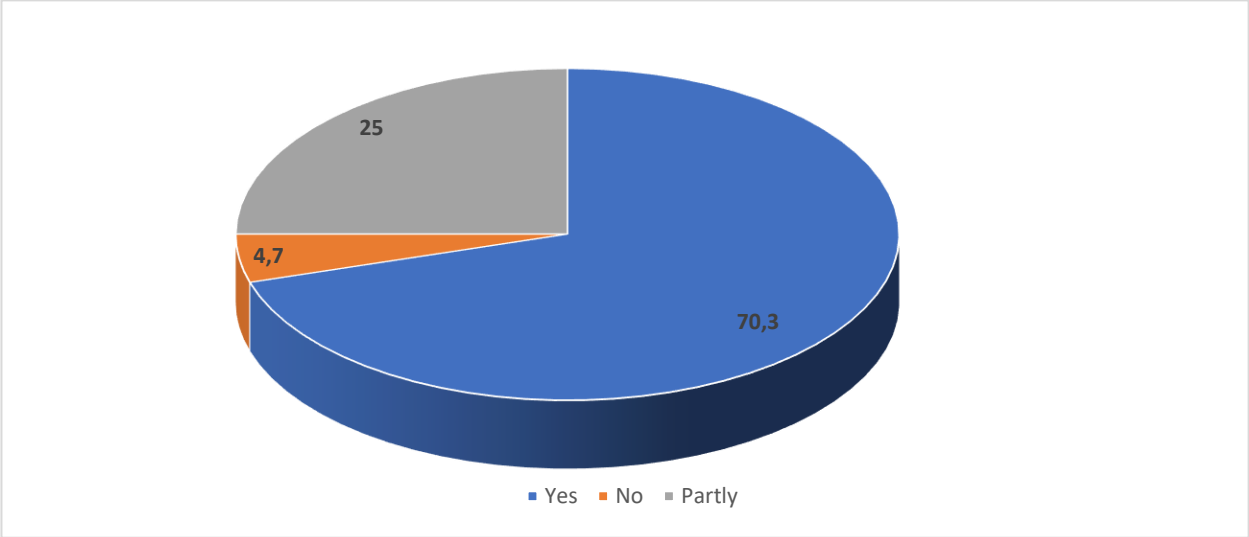

Fig. 1. Assessment the flexibility of digital learning, in %

"Did the new type of learning lead to higher personalization (to have emphasis / attention on the needs and problems of each individual learner)" is the following question from the questionnaire. Here there is no such predominant preferred answer as was the previous question. However, 43,6% from responders admit that this type of learning meets individual needs of student and other 33,6% claim that these needs were met only sometimes. Here the share of responders with direct negative assessment is 22,8% which fact is indicative of the level of satisfaction or lack of satisfaction with regard to personalization achieved in digital learning (Fig. 2).

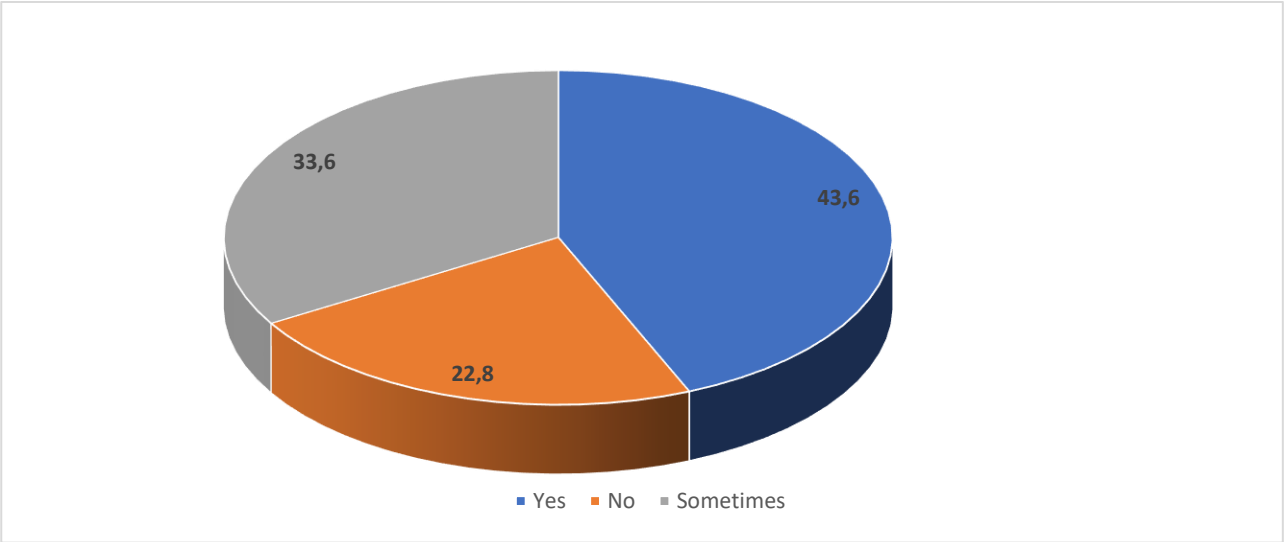

Fig. 2. Flexibility assessment of digital learning, in %

The next question "Was remote assessment good and effective?" presents an interesting distribution of answers (Fig. 3). Here the major part of responders claims positive assessment.

The completely opposite opinion is shared by 12,2 % of the respondents, who strongly disagree that remote assessment is good and effective. Here we have two other answers, the first of which (preferred for 11,1% of the responders) contains negative assessment for the start of the period, but at the same time – recognition that the assessment was improved during the time. However, 18,9% claimed to be rather positive about the current state of assessment now, but at the same time they admitted that they expect further improvement and development.

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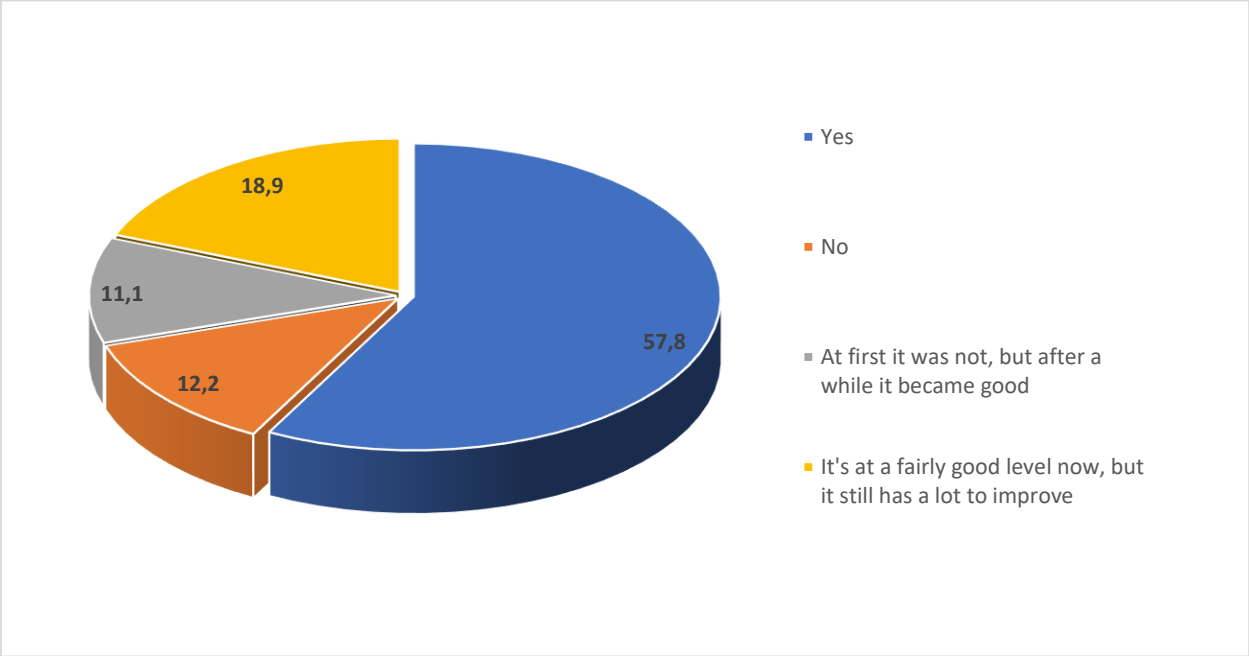

Fig.3. Evaluation on the remote assessment effectiveness, in %

The next question "What is the degree of digitization of the process of application and admission of students at the university" collects information for the overall process and for specific typical services conducted for this purpose: Document application; Acceptance of application documents; Admission to exam; Conducting competition exam; Admission of students based on their grades; Enrollment of newly admitted students (Fig. 4).

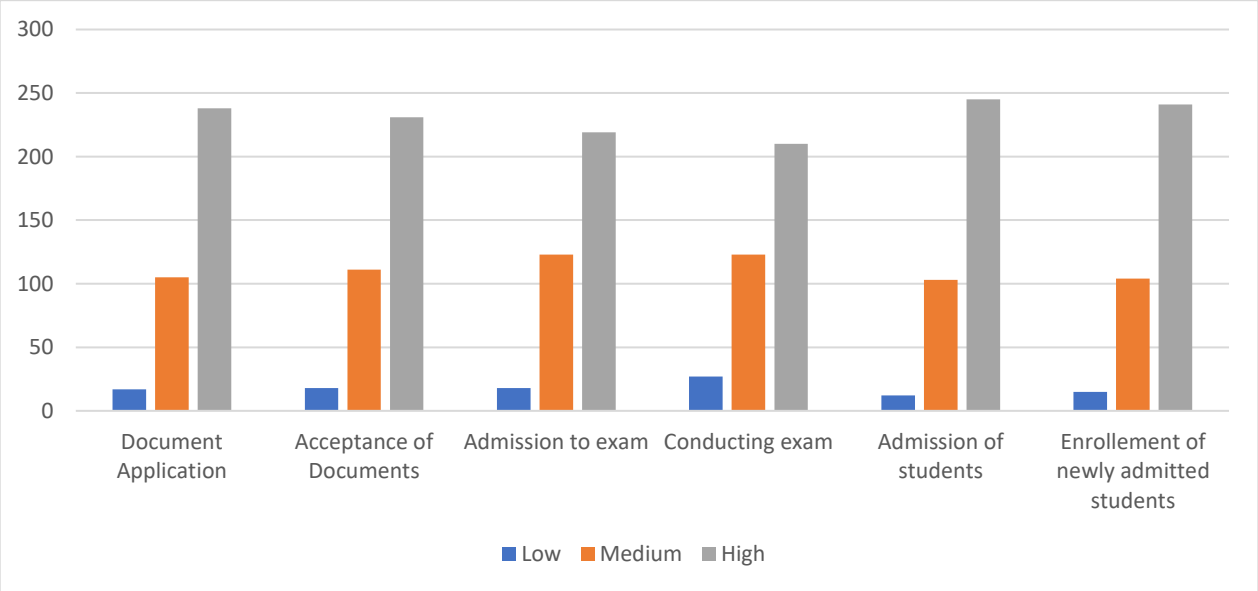

Fig.4. Assessment of the application and admission process of students at the university

As it can be seen on the figure above, the students predominant assess the level of digitalization of the process for application and admission in universities as high, with slight differences between different operations. According to their opinion, the admission of students based on their grades is the operation with highest level of digitalization, while the conducting of competition exam for admission is the operation with lowest level of digitalization (but this assessment still remains positive for the serious majority of responders).

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The next question measures the level of digitalization of traditional administrative services for students. Here the results, especially compared to the results of the previous question, show that there are specific activities where the digitalization has to be drastically improved (Fig. 5).

Results indicate that service for Dorm Accommodation achieves the lowest assessment in terms of digitalization. This finding is clear evidence that students' satisfaction on the digitalization level of the procedure for dorm accommodation remains insufficient and has to be further developed. At the same time this procedure is the only one from four, where the number of responders choosing assessment "medium" is highest than the number of responders with answer "high" for the level of digitalization. Apparently, the digitalization of the Study Schedule in the majority of the Bulgarian universities achieved the highest level of recognition from the students.

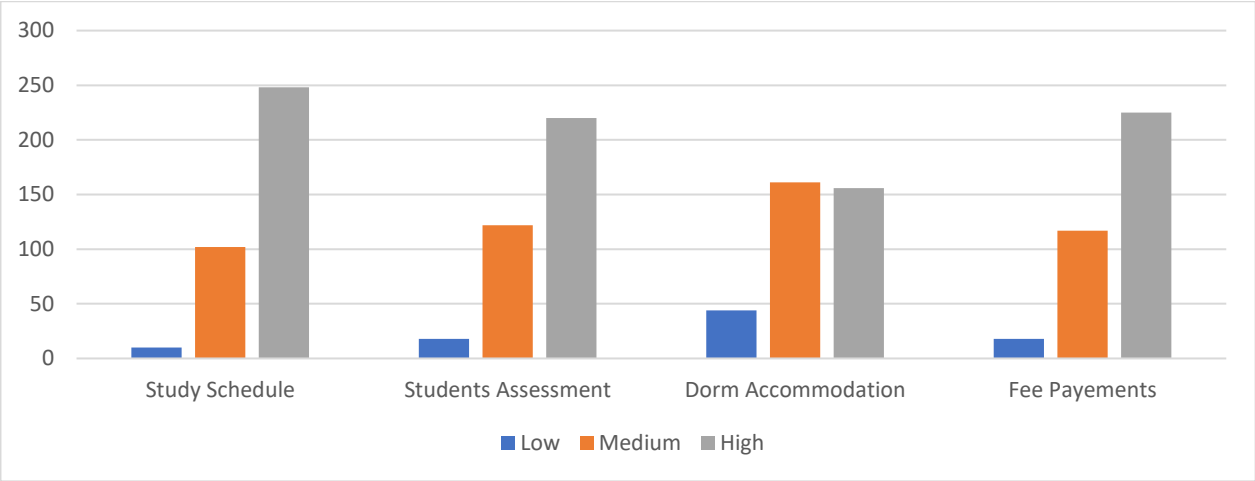

Fig. 5. Assessment of level of digitalization of traditional administrative services for students

Next question measures the level of digitalization in different forms of education – regular (full-time), part-time and distance learning. The results are explicable, considering the general idea behind these three forms of education. According to our responders, the digitalization in distance form of learning accumulates the highest assessment, while the digitalization in part-time learning remains the lowest (Fig. 6).

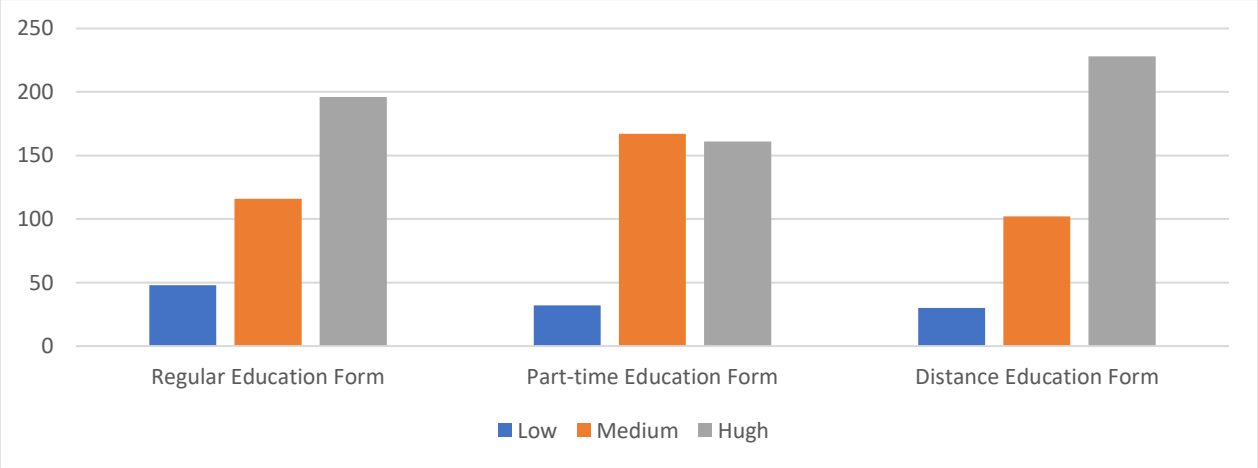

Fig.6. Assessment the level of digitalization in different forms of education

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The results obtained for the next question reveal a clear picture for further improvements and development of the level of digitalization, developed so far by the universities. Interesting finding is the fact that students assess the level of digitalization during lectures higher than the level of digitalization during seminars. On the other hand, depending on the subject of the education itself, the lecture usually is more theoretically focused rather than the seminars, where it is expected to developed some skills and abilities more closely connected to the practice. In this regard sometimes, the digitalization could be difficult where the practical exercises are required (for engineering students, medicines students etc.). At the same time, the digitalization during the exams gains the highest level of assessment, comparing to the other activities. This is also logical, considering the fact that in almost all universities there are built test centers, used for this purpose (which support also the effort of the academic staff in assessment of students).

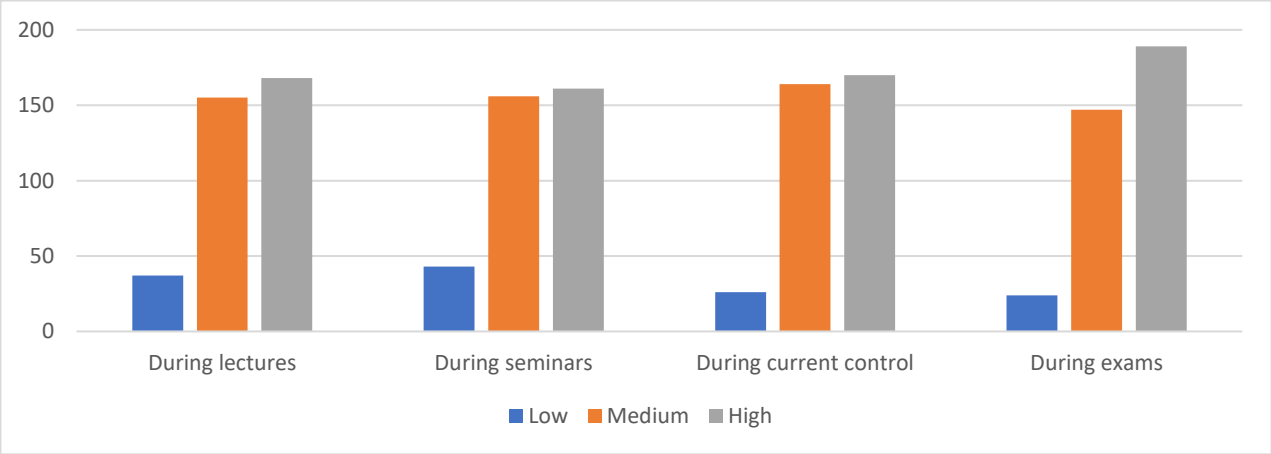

Fig. 7. Assessment the level of digitalization in different educational activities

One of the major problems when we explore the quality of educational process in digital environment is the content of educational material. The next two questions focus attention namely in this serious aspect of digitalization in HEIs. The question "Should educational institutions ensure/improve their online content and resources to be accessible to people with disabilities" shows the understanding of students on the accessibility of materials and resources for disable people (Fig. 8).

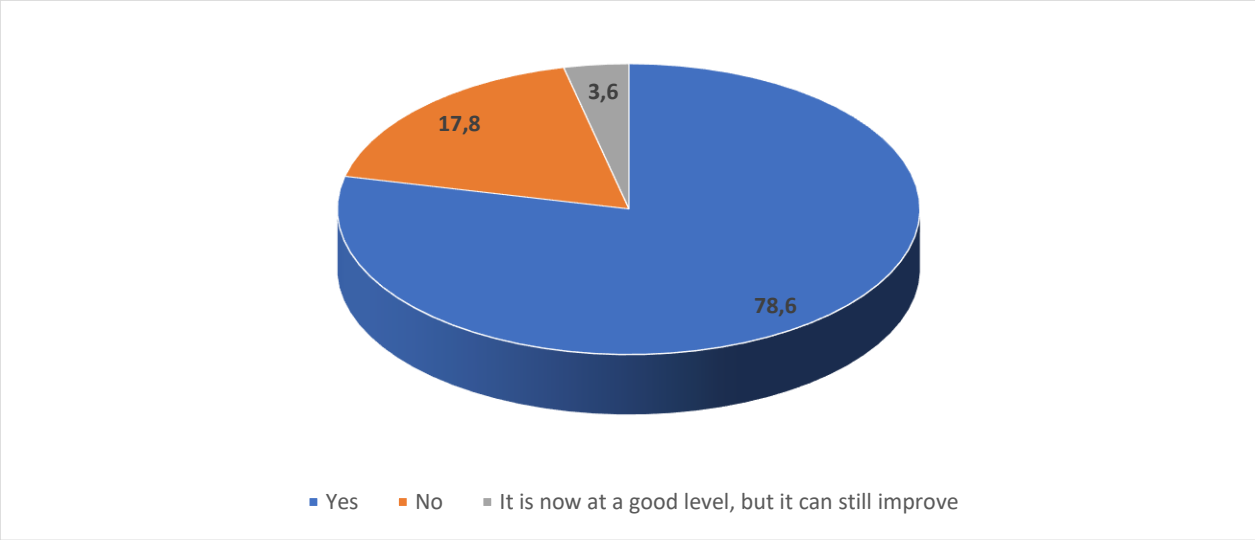

Fig. 8. Assessment the quality and applicability of digital resources and materials for students with disabilities, in %

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The majority of responders claim that there is a clear necessity of improving the applicability and accessibility of digital materials and resources to be adapted for students with disabilities (78,6%). At the same time, another almost 20% (17,8%) felt that the materials available were of good quality, but could still be further improved and only 3,6% consider that the current quality of materials is good and therefore, it does not need to be upgraded.

The opinion of students on the quality of the educational materials and its adaptation is collected through the following question "Is it necessary to develop high-quality digital educational content that is brand new and aligned with curriculum standards?". The obtained results indicate unambiguously that university students in Bulgaria found the necessity of developing new content appropriate for digital learning and digital environment (Fig.9).

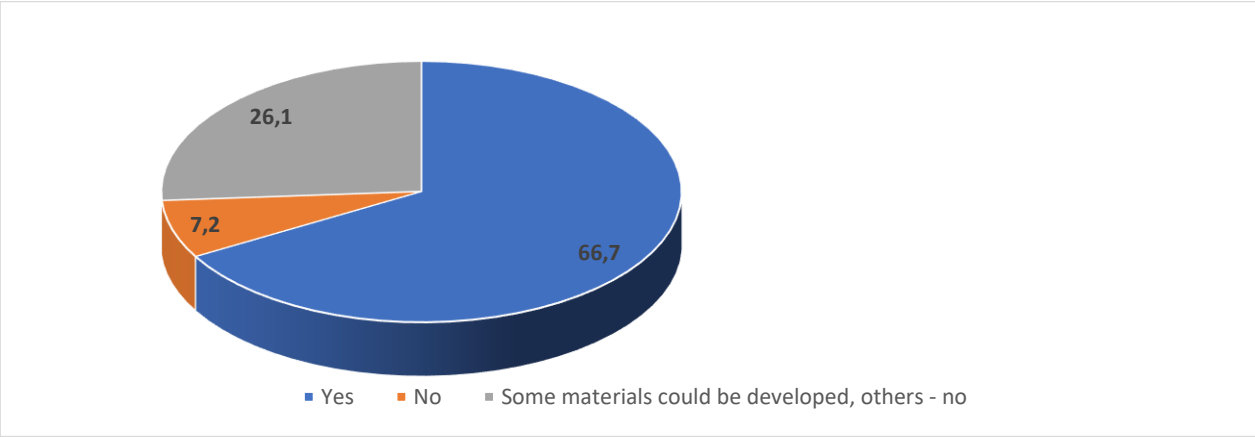

Fig. 9. Assessment the necessity of the development of brand-new digital content of educational materials, in %

When we consider digitalization, the problem for protection of personal data remains one of the important topics that has to be payed special attention, considering the speed of development of ICT, including the possibility of emergence of new threats and sophistication of hacker attacks. The answers of the question "Is it important to increase measures to protect students' personal data and ensure the security of online platforms?" presents the understanding of students for further development and guaranteeing protection of the personal data (Fig. 10).

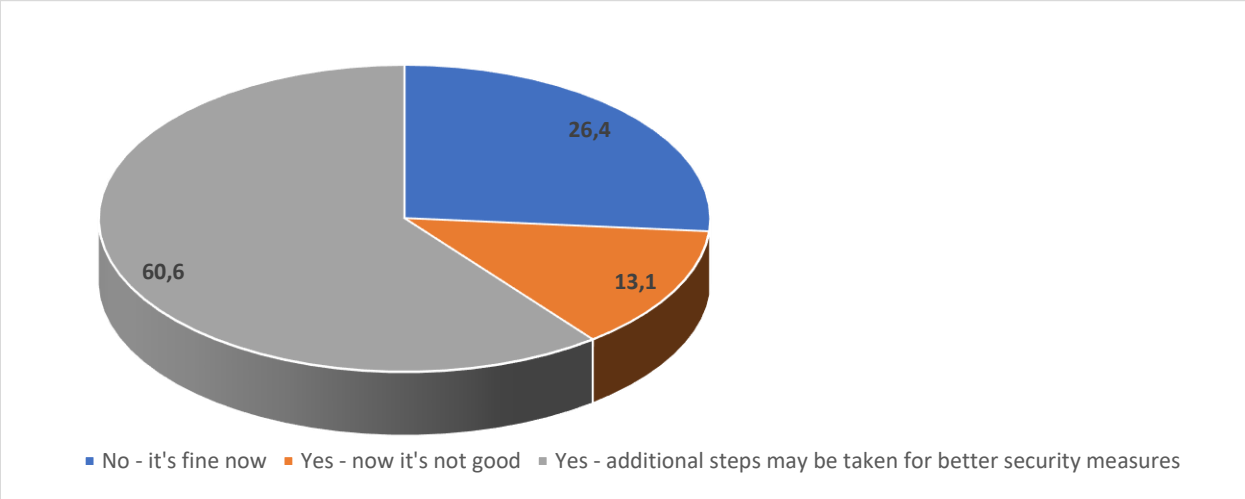

Fig. 10. Assessment the level of personal data protection of university students in digital environment, in %

As it can be seen from the figure, the majority of responders (60,6%) admit that additional steps for better security measures in digital environment could be taken. This result is in line with the responsible understanding

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that cyber security must be seen as a continuous improvement process, parallel to the development and advancement of ICT technologies. At the same time 26,4% from our responders claim that the universities put enough effort into securing personal data and the current state of the systems is good enough.

Results, obtained through the question "Is it necessary to develop and improve hybrid learning models that combine both face-to-face and online elements?" clearly draw the expectation of university students (Fig. 11). The majority of them (almost 80%) find the future development namely in hybrid learning, combining the advantages of different forms to achieve high quality education in compliance with the new technologies and business requirement.

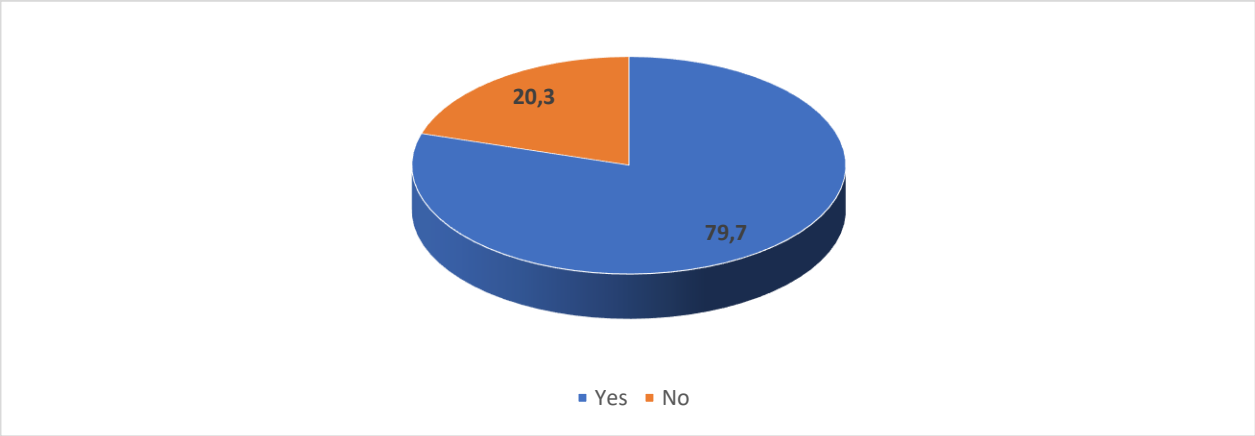

Fig.11. The attitude of students to hybrid learning process (both in traditional and digital environment), in %

Next question is the following: "Do student assessment methods need to be revised and refined to align with the positives and negatives of online learning?" and it is not surprising the fact, that the majority of responded students answer with "yes" (76,1%) versus only 23,9% whose answer is "no". Therefore, it would be useful to come up with a comprehensive toolkit related to ensuring a fairer assessment of knowledge in digital evaluation process.

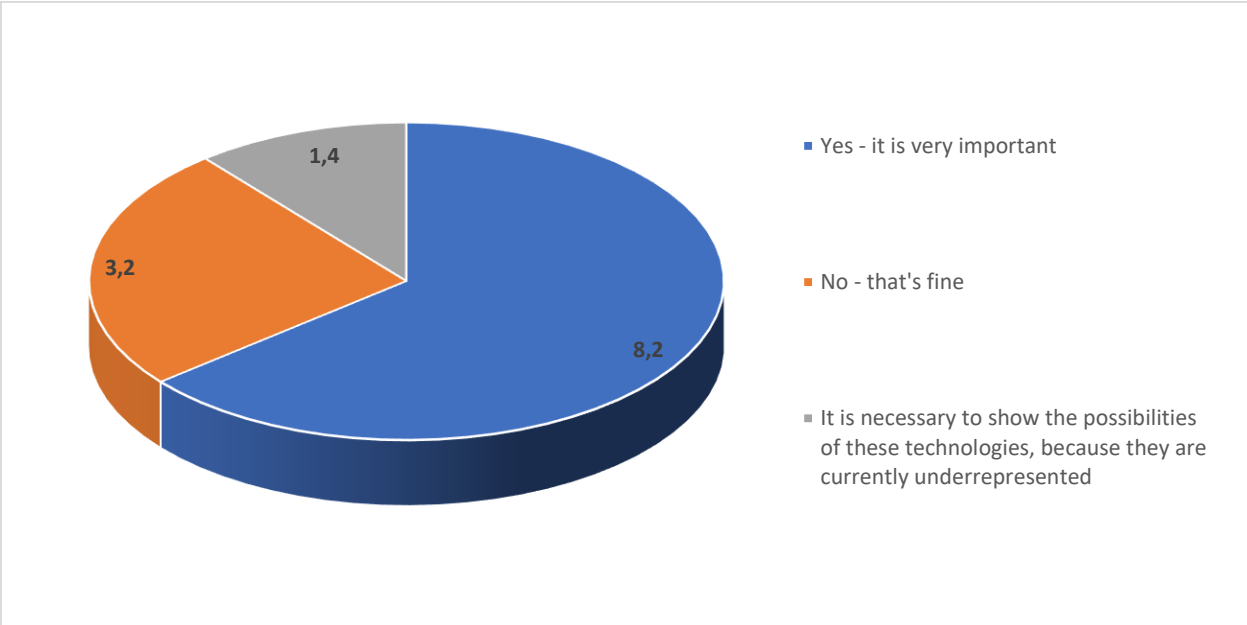

Fig.12. Further adoption of innovations in education process, in %

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The final question collects information on the students` opinion for the further implementation of innovations in digital learning process. The majority of responders answered positively (almost 80% in total) to the question „Is there a need to focus on additional innovations in educational technology, including gamification, virtual reality, etc.?“. For almost half of the responders (47,5%) the innovations in digital learning process are very important aspect of the education. At the same time 31,7% of responders consider that these new technologies are poorly implemented at the moment and have to be further integrated in the learning process. Only 20,8% think that current state of play is fine and there is no need to be improved (Fig. 12).

In summary of the presented results of the empirical research, it should be said that students generally positively evaluate the efforts of universities to digitize the educational process. At the same time, some aspects of the educational process - such as the assessment in a digital environment, or the provision of administrative services - such as the application for dorm accommodation, which should be improved, are outlined. However, the need to make constant efforts to protect personal data and provide quality educational digital content is considered.

5. Identification of workable indicators for the assessment of the effective level of digitalization in HEIs

Based on the results and analysis of the research as well as authors study of different processes and systems of the universities in terms of digitalization, it could be identifying the following indicators for the assessment of the effectiveness of digitalization in HEI:

5.1. Online learning platforms adoption

The extent to which the university has adopted online learning platforms like Learning Management Systems (LMS). Online Learning Platforms Adoption refers to the incorporation and utilization of digital platforms designed to facilitate teaching and learning activities in higher education institutions. Common examples of these platforms include Moodle, Canvas, Blackboard, Sakai, and others. These platforms serve as centralized hubs where it can be organized course materials, facilitate communication, and administer assessments. Higher adoption of online learning platforms can streamline administrative tasks for instructors, making it easier to manage course materials, communicate with students, and assess learning outcomes. At the same time online platforms offer students greater flexibility in accessing course materials and participating in learning activities, potentially accommodating diverse learning styles and schedules. By tracking usage metrics and engagement levels on the online platform, university staff and managers can make data-driven decisions to improve teaching practices, allocate resources effectively, and enhance the overall educational experience for students.

The usage metrics such as course enrollment, content creation, student engagement, and assessment activities can indicate the level of digital integration in the teaching and learning process. Course Enrollment: This metric measures the number of students enrolled in courses offered through the online learning platform. Higher enrollment numbers typically indicate greater adoption and utilization of digital platforms across the university's curriculum. Content Creation: It evaluates the extent to which instructors are utilizing the platform to create and distribute course materials such as lecture slides, readings, videos, quizzes, and assignments. Metrics might include the number of new content uploads, types of content shared, and frequency of updates. Student Engagement: This metric assesses the level of student interaction and participation within the online learning environment. It could include indicators such as discussion forum activity, participation in virtual classrooms, and submission of assignments. Assessment Activities: It evaluates how extensively assessments, such as quizzes, tests, projects, and assignments, are administered and graded through the online platform. Metrics might include the number of assessments conducted online, variety in assessment types, and timeliness of feedback provided to students.

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5.2. Digital resources availability

Availability and accessibility of digital resources such as e-books, online journals, databases, and multimedia materials and other digital assets, which are accessible to students, academic staff, and researchers through the university's library and online repositories.

Metrics for assessment of this indicator could be the following: quantity – by measuring the total number of digital resources available within the university's library and online repositories. It includes the total count of e-books, online journals, databases, and multimedia materials accessible to users; Coverage of digital materials: It evaluates the breadth and depth of subject coverage across different disciplines and fields of study. The richness and diversity of these resources can reflect the institution's commitment to digitalization in supporting research and academic activities; Accessibility and usability: the ease of access and usability of digital resources, including user interface design, search functionality, navigation tools, and availability of user support services. Here have to be added materials adopted for the needs of university students with disabilities; Statistics: Tracking usage statistics such as downloads, views, citations, and interactions with digital resources provides insights into the popularity and relevance of specific materials among users.

5.3. Available technology infrastructure

Available technology infrastructure refers to the physical and virtual resources, including hardware, software, networking capabilities, and support services, that are accessible to students, faculty, and staff within the university ecosystem to enable effective utilization of digital technologies. This indicator assesses the adequacy and accessibility of technological resources and support systems within a university to facilitate teaching, learning, research, and supportive administrative activities. It measures the quality and robustness of the technology infrastructure including network bandwidth, Wi-Fi coverage, computer labs, and availability of digital tools for students and faculty. A reliable and up-to-date infrastructure is essential for facilitating digital learning, research, and administrative tasks.

The indicator could be measured by the following metrics: Coverage and Accessibility: assessment the accessibility of technology infrastructure across different campus locations, including classrooms, laboratories, libraries, study areas, administrative offices, and remote learning environment; Reliability: it assesses the reliability, speed, and performance of technology infrastructure components such as network connections, hardware devices, and software applications to ensure uninterrupted access to digital resources and services; Scalability and Future Development: This metric examines the scalability and capacity of technology infrastructure to accommodate growing user demands, technological advancements, and emerging trends in digitalization, ensuring long-term sustainability and future readiness; User satisfaction and feedback: gathering feedback from students, both academic and administrative staff through surveys, focus groups, and feedback mechanisms helps in assessing user satisfaction levels, identifying areas for improvement, and addressing specific needs and preferences related to technology infrastructure.

5.4. Virtual collaboration tools usage

Utilization of virtual collaboration tools such as video conferencing platforms, online project management tools, and communication platforms. These tools enable remote collaboration among students and staff, promoting teamwork, communication, and productivity. Virtual collaboration could be implemented using: Video Conferencing Platforms: Examples include Zoom, Microsoft Teams, Google Meet, and Cisco Webex. These platforms enable real-time audio and video conferencing, screen sharing, chat, and collaboration on documents and presentations; Collaborative Document Editing Tools: Platforms like Google Docs, Microsoft Office Online, and Dropbox Paper allow multiple users to collaborate on documents, spreadsheets, presentations, and other files simultaneously, facilitating collaborative editing and version control; Instant Messaging and Chat Applications: Tools such as Slack, Microsoft Teams, Discord, and WhatsApp provide instant messaging, group chat, file sharing, and integration with other productivity apps, enhancing communication and collaboration among team

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members; Project Management Software: Platforms like Trello, Asana, Basecamp, and Jira enable teams to plan, organize, track progress, assign tasks, and collaborate on projects using visual boards, task lists, timelines, and workflow automation feature; Virtual Whiteboarding Tools: Applications like Miro, MURAL, and Jamboard allow users to create and collaborate on digital whiteboards, diagrams, mind maps, and visual presentations, facilitating brainstorming, ideation, and collaborative problem-solving.

5.5. Integration of data analytics

This indicator assesses the extent to which a university utilizes data analytics techniques and tools to gather, analyze, and derive insights from various sources of data across academic, administrative, and operational domains. Adoption of data analytics tools and techniques for decision-making processes such as student performance analysis, course optimization, resource allocation, and strategic planning. Leveraging data analytics can enhance operational efficiency and effectiveness in various aspects of university management.

Integration of Data Analytics refers to the incorporation of data analytics methodologies, technologies, and practices into the university's decision-making processes, academic programs, research endeavors, student support services, and administrative operations to drive insights, improve performance, and enhance outcomes. This involves collecting, organizing, and managing diverse sources of data generated within the university ecosystem, including student information, academic records, research data, financial transactions, institutional operations data, and external data sources. This indicator includes Data analysis and modeling, Data Reporting, Predictive Analytics and Machine Learning.

5.6. Electronic Document Management

Implementation of electronic document management systems (EDMS) or digital repositories for storing, organizing, and managing administrative documents and records electronically. It assesses the extent to which a university has implemented digital systems and processes for the creation, storage, organization, retrieval, sharing, and management of electronic documents and records across various academic, administrative, and operational functions. EDM refers to the systematic management of electronic documents and records throughout their lifecycle, from creation or receipt to disposal or archiving, using digital technologies and tools to improve efficiency, accessibility, security, and compliance. This includes digitizing paper-based documents, enabling electronic signatures, and ensuring document version control and access permissions.

Metrics for assessment could be the following: adoption and utilization of electronic document management systems and tools across academic departments, administrative units, and operational functions within the university; Accessibility and usability: It assesses the ease of access, navigation, and usability of electronic document management systems for users, including students, administrative and academic staff, and external stakeholders, through user satisfaction surveys, feedback mechanisms, and usability testing; Efficiency and productivity - the impact of electronic document management on workflow efficiency, productivity gains, time savings, reduction in paper-based processes, and elimination of manual tasks such as printing, copying, filing, and physical document storage; Compliance and Risk management - the degree to which EDMs comply with relevant legal, regulatory, and institutional requirements, including data protection laws, records management policies, retention schedules, and audit trails; Cost Savings and ROI - cost-effectiveness and return on investment (ROI) of electronic document management initiatives, including savings in paper, printing, storage, and administrative overhead costs, as well as improvements in operational efficiency and productivity.

5.7. Digital marketing and recruitment efforts

The university's digital presence and activities in marketing, recruitment, and student engagement through social media, websites, online advertisements, and virtual events. This indicator assesses the effectiveness of a university's digital strategies and initiatives aimed at attracting, engaging, and converting prospective students and stakeholders through online channels and platforms. Digital Marketing and Recruitment Efforts refer to the strategic use of digital channels, technologies, and tactics to promote the university's brand, academic programs,

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campus culture, and unique value proposition to prospective students, parents, alumni, business, partners, and other stakeholders.

Components of the digital marketing could be: Online Presence and Branding – establishing a strong and cohesive online presence through the university website, social media profiles, blog posts, videos, virtual tours, and other digital platforms to showcase the institution's brand identity, values, and offerings; Search Engine Optimization – to optimize the university's website and digital content for search engines, improving visibility, organic traffic, and search engine rankings for relevant keywords and phrases related to academic programs, campus facilities, and student life; Content Marketing and Social Media – creating and sharing valuable, informative, and engaging content across social media platforms, blogs, podcasts, webinars, and other channels to attract and engage prospective students, parents, influencers, and other stakeholders; Email Marketing and Automation – to nurture relationships with prospective students, provide personalized communication, deliver targeted messaging, and guide them through the admissions funnel from inquiry to enrollment using automation tools and drip campaigns; Paid Advertising - such as pay-per-click (PPC) ads, display ads, social media ads, and remarketing campaigns are deployed to reach specific audience segments, retarget website visitors, and drive traffic, leads, and conversions for key recruitment goals; Data Analytics and Performance Tracking – to monitor and analyze the performance of digital marketing campaigns, track key performance indicators (KPIs), measure ROI, and optimize strategies based on data-driven insights and actionable analytics. Effective digital marketing strategies can help attract prospective students, engage current students, and strengthen the university's brand reputation.

5.8. Cybersecurity policy

Implementation of robust cybersecurity measures to safeguard digital assets, sensitive information, and personal data against cyber threats and breaches. This indicator assesses the effectiveness of a university's strategies, policies, and practices in protecting digital assets, information systems, and sensitive data from cybersecurity threats, vulnerabilities, and breaches.

Metrics of assessment under this indicator could be the following: Security posture and maturity - assessing the university's overall cybersecurity posture and maturity level based on cybersecurity frameworks such as NIST Cybersecurity Framework, ISO/IEC 27001, CIS Controls, and maturity models like Cybersecurity Capability Maturity Model (C2M2); Incident Response Time and Effectiveness – measuring the average time to detect, respond to, contain, and recover from cybersecurity incidents, breaches, and data breaches, and evaluating the effectiveness of incident response procedures and mitigation efforts; Compliance and regulatory adherence: Ensuring compliance with relevant Bulgarian laws and European regulations, and industry standards such as GDPR and other, and assessing adherence to compliance requirements through audits and assessments; Security Controls: assessing the effectiveness of security controls, patches, updates, and vulnerability management processes in mitigating known vulnerabilities, patching critical vulnerabilities, and reducing the attack surface; User Awareness and Training: Measuring the effectiveness of cybersecurity awareness training programs, phishing simulations, security quizzes, and user feedback surveys in improving user awareness, behavior, and adherence to security policies and best practices. Regular security audits, compliance with data protection regulations, and cybersecurity awareness programs are crucial for maintaining a secure digital environment.

5.9. Feedback mechanisms and continuous improvement

Availability of feedback mechanisms such as online surveys, evaluation forms, and digital suggestion boxes to gather input from stakeholders including students, academic and administrative staff. It evaluates the effectiveness of mechanisms and processes implemented by a university to gather, analyze, and act upon feedback from stakeholders regarding various aspects of digitalization efforts.

Metrics for its evaluation could be the following: Feedback response rates – the percentage of stakeholders who provide feedback in response to feedback requests or surveys. Higher response rates indicate greater engagement and participation in feedback mechanisms; Feedback satisfaction scores: the satisfaction levels admit by users

in terms of accessibility, ease of use, responsiveness, transparency, and perceived impact on addressing their concerns and suggestions; Improvement Culture - the development and promotion of a culture of continuous improvement within the university, where feedback is valued, encouraged, and integrated into decision-making processes at all levels of the organization. Monitoring of feedback and subsequent improvements demonstrate a commitment to enhancing the digital experience and addressing emerging needs.

5. Conclusion and recommendations

Universities should by default be institutions where knowledge is preserved during centuries and shared by new generation of young people, eager for study. In this sense, higher education institutions are the guardians of traditions. At the same time, however, they are called to prepare the new generation for the new challenges of the economy and the demands of business. Which means that in addition to preserving traditions, they must also be open to the latest technologies.

The digitization of higher education and, in particular, education process at a university is an extremely complex process, which, among other things, should guarantee the provision of quality education. From this point of view, digitization in universities should not be seen only as the transfer of activities and services from a traditional to a digital environment. Here comes precisely the moment for the importance of evaluating the effectiveness of the level of digitization in universities. For this purpose, we have developed 9 complex indicators with their evaluation metrics, through which a clear idea can be given of the level of effectiveness of digitization in higher education institutions.

Based on an empirical survey among 360 students, we established their assessment of the current state of the system in Bulgarian higher education institutions, and after a thorough analysis of the collected information and additional research, we developed and presented the following indicators for evaluating effectiveness, which have to be assessed at the same time in order to analyze properly the achieved effective level of digitalization: Available online platform and their adoption in university activities; Availability and accessibility of digital resources; Available technology infrastructure; Usage of virtual collaboration tools; Integration of Data analytics; Electronic document management; Digital marketing and recruitment efforts; Cybersecurity policy and Feedback mechanisms and continuous improvement.

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FINANCIALISATION OF EUROPEAN UNION COUNTRIES - AN ATTEMPT TO DETERMINE DIFFERENTIATION THROUGH CLUSTER ANALYSIS

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Abstract. The process of increasing the importance of the financial sector in the economy is referred to as financialisation. This process can be observed in many sectors of the economy. The article aimed to identify the differentiation in the financialisation of European Union countries. The article verified the research hypothesis according to which the differentiation of EU countries due to financialisation, determined using cluster analysis, consent with the division into groups of countries according to geographical criteria. The k-means cluster analysis method was used to assign countries to individual groups. Six variables were adopted for the research (the ratio of the current level of budget balance to GDP, the ratio of public debt to GDP, the ratio of public expenditure to GDP, the ratio of household debt to GDP, the ratio of household consumption expenditure to GDP, the investment rate of non-financial enterprises). Based on the average values of indicators for the period 2011-2021, EU countries were assigned to characteristic groups differing in the specificity of financialisation. The results indicate that the countries of Central and Eastern Europe were classified into one cluster, while the countries of Southern Europe were classified into two separate clusters. It seems essential to classify the countries of Western Europe and Northern Europe into one cluster. The literature on the subject includes studies of financialisation and its impact on the economy. However, it is difficult to find studies that divide countries according to characteristics related to financialisation.

Keywords: financialisation; EU countries; k-means method; differentiation of financialisation

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JEL Classifications: G21, G23, G30

1. Introduction

Since the financial crisis on the subprime loan market, attention has been drawn to the increasing importance of the financial sector in the economy, which is referred to as financialisation (French et al., 2011). The crisis mentioned above highlighted the process of financialisation and its impact on the economy. However, the beginnings of financialisation can be traced back to the late 1950s. At that time, the economy began to be described by two values: risk and profitability. This approach developed over the following years and became the reason for reducing systemic security (Szczepankowski, 2015). Another manifestation of financialisation can be defined as a decrease in importance (in the 1970s) (Villani, 2021) and the subsequent collapse of the Bretton-Woods system (Vogl, 2012). The reason for these events was the introduction of an innovative solution by commercial banks, which was the convertibility of US dollars into euros and then the euro into currencies of European countries (Dembinski, 2011). Combined with the collapse of the Bretton-Woods system, this created market instability that resulted in flexible exchange rates. Using such exchange rates resulted in the lack of a

price reference, which was previously gold. Market changes fostered market uncertainty and volatility. This resulted in high costs of securing investments. The desire to reduce these costs favoured the creation of new financial instruments that reduced currency risk (Ma & Ji, 2023). Such an instrument were currency futures contracts, which hedged possible differences in currency prices in different periods. Using these instruments enabled the creation of a speculative market that allowed profits to be made through the differences between real prices and those resulting from derivative instruments (Vogl, 2012).

Changes in the financial sector have increased the role of financiers, financial institutions, financial instruments, interest rates and profitability of enterprises in the economy (Sokol, Pataccini, 2020). The second half of the 20th century was characterised by the spread of financialisation in the economy. Innovations and new financial instruments on commodity markets favoured this phenomenon (Zaremba, 2015).

The financialisation process is often discussed in the literature on the subject. However, it is difficult to find research focusing on the similarities and differences in the financialisation of individual countries. For this reason, it seems essential to address the issue of countries' differentiation due to the increasing importance of the financial sector in the economy. The diversity of financialisation can be defined in many ways. Various research methods can be used depending on the selected part of the economy affected by the financial sector. The article aims to identify the differences in the financialisation of EU countries. The research was carried out using selected indicators describing financialisation, which made it possible to specify groups of countries with similar characteristics related to financialisation. The division of entities into groups was researched using taxonomic methods (cluster analysis) (Pfeifer, 2007).

The research sample consisted of European Union Member States, a group of developed and developing countries. When examining the European Community, geographical division is used (Western Europe, Southern Europe, Northern Europe, Central and Eastern Europe). This division also corresponds to the differences between the financial sectors of the researched countries. For this reason, it seems essential to research the division of EU countries in terms of the financialisation of the economy. Therefore, the article verified the research hypothesis that the differentiation of EU countries due to financialisation, determined using cluster analysis, consent with the division according to the geographical criterion:

- Western European countries: Austria, Belgium, France, the Netherlands, Ireland, Luxembourg, Germany,
- Central and Eastern European countries: Bulgaria, Czech Republic, Croatia, Estonia, Lithuania, Latvia, Poland, Romania, Slovakia, Slovenia, Hungary,
- Northern European countries: Denmark, Finland, Sweden,
- Southern European countries: Cyprus, Greece, Spain, Malta, Portugal, Italy.

The following parts of the article introduce the concept of financialisation. The methodology for researching the differentiation of financialisation is described, and the adopted variables are indicated. Then, the research results were presented and explained. The last part discusses the results obtained and a summary of the research conducted.

2. Review of literature

The increasing importance of the financial sector in the economy is most often referred to as financialisation. Many definitions describing this process can be found in the literature on the subject. Some describe this process as an increase in the importance of the financial sector and its primacy over other sectors of the economy (Gołębiowski, Szczepankowski, 2015). Others define it as the domination of the financial sector highlighted by the growing role of financial motives (Jajuga, 2014), financial markets, and financial institutions in the functioning of national and international economies (Epstein, 2005). The development of financialisation is facilitated by disseminating the tendency to make profits using financial channels rather than from production activities (Krippner, 2011).

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Financialisation is linked to globalisation, as demonstrated by the spread of the 2007 financial crisis to the economies of subsequent developed and developing countries (Lapavitsas, Soydan, 2022). Both processes (financialisation and globalisation) have become an element of the neoliberal doctrine, in which the market is identified as perfectly competitive, efficient, stable and self-regulating, enabling the allocation of savings and capable of creating wealth (Urban, 2020). The development of financialisation was favoured by the deregulation of the financial sector (Knafo, 2022), which was carried out as part of the neoliberal variant of the economy (Mader, 2014).

The literature on the subject distinguishes three models of the development of financialisation. The first includes increased profits from non-trading operations, which results from the focus on added value for shareholders and its accumulation. The second one indicates that an increase in the share of profits in state revenues accompanies the development of financialisation. The last model concerns the focus on profitable investments, growth of cash flows and consumer credit (van Treeck, 2007).

The current form of financialisation results from changes that began at the end of the 20th century in the global approach to economics. The increasing importance of the financial sector in the economy resulted in a transition from an economic model based on the production of goods to an economy focused on financial indicators (Davis, Kim, 2015). Financialisation can be observed at the level of the financial sector, non-financial enterprises and households (Jain, Gabor, 2020).

Financialisation in the financial sector is developing by creating new types of institutions and financial instruments. The newly created instruments have an extensive and diverse structure, making assigning them to prudential regulations difficult. The financial market is also characterised by securitisation, which enables the conversion of assets into financial flows (Pemberton, 2021). It applies, among others, to the case of mortgage loans, which can be converted on the bank's balance sheet into securities secured by cash flows from the repayment of loan instalments. Thanks to this, the bank obtains funds to increase lending. The investor who purchased these securities has a guarantee of return of funds, with the security being the loan repayment by the bank's client (Schwartz, 2020).

It should be noted that non-financial companies' activities are assessed mainly using calculation methods, i.e., financial balances, rate of return, and profitability. These values do not influence investment decisions in a given enterprise but are the basis for assessing how the enterprise is managed (Bracking, 2012). For potential investors, these indicators may be the basis for committing their funds to the activities of a given company (Cordeiro Santos, 2023). Therefore, non-financial companies are increasingly directing their activities towards operations on the financial market, which in the short term may bring more significant profits than the development of operational activities (Barradas, Lakhani, 2023).

Financialisation is, therefore, causing significant changes in the non-financial companies' sector. Profits from the business were invested in the company's development, and now, these funds are increasingly used to invest in financial assets (Schwan, 2021). These activities resulted in slower employment growth and wages in non-financial companies. However, the differences in profit achieved in financial and non-financial activities decreased (Soener, 2021). Running the economy according to neoclassical and Keynesian ideas, combined with the process of financialisation, enabled the emergence of global corporations, whose market dominance became visible in the 21st century (Correia, Barradas, 2021).

The increasing importance of the financial sector can also be observed in the household sector. Household members' investments are often related to retirement plans, which should protect their future living costs. These funds, taking into account various models of the pension system, are invested by intermediary organisations on international financial markets (Austen et al., 2022). The risk of these investment activities is held by households whose members may be unaware of all the associated risks (Mandelkern, Rosenhek, 2022). In this way, trends in the economy spread to smaller and smaller entities operating in the economy (Wiess, 2015). Financialisation also manifests in households through widespread access to credit money (Sparkes, Wood, 2021). Easier access to credit financing for excessive consumption favours household debt. Consumer spending increases with a

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simultaneous increase in inequality between income and the distribution of financial resources (Martínez, Borsari, 2022).

Financialisation permeates various sectors of the economy. Consequently, it is challenging to point to the definition of financialisation for all research topics. Some authors focus on the financial or individual economic sectors in which financialisation occurs. Therefore, it is essential to identify a definition of financialisation that is valid for this article. The author has adopted an approach related to the role of the financial sector in the economy. According to the definition current for this study, financialisation is a long-term process characterised by the growth of the banking sector and its impact on the real sphere of the economy.

3. Cluster analysis – brief description

This research aimed to identify the differences in the financialisation of EU countries, which illustrates the assignment of the studied countries based on similarities in financialisation indicators. The classification of entities or objects is the subject of research in taxonomy (knowledge of the principles of ordering) (Gatnar, 1998). The use of quantitative methods in research in this field is referred to as cluster analysis. Using methods from this group is essential when using databases containing multidimensional variables (taking into account entities, indicators describing them, and various periods showing values for these indicators) (Migdał-Najman, Najman, 2013). Therefore, cluster analysis grouping methods, a branch of multivariate statistics (Buszkowska, 2016), can be used to examine the diversity of financialisation.

Several cluster analysis methods exist in the subject literature (Kopczewska et al., 2016). Their basic division most often includes hierarchical methods (during grouping, it creates a class tree, in which single "leaves" symbolise each research entity, and the "nodes" of the classification tree are sets of entities) and non-hierarchical methods (assign entities to several clusters specified by the researcher, which affects the quality of the obtained grouping) (Lotko, Lotko, 2015).

Non-hierarchical methods are divided into methods creating inseparable clusters (one entity may belong to more than one cluster) and optimisation-iterative methods (creating a k-class structure optimal due to a specific division quality criterion). The k-means algorithm is a popular non-hierarchical method in which cluster membership is calculated to minimise intern-group variability (Rozkrut, Rozkrut, 2014).

The first version of the k-means method, including the function of dividing entities into k-groups based on a one-dimensional variable with a normal distribution, was presented by D. R. Cox (Balon, Dziadkowiec, 2015). However, the division of random selection of entities for distinguished groups was studied by J. McQueen, who is credited for the authorship of this method (Pietrzykowski, Kobus, 2006). The object of analysis in this method are j-objects, which are described by i-variables. This algorithm aims to divide the studied entities into k-clusters optimally. The basis of this method is the iterative assignment of objects to the number of k-clusters determined by the researcher (Skikiewicz, 2011). This method determines the distances between entities using the Euclidean distance (Sobolewski, Sokołowski, 2017).

The sequence of actions in the classic variant of the k-means method first includes determining the number of clusters and the number of iterations in which improvements are made. Then, the centres of gravity of the initial clusters of entities are determined (Panek, 2009):

$$O_{i^c} = \left[z_{i^c j}\right] = \bar{O}_r = \frac{1}{n_r}\sum_{i=1}^{n_r} O_j$$

r =1,2, …, z,
$z_{i^c j}$ – the value of the j-th variable for the i^c-th center of gravity of a given cluster of entities,
O_j – the value of the j-th variable for the O-th entity.

Entities are assigned to individual clusters based on the entity's distance from the centre of gravity. The assignment is based on the smallest distance to the centre of gravity of individual clusters. At further stages of

the research, the assignment of entities to clusters is improved iteratively. In this way, the configuration of clusters of examined entities is optimised. Subsequent iterations strive to minimise the clustering error. These processes are accomplished by calculating the change in clustering error for the first entity. The change in clustering error results from classifying into subsequent clusters different from the one to which this entity is currently assigned. The value of the change in the clustering error determines whether the examined entity should be left in the cluster to which it now belongs. If not, the entity should be moved to another cluster. If no entity is moved to another cluster in any of the iterations, it means that the optimal division into k-clusters has been achieved. The results of applying cluster analysis are sensitive to the quality of the data accepted for the research. For this reason, outlying observations that may distort the algorithm's operation should be removed from the examined database (Rogalewicz, Kujawińska, 2016).

4. Research objective and methodology

The research on the differentiation of financialisation covered 27 European Union countries. This is a group of countries with diversified economic characteristics and a degree of financial sector development. Taking all countries from this group into the research makes it possible to identify similarities between countries based on indicators describing financialisation. Due to data availability, the research period was 2011-2021.

The research aimed to identify the differentiation of financialisation of EU countries, which illustrates the classification of the studied countries based on similarities in financialisation indicators. The k-means method was used to achieve this goal. For the described method, it was assumed that the studied group of countries would be divided into 5 clusters selected in a maximum of 10 iterations. The geographical division of the EU includes 4 groups, but the adopted number of clusters results from the specificity of some EU countries that may create separate clusters (e.g. Cyprus, Luxembourg, Greece). Based on the statistical description, it is possible to indicate the characteristics of individual clusters (i.e. high or low average value of specific variables for a given cluster). However, it is impossible to distinguish which cluster has the highest financialisation. To indicate which cluster is characterised by the highest financialisation, the zeroed unitarisation method was used based on the range between the maximum and minimum value of the indicator (Balcerzak, 2015).

Both methods are sensitive to the quality of the data received. Therefore, 15 variables were initially adopted to research the differentiation of financialisation (the ratio of the current level of budget balance to GDP, the ratio of public debt to GDP, the ratio of public expenditure to GDP, the ratio of financial sector deposits to GDP, the ratio of private sector debt to GDP, the ratio financial sector assets to GDP, ratio of employment in the financial sector to total employment, ratio of assets of the non-financial companies sector to GDP, ratio of gross debt to capital for non-financial companies, ratio of debt of non-financial companies to their capital, investment rate of non-financial companies, ratio of household consumption expenditure to GDP, ratio of household debt to GDP, ratio of household debt to its income, household savings rate), which were subject to standardisation (Rogalewicz, Kujawińska, 2016), research of variability of characteristics, research of correlation of variables (using an inverse correlation matrix) and research due to the descriptive statistics of the distribution (Panek, 2009). On this basis, six variables were adopted for the study at last: the ratio of the current level of the budget balance to GDP (the budget deficit favours external financing of budget expenditure), the ratio of public debt to GDP (a high ratio of public debt to GDP shows the important role of servicing the debt incurred by the state so far and high demand for external financing), the ratio of public expenditure to GDP (illustrates the amount of expenditure in the economy, the higher the expenditure, the higher financialisation), the ratio of household debt to GDP (illustrates the level of dependence of households on financing with credit money), the ratio of household consumption expenditure to GDP (the higher consumer spending, the higher the demand for financing with credit money, which can replace the increase in wages in the economy), investment rate of non-financial companies (investment expenditure of non-financial companies influence the rise in interest of external financing).

The research of EU countries' financialisation differentiation using average values of variables for the analysed period 2011-2021 included the following stages:

1. Calculation of average values of indicators in 2011-2021.
2. Transformation of destimulant and nominant into stimulants.

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3. Checking whether the averaged variables meet the conditions for admission to the test.
4. Application of the k-means cluster analysis algorithm (division of EU countries into 5 clusters).
5. Indication of the characteristics and average degree of financialisation of individual clusters.

The next part of the article presents the results of the conducted research. There was also a discussion about the results obtained and their comparison with the research results in the literature on the subject.

4. Results and discussion

Results

Based on the values of six variables (the ratio of the current level of budget balance to GDP, the ratio of public debt to GDP, the ratio of public expenditure to GDP, the ratio of household debt to GDP, the ratio of household consumption expenditure to GDP, the investment rate of non-financial companies), the composition of five clusters was determined for the period 2011-2021. The results of the research are presented in Table 1 below. The cluster numbers indicated in the table do not mean that cluster no. 1 is the best and cluster no. 5 is the worst. They only serve as a name and facilitate their identification. Clusters are distinguished based on characteristics resulting from the average values of variables describing these groups. The table below shows the characteristics of individual clusters and the countries assigned to a given cluster using the k-means method.

Table 1. Assignment of EU countries to characteristic clusters in 2011-2021 based on average values of variables for the entire period

Cluster name	Characteristics of the cluster	Countries assigned to the cluster
Cluster No. 1	The cluster is characterised by a high average: ratio of public expenditure to GDP; ratio of household debt to GDP. The cluster is characterised by a low average: ratio of the current level of budget balance to GDP	Austria, Belgium, Denmark, Finland, France, Germany, Luxembourg, Netherlands, Sweden
Cluster No. 2	The cluster is characterised by a high average: the ratio of the current level of budget balance to GDP; public debt to GDP ratio; ratio of public expenditure to GDP; ratio of household consumption expenditure to GDP. The cluster is characterised by a low average: investment rate of non-financial companies (% of GDP).	Greece, Italy
Cluster No. 3	The cluster is characterised by a high average: investment rate of non-financial companies (% of GDP) The cluster is characterised by a low average: ratio of public expenditure to GDP; ratio of household consumption expenditure to GDP	Ireland
Cluster No. 4	The cluster is characterised by a low average: the ratio of the current level of budget balance to GDP; public debt to GDP ratio; ratio of household debt to GDP. The average values of the remaining variables are relatively low.	Bulgaria, Croatia, Czechia, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovakia, Slovenia
Cluster No. 4	The cluster is characterised by a high average: the ratio of the current level of budget balance to GDP; ratio of household consumption expenditure to GDP; ratio of household debt to GDP. The cluster is characterised by a low average: investment rate of non-financial companies (% of GDP).	Cyprus, Portugal, Spain

Source: Based on research conducted by the author in the PS IMAGO PRO 5.1 - IBM SPSS program using data from the Eurostat Database

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The table above contains information about the five clusters created using the k-means method. The basis for assigning countries to individual clusters was six variables adopted for the research.

Cluster No. 1 was characterised by a high average value of the ratio of public expenditure to GDP and the ratio of household debt to GDP. This cluster had a low average value of the current budget balance to GDP ratio. Countries assigned to this cluster are characterised by relatively high public expenditure and household debt. The following were assigned to this cluster: Austria, Belgium, Denmark, Finland, France, Germany, Luxembourg, Netherlands, Sweden. Some of these countries can be attributed to Western European countries (Austria, Belgium, France, Germany, Luxembourg, the Netherlands), while the other half are Northern European countries (Denmark, Finland, Sweden). These countries belong to the group of developed countries and may be characterised by similar financialisation results.

Greece and Italy were assigned to cluster no. 2. This cluster was characterised by a high average of the ratio of the current level of budget balance to GDP, the ratio of public debt to GDP, the ratio of public expenditure to GDP, and the ratio of household consumption expenditure to GDP. These countries also have a relatively low rate of investment by non-financial companies (% of GDP). According to this characteristic, investments in the economies of the countries of cluster 2 are lower compared to the countries belonging to the other clusters. The high average values of indicators characteristic of this cluster take into account the specificity of the economies of the researched countries.

An interesting case is cluster no. 3, to which Ireland was assigned. Countries like Cyprus, Greece or Luxembourg could be assigned to a separate cluster. However, due to the variables adopted for the research (performed statistical tests indicated the rejection of variables describing the banking sector and most of the variables describing the non-financial companies' sector), Ireland turned out to be a country with characteristics different from the other countries under research. Referring to the indicators adopted in the research, this country was characterised by a high average investment rate of non-financial companies, with a low average ratio of public expenditure to GDP and the ratio of household consumption expenditure to GDP. This means relatively large development investments are carried out in the country's economy. An excessive increase in public spending and household consumption expenditure does not accompany higher investment expenditure.

In cluster no. 4, one can notice a low average ratio of the current level of budget balance to GDP, the ratio of public debt to GDP and household debt to GDP. This group includes Bulgaria, Croatia, Czechia, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovakia, and Slovenia. Most of these are Central and Eastern European countries, which have characteristics similar to the description of this cluster. An interesting case is Malta, which was also classified in this group. The reasons for this classification may vary.

For this reason, it is worth paying attention to the degree of each of the analysed indicators in each country assigned to this cluster. When constructing the synthetic financialisation index (with use of zeroed unitarisation method), six variables adopted for the research were used. The indicator determined using the zeroed unitarisation method allowed to determine the average level of financialisation of the examined cluster. Considering this indicator's level, Malta is in the middle of the cluster (it's neither the highest nor the lowest financialisation in this cluster). This means that in terms of financialisation, Malta is similar to Central and Eastern European countries.

The last clusters obtained consisted of Cyprus, Portugal and Spain. These countries are classified in the literature as Southern Europe. Cluster No. 5 was characterised by a high average ratio of the current level of budget balance to GDP, the ratio of household consumption expenditure to GDP, and the ratio of household debt to GDP. A low average investment rate of non-financial companies also characterised this cluster. This means that in the countries belonging to this cluster, many budget expenditures exceed the accumulated budget revenues. This occurs amid household consumer spending and a low investment rate by non-financial companies. These countries are characterised by high financialisation.

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To check the level of financialisation in the researched clusters, research was carried out using the zeroed unitarisation method. It took into account six variables adopted for the research. The results indicating the level of financialisation of the researched clusters are illustrated in Figure 1.

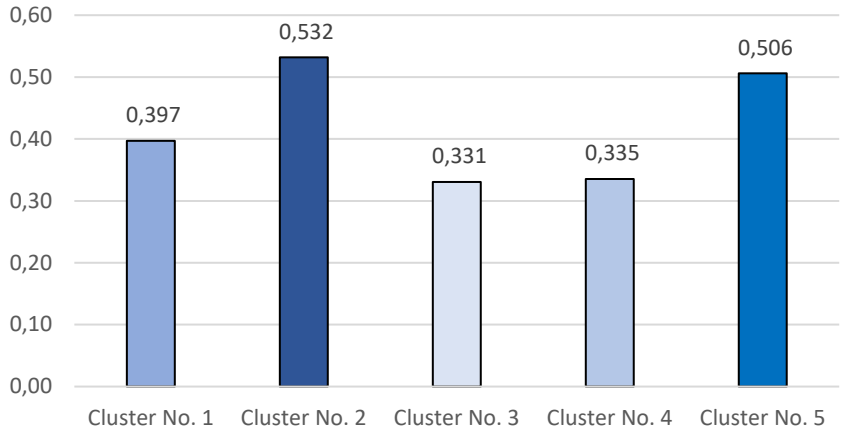

Figure 1. The degree of financialisation in clusters determined using the k-means method
Source: Based on research conducted by the author using data from the Eurostat Database.

The information contained in Chart No. 1 indicates that cluster no. 2 is characterised by the highest financialisation (synthetic indicator equal to 0.532). The countries assigned to this cluster are Greece and Italy. The financialisation of these countries' economies seems consistent with their specificity. Slightly lower financialisation characterises cluster no. 5 (synthetic indicator: 0.506), which consists of three countries: Cyprus, Portugal and Spain. As in the case of cluster no. 2, the level of financialisation corresponds to the specificity of the countries examined. The lowest financialisation characterises clusters no. 3 and 4. It should be noted that cluster no. 3 covers only Ireland, which was assigned to a separate cluster due to the average values of the studied variables. Cluster no. 4 consists mainly of Central and Eastern European countries (Bulgaria, Croatia, Czechia, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia, Slovenia). Due to historical economic changes, these countries have quite similar characteristics. Cluster no. 1 covers most of the countries of Western Europe and the countries of Northern Europe. They are characterised by average financialisation (synthetic index equal to 0.397). Regarding the level of financialisation, the research results confirm the characteristics of each group of countries.

Discussion

The research on the financialisation of the financial sector gained importance after 2007 (the beginning of the financial crisis). Stockhammer (2010) researched financialisation in the USA, Anglo-Saxon and European countries. This research aimed to determine the macroeconomic changes caused by financialisation. In particular, the focus was on determining this process's impact on the financial sector's stability and income distribution. In turn, J. Müller (2013) identified financialisation and the potential crisis of eurozone countries resulting from the crisis orders after 2008. It was found that the changes introduced to contain the crisis were aimed at restoring the financial sector's profitability. Looking at capitalist regions and/or national economies in Europe, the main result of financialisation may be, on the one hand, the decoupling of profits from production and, on the other hand, an increase in investment and wages. Moosa (2018) took a slightly different approach, whose research included presenting empirical evidence on the relationship between economic growth and financialisation measured by the ratio of credit to GDP and the ratio of publicly traded shares to GDP. Barradas (2020) also researched the relationship between the financial sector and economic growth. The research took into account Portugal in the years 1977-2016. The results of this research indicated that the financial (banking) sector has a negative impact on Portugal's economic growth.

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The research described in this article included the identification of differentiation in the financialisation of EU countries in the period 2011-2021. The research used the k-means method, which divided the EU countries into characteristic clusters. Assigning countries to individual clusters based on the average values of indicators for the period 2011-2021 reduced the impact of results from a single year on the results obtained. On the other hand, research showing changes in the assignment to particular clusters during the period under research could indicate potential changes in the similarities in the financialisation of the countries under research. The literature on the subject contains studies relating to individual countries (e.g., Portugal and Poland). K. Ciuman's (2014) research included presenting the role of the financial sector in the economy, the essence of financialisation, and the relationship between financialisation and the insurance sector in Poland's example. The conclusions from these studies indicate that it is possible to transfer high-risk to the capital market through financial insurance instruments. Reducing the size of the operations of insurance companies and pension funds means that less cash is regularly directed to the financial market. Some authors studied groups of countries. Wrzesiński's (2014) research covered the USA, selected countries of Central and Eastern Europe and the euro zone countries. This research aimed to present the phenomenon of financialisation and its genesis, as well as to attempt a preliminary assessment. The financial sectors of selected Central and Eastern European countries were also researched by Gołębiowski and Szczepankowski (2015). They tried to assess the degree of financialisation of the economies of selected Central and Eastern European countries. It was pointed out that there are differences in assessing the scale of financialisation of Central and Eastern European countries depending on the adopted measure. It was also determined that this part of Europe is relatively small.

Referring to the specificity of financialisation research, most research focused on European countries and the United States. Some studies included countries in Asia and Africa. These studies concerned individual countries, comparisons of several countries, groups of countries or comparisons between groups. The size of the studied groups ranged from one (Ciuman, 2014; Barradas, 2020) to several countries (Müller, 2013).

The goals pursued in the analysed studies were varied. The common denominator of most of these goals was determining financialisation in the economies of the countries studied. These goals were achieved using ratio analysis (Stockhammer, 2010; Gostomski, 2014), unobserved components model (Moosa, 2018), and econometric analysis of time series (Barradas, 2020). In the subject literature, it is difficult to find studies that divide a group of countries into characteristic clusters due to financialisation. It should be noted that much research focuses on attempts to determine the level of financialisation or its impact on the economy.

For this reason, it seems justified to undertake research related to the division of European Union countries due to financialisation. The research of financialisation requires the use of research methods appropriate to the adopted goal and variables describing the growth of the financial sector adapted to the scope under research (e.g., economy, banking sector, insurance sector). Based on other authors' research, financialisation research can be continued using both parametric and non-parametric methods.

5. Conclusions

Since the financial crisis of 2007, attention has been paid to the increasing importance of the financial sector to other sectors of the economy. In the literature of the subject, this process is referred to as financialisation. The growth of the financial sector is observed, especially in developed and developing countries. This article discusses the topic of financialisation in the European Union countries. These countries constitute a heterogeneous group that may vary in terms of financialisation. Therefore, it was essential to research similarities in the financialisation of individual countries. The article aimed to identify the differentiation in the financialisation of EU countries, understood as the classification of the studied countries based on similarities in financialisation indicators. To achieve this goal, a five-stage research was carried out. The first three included determining the conditions for examining financialisation: variables, time sample, cross-sectional sample, and research methods. The following two stages focused on empirical research and interpretation of the obtained results.

The research on the differentiation in the financialisation of EU countries was carried out using the k-means method, taking into account six variables: the ratio of the current level of budget balance to GDP, the ratio of

public debt to GDP, the ratio of public expenditure to GDP, the ratio of household debt to GDP, the ratio of household consumption expenditure to GDP, investment rates of non-financial companies. The research based on the average values of indicators describing financialisation in 2011-2021 was intended to average the division results and indicate the assignment of countries to significantly different clusters. The use of such values reduced the impact of changes occurring from year to year in the economies of the countries under research. Verifying the research hypothesis based on the average values of the indicators, it can be seen that cluster no. 1 consists of most Western European countries and Northern European countries. The second cluster, which is similar to the geographical division, is cluster no. 4, consisting mostly of Central and Eastern European countries.

Interestingly, the Southern European countries were classified into two separate clusters no. 2 and 5. Based on the results obtained, the research hypothesis was partially positively verified. The clusters identified due to financialisation partially overlap with the groups of countries identified based on geographical criteria.

The results obtained indicate that the characterisation of countries by the financialisation of the economy does not coincide with the geographical breakdown. Relevant to the study of financialisation is the similarity of Luxembourg, a country characterised by an economy based on the financial sector, to some countries of Western Europe and Northern Europe. It's probably the result of using indicators describing the financialisation of different sectors of the economy. It is also interesting to note that Ireland is classified in a separate cluster. This indicates that the financialisation of this country's economy is differentiated from the rest of researched countries. In the literature, it isn't easy to find studies showing similarities in the financialisation of European Union countries. The results obtained make it possible to conduct further research in similar countries in the context of financialisation and make a division of EU countries not based on geographical criteria.

Examination of the differentiation of financialisation using the k-means cluster analysis method made it possible to determine characteristic groups of EU countries similar in financialisation. The results of the research depend on the adopted variables. For this reason, using different indicators or variables in absolute terms could produce different results. Paying attention to the variant of cluster analysis used, one can notice at least two possibilities. On the one hand, it would be essential to divide the data into more than five clusters using the k-means method. This research could lead to groups that differ more from each other than in the case of five clusters because the k-means method partitions by maximising the differences between clusters. It is possible that a larger number of clusters would reduce the number of countries assigned to individual clusters. This research may include a variety of results due to the number of clusters adopted.

On the other hand, other cluster analysis methods can be used. Interesting results could be obtained using agglomeration or deglomeration methods, which show how the division into clusters was made. The results obtained using the k-means method are related to the limitations mentioned above. It seems essential to undertake research using a more significant number of clusters and other data describing further financialised sectors of the economy.

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TOWARDS A NEW FRAMEWORK OF CIRCULAR ECONOMY

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Abstract. Although governmental institutions are talking loudly about the importance of businesses moving towards sustainability and adopting a circular economy (CE) approach, moving towards CE can take time for business companies. Business entities must review their business ideas and the possible implementation and adoption of their business processes towards more sustainable business activities. Adapting various sectors' business models towards the circular economy is not easy, and in many cases, there is a lack of motivation from business entities, as well as the knowledge and lack of confidence in starting changes, which can question the profitability of changing businesses. The difficulty of transition can be seen in various discussions in scientific publications. This article uses the literature review approach, comparison, synthesis, and analysis methods to collect and analyse CE principles and processes. The main goal of this article is to systematize all possible processes approaching CE in businesses and suggest a framework for CE, attributing processes into creative and technological categories. This created framework can better help business entities moving towards CE to plan the implementation of various business activities, reviewing and improving business ideas while preparing to move towards the CE approach. After analysing, systematizing, and comparing scientific literature about CE, a framework was developed that embraces a variety of processes that can ease changing business actions moving towards CE. The developed framework identifies two creative CE processes, six technological processes and one combined process containing creative and technological features.

Keywords: circular economy; circular economy processes; creative processes; technological processes; sustainability

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JEL Classifications: O11, F64, L00, Q5

1. Introduction

The awareness about the importance of circular economy (CE) for the world's sustainable development is growing. Some changes must appear in the business environment for the circular economy to become a reality. The pressure for businesses to become circular is increasing from various sides – governments have already prepared the European Green Deal (52021IP0040, 2021). The Industrial Demonstrations Program (USA) led to new business orientations and re-planning production and services to become more sustainable via adopting CE principles and moving towards zero emissions. Governments of various countries are already giving support in different ways for more sustainable, eco-friendly and circular production. Also, pressure could be noticed from the consumer's side as more and more people are looking for information about products they are purchasing and where to place them after the product is no longer needed. Changes in consumption preferences for products and services produced in more sustainable and circular ways are already appearing and will be growing in modern economies in the future. Financial institutions have also started to impact the choice of business models. Businesses are already beginning their transition towards circularity, but only in some fields that work in business-to-customer sectors and involve plastic packaging or other materials that can be recycled or

reprocessed; also, some brands in the fashion business and sustainable furniture producers care about their customer's attitudes and choices. Most traditional business-to-business and business-to-customer industries are still thriving using a linear economic approach and see the challenges of the Circular economy as a threat to their profitability and stability in business. Government support for more sustainable companies might change to pressure for a more circular approach, such as additional taxes on a linear business approach, which could become a great challenge for many business entities. With all this, businesses have many questions about how to change towards a circular business model.

The authors reviewed Chu et al. (2021), Blomsma and Brennan (2017), Blomsma et al. (2019), Jawahir and Bradley (2016), Guldmann (2016), Sharpe and Giurco (2018), Hahladakis and Iacovidou (2019), Flowers and Gorski (2017), Potting et al. (2017), Tang and Chen (2022), Lyu and Liu (2023). and other authors' studies in a field of Circular economy processes. The authors of this research use the processes to embrace the variety of notions used by other authors, such as principles, approaches, etc. While systemizing processes, a need was identified to narrow circular economy processes from the current variety and structure them into technological or creative categories.

A new circular economy processes framework will provide a tool for new companies looking into the transition towards circularity in businesses. The framework will help identify creative and technological processes that the company's management should plan while preparing for changes in future business models.

The scientific problem for this research is to review CE processes found in scientific literature and structure them into categories that could help business entities overthink their possibilities to move towards a circular business approach.

The object of the research: processes of circular economy. The research aims to suggest a new framework for circular economy (CE) processes by attributing them to creative and technological categories.

The tasks of research: 1. To analyse a variety of CE processes discussed by a diversified academic community. 2. To identify possible reallocation of standard CE processes into two action groups.

Research methods: scientific literature review and generalization, synthesis and analysis.

2. Knowledge and circumstances needed for the CE processes identification and structuring

Circular economy as a theoretical concept has been analysed already for a while. In practice, we still see relatively slow growth of companies implementing CE in their businesses. It's necessary to overview the obstacles that hinder CE implementation.

Authors Walmsley et al. (2019) discuss that increasing circular flows in processes should combine engineering knowledge and design skills with economic benefits. Circular integration combines process integration, industrial ecology, and circular economy paradigms.

Blomsma et al. (2019), in their article, discuss that a circular strategies framework can be developed for a specific business type with the ability to support Circular Oriented Innovations (COI) processes and, at the same time, state the importance of a circular strategies framework for the manufacturing context which links to Circular Strategies Scanner. This shows that Blomsma et al. (2019) agree with other authors researching CE and adopt the view that both resource efficiency and resource effectiveness are important in the manufacturing context. Transitioning towards a more sustainable future requires knowledge of various fields, the possibility to accumulate and implement this knowledge, and a broader view of business.

Blomsma et al. (2019) analyse how a circular strategies framework can be developed for a specific business type that can support Circular Oriented Innovations (COI) processes, and it proposes a circular strategies

framework for the manufacturing context. A collaboration of industries and academia can help achieve the results of improvements in CE and COI.

Jawahir and Bradley (2016) state that to develop the circular economy with the inclusion of the 6R elements, there must be mechanisms to drive sustainable value creation. Authors identify these mechanisms as product/process innovation, quality education and training, novel methodology and visionary thinking. All this shows that more is needed to talk about CE and support it with technological advances and optimisation of products, processes and systems. Rizos et al. (2016) identified that the lack of technical know-how for CE appears because of a lack of resources in SMEs and the need for more time to acquire skills training. Also, companies need more financial possibilities to hire external experts. Jawahir et al. (2013) discussed the importance of educating youth not only in formal university education in the field but also through technical schools to educate and train an entirely new industry workforce for next-generation manufacturing. Jawahir and Bradley (2016) also identify the importance of visionary thinking, which should combine creativity with an established technical basis and resolve existing problems.

Nunez-Cacho (2018) indicates that companies looking at the sustainability issues and implementing the CE model should be thinking about the long-term orientation of their reputations and place more efforts towards the conservation of resources, the use of sustainable energy, and the reuse of components, all valued as critical factors in a new form of future entrepreneurial competition. According to Suchek et al. (2021), cleaner production, pollution controls, waste management, product-service logic, and reverse logistics are the main changes observed in the transition to circular business models.

Jawahir and Bradley (2016) discuss that it is essential to create an assessment toolkit that should define the scope of relevant mechanisms and involve the creation of metrics and indicators for sustainable value creation. A cost model would help assess economic performance from the view of the total life cycle. Environmental view could appear by determining the environmental impact/burden of the product. Looking towards society's needs would help to develop more social metrics and indicators that could be used to assess societal well-being. According to Jawahir and Bradley (2016), combining the abovementioned mechanisms and assessments is the primary approach in implementing the 6R elements as the technological basis for the circular economy.

Romero et al. (2021) agree that CE is based on eco-conceptions, industrial and territorial ecology, functional economy, second use, reuse, repair, recycling, and valuation. Still, at the same time, the authors express the concern that there are not enough studies showing positive benefits for individuals and guarantees for the development of sustainable life from a social and political perspective. Sharpe and Giurco (2018) indicate the importance of governmental help in creating a methodology for business entities to enter CE mode. Kyriakopoulos et al. (2019) notice a need for a social dimension in the design of CE policies. There is enough attention paid to sustainability, but consumption behaviour should also be researched as it relates to CE and transforms problems into opportunities regarding regulated waste management, modelling analysis, and trade-off proposals and policies for municipalities. Efficient and effective waste management ways should be researched and developed, as they benefit city and enterprise management.

According to Iacovidou et al. (2017), using processes such as repair, remanufacture, reuse and recycling can reduce additional negative value creation and minimise wastefulness of materials, components and products (MCPs) environmental (e.g. water, energy), economic (e.g. costs of design, manufacture and distribution), social (e.g. labour intensity) and technical (e.g. properties, quality) values. A few years later, Iacovidou et al. (2021) identified that the lack of supply and demand networks for second-hand components and products limits repair, remanufacture, and reuse options.

Meanwhile, Kyriakopoulos et al. (2019) identify the importance of reverse logistics for companies planning to follow circular economy principles and promote cost-efficiency and better quality in dedicated collection areas through an incentivised system to return materials and recover energy flows. Suchek et al. (2021) discuss business model innovations in creating value by implementing Circular economy principles and that tools evaluating the life cycle and ecological design are highly needed. In this case, start-ups are more flexible, capture

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opportunities and develop innovations. Meanwhile, existing businesses influence CE development opportunities.

The literature review provides insights into multiple aspects, including needed circumstances in business and society, missing tools for evaluation, governmental help, and cooperation between business and academia to spread knowledge and improve skills required. The following insights should be helpful for CE's broader establishment into the economy in general.

3. Research Methodology

This article uses theoretical scientific literature review analysis, considering the main principles of comparison, structuring, analysing, and synthesis of scientific publications in CE processes. This article aims to identify and systemise CE processes and develop a framework of categories: creative and technological. The possibility of seeing the whole scope of CE processes in the scientific literature will allow us to identify how many of those processes are crossing/covering the same or similar actions and how many analyzed processes can be developed into technological or creative (see Figure 1).

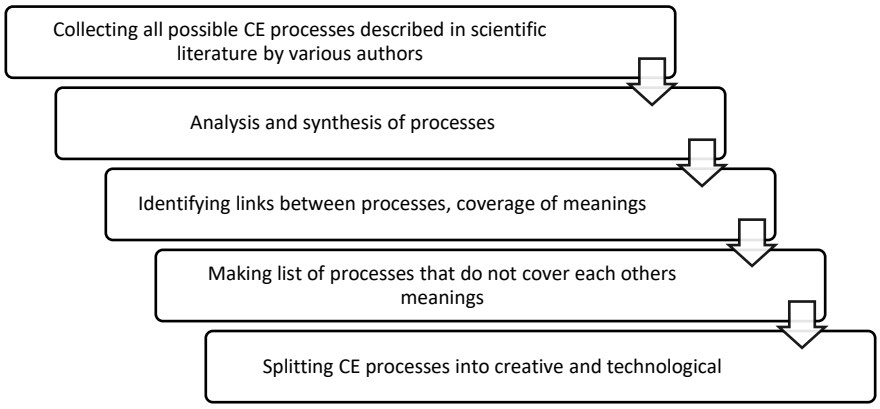

Figure 1. Theoretical Research Methodology

Various authors distinguished and offered a wide range of circular economy processes. The first core processes of CE are 3R: reduce, reuse, and recycle over time. Various authors extended them. The variety of extensions reached 6R, 10R, etc., even not having R as the first letter of the process. In reviewing the offered processes, it can be noticed that offers differ across continents and fields where CE will be implemented.

The core idea of this article is to systematise CE processes that can be relevant for most businesses and identify those processes which could be called creative and are related to the managerial part of business planning and the technological processes that could have general meaning but at the same time different content depending on the business field either industry.

This theoretical analysis is not oriented to any specific business field, so the peculiarities of various businesses (industries) must be considered. Also, have to be taken in mind that companies have to consider possible processes and outcomes from them, but according to business structure, field of action and peculiarities, it might just analyse but not take any actions in a field of some CE processes as they might be not relevant enough.

4. Theoretical overview of Circular Economy processes

The World Commission of Environment and Development (1988) noted that experience in industrialised nations has shown that anti-pollution technology has been cost-effective in terms of health, property, and environmental damage avoided and has made many industries more profitable by making them more resource-efficient. According to Dagiliene et al. (2023), this reference from the Brundtland Report (World Commission on Environment and Development, 1988) can be identified as the first reference to the circular economy idea.

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For a long time, the circular economy has heavily relied upon the principles of the 3Rs: Reduce, Reuse and Recycle. It aims at optimum production by utilising reduced natural resources and producing minimum pollution, emissions, and wastes using the 3R (Jawahir, Bradley 2016) and according to Potting et al. (2017), reducing means increased efficiency in product manufacture or use by consuming fewer natural resources and materials. According to Jawahir and Bradley (2016), the idea of one of the 3Rs came in the 1980s, when it started to talk about 1R (*Reduce*), which became very important in lean manufacturing later. Jawahir and Bradley (2016) state that new manufacturing technologies and innovations are required at product, process, and system levels to shift towards sustainable value creation for humanity, and it is essential to move from lean to green and sustainable manufacturing.

Meanwhile, Guldmann (2016) describes *reuse* as easily understood and explains use for a second or further time.

*Recycl*ing, according to the Oxford English Dictionary (2013), can be separated into additional processes, such as reusing (material) in an industrial process and returning (material) to a previous stage of a cyclic process. To process (waste) to convert it into a usable form; to make it available for processing into a reusable form. Also, it is used to reclaim (a material) from waste so that it may be reused. According to the European Union (2008), recycling refers to any recovery operation by which waste materials are reprocessed into products, materials or substances, whether for the original or other purposes. It includes reprocessing organic material but does not include energy recovery and reprocessing into materials to be used as fuels or for backfilling operations.

With time and awareness of the circular economy, the number of processes used to describe its implementation increased. According to Jawahir and Bradley (2016), the conceptual message of the circular economy is compelling as it is based on reducing wasteful resources through effective design and implementation of products and processes for improved resource efficiency with circular material flow involving recovery, reuse, recycling and remanufacturing of products. From this statement, we see that there are additional terms used, like recovery and remanufacturing. According to Rli (2015), *recover*y means the incineration of materials with energy recovery. Guldmann (2016) describes *remanufactur*ing as putting (a manufactured material or product) through a manufacturing process again to manufacture from recycled material or parts.

Blomsma and Brennan (2017) and Blomsma et al. (2019), analysing manufacturing companies, identify that many operate in complex scenarios using two or more circular strategies based on CE processes. Authors explicitly include reducing and avoiding resource use and impacts and resource productivity strategies aimed at continued use and value delivery (Blomsma et al., 2019). Also, authors Blomsma et al. (2019), in their analysis, offer to think of product/service systems where direct reuse, repair, refurbishment and remanufacturing are taking place, in addition to the recycling of materials.

Here, two more terms – processes are included in the circular economy description: repair and refurbishment. *Repair*, according to Rli (2015), is understood as the repair and maintenance of a defective product so it can be used with its original function. The Oxford English Dictionary (2013) describes *refurbishing* as the action that is restored to good condition, renovated, repaired and redecorated.

Guldmann (2016) also indicates one more possible process of Circular economy – *redistribution*, which can be described as the distribution of something again or differently. This also refers to the idea that many things in CE can be achieved differently or more sustainably.

There can be found the 6R methodology in CE analysis. This methodology introduces 6 Circular economy processes and assumes that everything should be based on that 6R. Jawahir and Bradley (2016) describe reduction as mainly focusing on the first three stages of the product life-cycle and refers to the reduced use of resources in pre-manufacturing, reduced use of energy, materials and other resources during manufacturing, and the reduction of emissions and waste during the use stage.

The second stage of processes would go to *reuse*, which is understood as using the product or its components again after the first file cycle, thus reducing virgin materials for its production. The third would be *recycling*,

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involving those things that earlier would have been considered waste and turning them into new products or materials for them. According to Jawahir and Bradley (2016), collecting products at the end of the use stage, disassembling, sorting and cleaning for utilisation in subsequent product life cycles *is called "recover*". As noted by various authors, CE is about not leaving things for trash and unsorted. The total involvement of all economic actors is needed, although the outcomes and the processes might vary. Another activity from 6R is the possibility of *redesigning*. It would be oriented toward redesigning next-generation products using materials, components, and recovered resources from the previous life-cycle products. The following process involves the re-processing of already used products for restoration or the reuse of as many parts as possible without loss of functionality, and this process is called *Remanufacture*.

Meanwhile, Rli (2015), in introducing circular economy, introduces CE strategies within the production chain that are supported by 10 processes named R's. Those processes are: Refuse, Rethink, Reduce, Reuse, Repair, Refurbish, Remanufacture, Repurpose, Recycle, Recover. As most of the R's were already met in the previous analysis, it is necessary to overview the meaning of the new ones added to CE processes.

According to Rli (2015), *refuse* means making a product redundant by abandoning its function or offering the same function with a radically different product. This process requires excellent creativity, changes in society and demand. Potting et al. (2017) describe the rethinking process as making the products more intensive by offering the market multi-functional products through sharing them. Meanwhile, another new process, *Repurpose*, is understood as the use of a discarded product or its parts in a new product with a different function (Rli, 2015).

Authors Sharpe and Giurco (2018), analysing circular economy implementation and its need in Australia, provide a slightly different list of processes companies could overview considering becoming circular. Those processes are: Repair, Reduce, Reuse, Remanufacture, Rethink, Recycle, Recover, Reclaim, Respect, Redesign, Reimagine. This widened variety (11) of R's brings a new approach and identifies local issues that industries face with their supply chains and the costs of new materials.

The expansion of processes is only sometimes entirely related to other authors' suggestions or previous analysis, so there appear to be additional suggestions and a widening variety in R's as CE processes. The different R's mentioned by Sharpe and Giurco (2018), but not identified and described earlier, are: Reclaim, Respect, Reimagine.

In this case, *Reclaim* is not described by authors, but according to the Oxford English Dictionary (2013), it would mean to take something that was yours. It is a possible reclaim of products already used in the market and, after their life-cycle, returned to the producer for further processing.

The processes of Respect and Reimagine are more related to sustainability and the possible creativity of business entities. As the Oxford English Dictionary (2013) describe, *Respect* is admiration felt or shown for someone or something that you believe has good ideas or qualities, and reimagining is to have a new idea about the way something should be.

Circular economy goes beyond waste reduction and embraces the idea that materials, components and products (MCPs) should be designed and produced so that they can be restored, retained and redistributed in the economy for as long as it is environmentally, technically, socially and economically feasible (Hahladakis, Iacovidou 2019).

According to Jawahir and Bradley (2016), all the above-listed circular economy processes show that it becomes not an option but inevitable for continued economic prosperity and ecological balance to maintain biodiversity with human life and economic growth.

The other related to the CE process found in various articles is *Recommerce* or *Re-sell*. According to Tang and Chen (2022), it's to sell, trade in and recycle used products. Chu et al. (2021) add that this is related to costly reverse returns resulting from sellers overestimating the grades of their used products.

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Meanwhile, *upcycling* is a type of recycling where discarded products are remanufactured into other products of higher value (Flowers, Gorski, 2017). Wang (2011) explains that upcycling can add value by reinventing or transforming to higher quality something that would be disposed of.

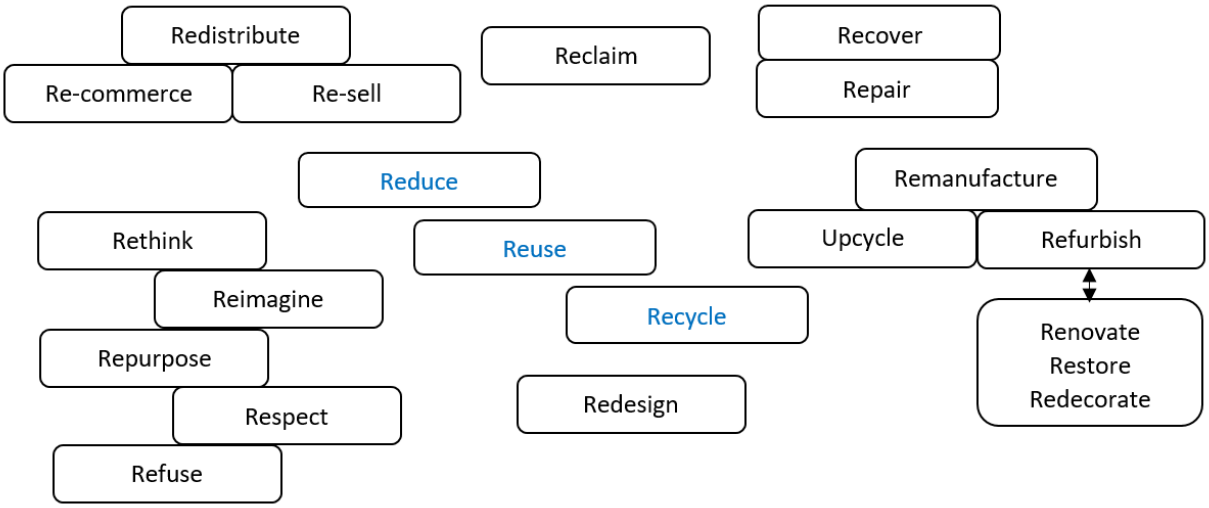

Figure 2. Circular economy processes found in the scientific literature

As can be seen, the variety of Circular Economy processes from simple 3R increased a few times. Still, simultaneously, some of those named processes complement each other and even bring more difficulties to businesses that could change their linear approach to circular.

5. Technological processes and creative processes in Circular economy

Technological processes, according to Varese et al. (2020), are activities involving the preparation of goods. Hollen et al. (2013) are writing about preparing technological process innovations to introduce new input materials, physical equipment or software systems in a firm's production operations. According to Hollen et al. (2013), technological innovation will lead to lower production costs, product quality improvements, lower disposal costs and the ability to use cheaper raw materials. The authors identify three stages of technological process innovations: 1) the discovery phase (creating new technological knowledge, 2) the development phase (developing from a laboratory scale and testing towards an industrial scale), and 3) the deployment phase (adopting in full-scale production operations). Those qualities could be adopted in the circular economy process, and innovations in those processes could be convenient for companies.

Harvey and Kou (2013) identify that the creative process can in a way that overcomes the challenges of collective creativity.

Mao et al. (2021) state that creative process engagement is usually perceived to be composed of three stages: problem identification, information search and encoding, and idea alteration and generation. During the first stage – the problem is defined and identified as what is beneficial for achieving high quality and originality of the solutions; it should involve environmental circumstances having relations with the situation and different views. After searching for information, encoding and interpretation of the information collected is also essential. The third idea generation stage combines and reorganises the gathered information about the identified problem (Mao et al., 2021).

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Managerial processes could be adopted in sorting circular economy processes. This could lead to understanding that success in CE might depend on creativity processes and the possibility of companies working out on them, as well as being capable of analysing and finding the best options in technological processes.

6. Discussion on a framework of the new CE Processes Model

The CE processes analysis showed that from core 3R: reduce, reuse and recycle, a variety of CE processes in scientific articles has grown with various explanations and even processes that cover each other. Meanwhile, it is essential to note that according to Bianchini et al. (2019), the terminology, methods, models, and KPIs to implement and assess CE are often very different and suitable only for the specific application. The proof for that can be an example of Reh (2013) in steel production, where steel from a demolished structure is separated and distributed to the different reuse, incineration, down cycle, and landfill flows. Here, we see additional processes: incineration, down-cycle, and landfill. According to the Cambridge Dictionary (2023), *Incineration* is the process of burning something completely. *Downcycle/ downcycling* is using waste material or old or used objects to make a product of lower value than the original material or object.

Meanwhile, the process "down-cycle" is mentioned, and in other resources, it analyses other industries adopting CE principled processes. *A landfill* is the process of getting rid of large amounts of rubbish by burying it (Cambridge Dictionary, 2023). According to Reh (2013), choosing the optimal recycling process becomes extremely complex, but finally, releasing the burden in many cases makes it worthwhile.

Group of authors Ciliberto et al. (2021) additionally to traditional Reuse, Recycle, Repair, Refurbish, Remanufacture, added also *Cannibalize*. Although they admit that the processes – repair, refurbishment, remanufacture, and cannibalisation- are parts of disassembling in the production process.

After reviewing the processes of CE, it is vital to discuss the involved technological elements. As Jawahir and Bradley (2016) state, it is assumed that the activity Reduce is blended in all stages of the life-cycle, and the first necessary step in the post-use stage is Recover, from which all other four innovation-based Rs (Reuse, Recycle, Redesign and Remanufacture). According to the authors, these elements can create sustainable value in the economy, society and the environment. Nidumolu et al. (2009) discuss value creation in the context of sustainability (referred to as the Triple Bottom-Line (TBL/3BL)) serving as the driver for innovation and having a significant impact on the integral elements of sustainable manufacturing, such as products, processes and systems.

Meanwhile, Bianchini et al. (2019) state that comparing circular initiatives is difficult because of the variety of definitions, elements, and underlying models of CE and the use of different data to measure circularity.

Triguero et al. (2023) admit that Redesign can extend to multiple generations or life cycles of a product. And to implement a circular economy, it is obliged to think beyond a single circular loop. It makes innovations with advancements occur from one loop to the other.

As seen in Figure 2, circular economy processes found in various scientific resources show that some processes are quite similar, which could bring features into specific businesses but not into a general theory. The willingness to generalise processes is worth leaving only those that would not create additional meanings and will help companies move towards circular economy implementation in their businesses; the processes should be cleared and specified. It is essential to mention that the core 3Rs are the essence of CE, and the rest of the processes supplement them to clarify the understanding of CE and its performance.

The redesign process is independent and actual in today's economies, as many products and services must be reviewed and redesigned.

First of all, it is reasonable to group some of the processes. One cluster of similar processes includes remanufacturing, upcycling and refurbishing. Those processes all include old products or parts of them and the

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possibility of renovating, restoring, and redecorating them. A general understanding of all those processes can be described as Remanufacture, which can be achieved at different levels in each business domain. This process could be allocated to technological processes as activities producing new or renewed products will be proposed during this process.

Another group of processes identified in the literature is Recovery and Repair, which generally means the product after altering and fixing it. With the scarcity of fossil fuels used as raw materials for production, it is necessary to use alternative energy and other parts that could be used for output from earlier stages. This leads to the future, where one more process will be added. This Reclaim process could be used in many industries and is related to the recycling and sorting used products or materials. While the Recovery process could be called technological as it leads to new or renewed products, the Reclaim is the process of balancing technical decision-making and the creativity process of the company's staff.

One more cluster of very similar Creative processes that could be named complimentary to each other are: Rethink, Reimagine, Repurpose, Respect and Refuse. All those processes depend on each other and, first of all, alert businesses to stop and use their internal creativity to reduce something in their production. In the most precise way, all those processes can be named the Rethink process already used in some CE process descriptions.

The last group of processes (Redistribute, Re-commerce, Re-sell) join actions that link to creativity in achieving more sustainable distribution, reaching new groups of customers and introducing products more creatively to prove that all remanufactured either sustainably manufactured products can be sold through Re-commerce.

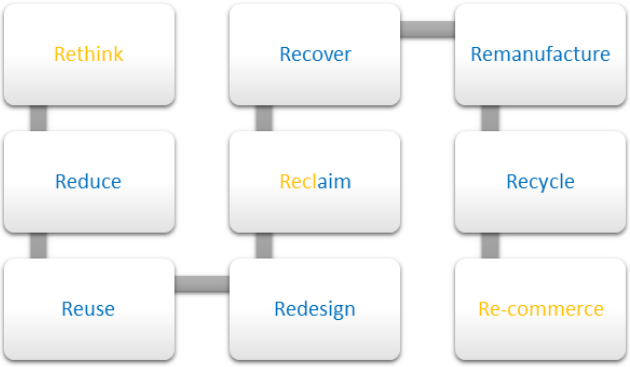

Figure 3. Revised Circular economy processes (blue – technological, orange – creative)

The visualised new circular economy processes in Figure 3 show that two of the processes (coloured orange) are purely creative and should cause the company's staff to consider possible actions to implement the circular economy approach. Meanwhile, six CE processes (coloured blue) can be called technological, as they could create final products during those processes. Process Reclaim takes as much of a creative approach as could be called technological. In the future, some of the products could be collected from the users and returned to companies to recover them, either reassembled or remanufactured. This will need a lot of creative approaches to working with customers, resellers, and manufacturing companies' departments.

The developed framework of restructured circular economy processes will give businesses a more effortless look into transforming their business models and activities into more circular ones. This will ease the beginning of circular business and ordinary business restructuring towards circular business and allow starting from creative processes moving towards technological ones.

Scientifically looking into the implication of the developed framework of Circular Economy processes, identifying Creative and Technological ones is an excellent ground for further research on implementing circular economy business models. It opens a gap for scientific research on how to use the developed frameworks of

processes in various industries, making those CE processes more effective. Also, this developed framework might help with research on practical Circular Economy implications in existing businesses.

Conclusions

Circular economy spread in the worldwide business market depends on various circumstances: customers demand more sustainable, environmentally friendly products, their approach towards consumerism and the attitude of using second cycle products, the government pressure either help and the readiness of business to adopt CE. The financial institutions' priorities to finance circular companies are increasing in many countries. Governmental policies through various strategic documents have indicated the need to move businesses towards an environmentally friendly circular economy.

More than eighteen processes named circular economy processes were found in various scientific literature. Additionally, various specific processes can be identified for particular industries that have no similarities in other business fields. Differences in identifying processes could be found between continents in naming processes that are different from other parts of the world. Some of the identified processes are complimentary or overlap with each other.

In preparing a new framework of circular economy, Creative and Technological processes were identified as core processes that can be relevant in all business fields. Also, summarized processes were separated into processes that can be developed as Creative and Technological. Two creative processes were identified in analysing CE processes: Rethink and Re-commerce and six Technological processes – Reduce, Reuse, Recover, Redesign, Remanufacture, and Recycle. One process, Reclaim, is understood to be combined and contains creative and technological parts. The balance of processes named in various scientific literature but not identified in the final developed framework is covered in one or another by the remaining processes identified in the framework.

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ARMS CONTROL AND ITS IMPACT ON SUSTAINABLE EUROPEAN SECURITY*

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Abstract. The international legal framework for arms control fundamentally impacts global security. However, this vital institution is currently dysfunctional, which, in conjunction with the war in Ukraine and the crisis in US-Russia and NATO-Russia relations, is reviving the threat of the European continent becoming a zone of uncontrolled deployment of Russian and US weapons and weapons systems. The collapse of the arms control mechanism has a high potential to spark an uncontrolled arms race across Europe, with potential global spillover. Arms control is a unique idea promoting sustainable international security. It is based on the premise that numerous reductions in weapons and weapons systems by world actors will reduce the likelihood of the outbreak of armed conflict. Arms control is a complex process implemented through international treaties and agreements. They aim to reduce the force potential of a state actor to a level that is only necessary to ensure internal security. This article aims to analyze the impact of the arms control system on sustainable European security and its role within the international order. The basic premise of the arms control process is the principle of equal security, which is based on the sovereign equality of states expressed in the UN Charter. Arms control is always based on the parties' objectives and is therefore not considered an end in itself but is consistently used as part of a process aimed at sustainable international security and building sustainable peace.

Keywords: armaments; sustainable security; European security; international treaties; sustainable development goals

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1. Introduction

Making progress in negotiating legally binding international arms control treaties is complicated. It is a process that is subject, on the one hand, to the influence of the level of trust achieved between the signatories and, on the other hand, to the influence of the individual political domestic arenas of the signatories in the ratification process. The existence of an arms control treaty is a means to ensure sustainable peace. The interests of state actors condition its final version because of their reluctance to give up the military capability needed to secure their existence.

Historically, the European continent has had the infamous experience of catastrophic armed conflicts whose symptoms, outbreaks or post-conflict periods have also had a significant impact on the development of arms

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control. In this area, there has always been a delicate and complex interplay between the actors' initiatives and the achievement of sustainable European security. The arms control system can be classified as one of the elements that, together with the socio-economic differences of society, the quality of the environment and the promotion of the interests of global actors on the European continent, constitute sustainable European security. Also, for this reason, a functional arms control system fundamentally influences the level of inclination of European state actors to maintain and further develop such a system.

The Russian Federation (hereafter referred to as the "RU") and the United States of America (hereafter referred to as the "US") are the most important actors that fundamentally influence the international legal framework of arms control and its impact on sustainable European security, given that they hold the largest arsenal of nuclear and conventional weapons and weapons systems and their power-political interests about the European continent have been fundamental and unchanging for both actors since the end of the World War I. The failure of the US and the RU to respect international treaties on arms control is causing a trend towards a renewed arms race between the RU and the US. The RU considers the existing international legal framework of arms control in Europe outdated and respects its binding nature only partially. In this context, for example, the RU suspended the implementation of the Conventional Armed Forces in Europe Treaty (hereafter referred to as "CFE") on 12 December 2007 and completely withdrew from it on 7 November 2023. The US has an analogous approach, exemplified, for example, in its unilateral termination of the Anti-Ballistic Missile Treaty (hereafter referred to as "ABM") on 13 June 2002, rendering the treaty null and void. The CFE is meaningless without the participation of the RU since the aim was to ensure a balance of conventional forces in Europe, which cannot be achieved without the RU. The consequence of such an act is a domino effect and, for example, caused 22 of the NATO member states that are also signatories to the CFE to suspend its implementation on 7 November 2023 (Alberque, 2023).

Withdrawal from arms control treaties by global actors such as the RU and the US has a significant impact on the sustainability of the security of the European continent. The significance of the treaties lies mainly in the fact that both actors were bound to limit, for example, the stockpiles of strategic nuclear arsenals or the numbers of conventional medium-range ballistic missiles, etc. At the same time, the treaties form the basis for strengthening and building stability and peace in Europe and play a role in avoiding the threat of a vicious circle in the arms race. From the point of view of the security concept, we can classify the given area in the military security sector (Jurčák, 2020), which demands or, on the contrary, reduces the need for financial resources allocated to the defence expenditures of the states.

The article aims to examine the impact of arms control on sustainable European security, which has historically been in a constant state of transition and is closely linked to the goal of peaceful and inclusive societies for sustainable development defined by the United Nations (hereafter referred to as "UN") in the Sustainable Development Project. Therefore, European security should also be examined in terms of regional security or regional security complex, which is in line with sustainable development (Díaz, 2022; Zuk, 2023; Batusaru & Sbârcea, 2023; Liakhovych et al., 2023).

2. European security

European security is firmly rooted in the traditions of power politics that have emerged on the European continent during the continent's historical development and have shaped the European security environment. In addition to the term European security, the terms European Security System, European Security Model, and European Security Architecture (hereafter referred to as "ESA") are synonymous (Budveselová, 2015). A security architecture is a set of normative and institutional arrangements part of a more or less stable security system. Hence, it does not exist on its own. Every security architecture should be seen as a superstructure of institutions, norms, principles, and conventions, which has more or less stable and functioning foundations of power relations on which the security system is built. In other words, it is an order. A security architecture directly depends on such foundations and must reflect them (Trenin, 2022).

The first historical architecture of European collective security, Trenin (2022) argues, was the European balance of power period, also called the European concert of 1814-1914. The architecture took the form of a set of conventions that organized the relations between the great powers of the time and the Holy Alliance (Russia, Austria-Hungary, Prussia), which brought together the main actors of the continent in creating a new post-World War I structure based on the Versailles Peace Treaty (hereafter referred to as "VPT") and creating the League of Nations to manage international relations. The European security architecture based on the VPT caused the RU to be excluded from the balance of power; the US chose not to join, and France and the United Kingdom needed more forces and resources to maintain the balance of power in Europe. World War II and the defeat of Germany determined Europe to be the scene of rivalry between the US and the then USSR. No formal peace was achieved; the new European security system was based on agreements made between the Allied powers at Yalta and Potsdam and, in essence, on the political-military state of the European continent at the end of the war. The bipolar system that gradually emerged during the Cold War was based primarily on mutual nuclear deterrence and the massive deployment of US and the then USSR military forces and weapons systems. The end of the Cold War, as assessed by Graef (2021), resembled an analogous period that occurred immediately after World War I with the series of treaties concluded under the 1919 VPT, when the arms control process codified a change in political relations that were inextricably linked to competing visions of the future shape of Europe. The conventional arms control system became a new instrument for creating a new security architecture in Europe; it was not an additional pillar of the old architecture. Within the broader security and political processes, it was a cornerstone in the process of creating a political and sustainable security architecture for Europe.

The Conference on Security and Co-operation in Europe (hereafter referred to as "CSCE"), a watershed moment in shaping the current European security system, was crucial in gradually moderating the adverse effects of great power rivalry during the Cold War. In particular, the CSCE highlighted security issues, including the principles governing relations between states and the military aspects of security; the free movement of people, information and ideas; cultural relations; cooperation in the economic sphere, applied science and technology; and cooperation in improving the environment. Since adopting the Helsinki Final Act (1 August 1975), the CSCE participating States have developed a system of common standards and commitments that form the basis for cooperation in the political-military, human, economic and environmental fields. The principles of the Helsinki Final Act constituted the primary basis for easing tensions, establishing general principles for relations between and within the participating states (Waisová, 2009). The role of the Organization for Security and Co-operation in Europe (hereafter referred to as "OSCE"), which was established in December 1994, in the field of European security is defined by Galbreath, Mawdsley, and Chappell (2019) as a balanced approach in regional security relations, which is the hallmark of the organization. It is based on the outcomes of the CSCE, which brought the East and the West together and set common goals in the field of security and cooperation that survived the détente period and are still present today. The OSCE has been active in early warning (Budveselová, 2015), conflict prevention and post-war stabilization. The organization's activities are also carried out in arms control, preventive diplomacy, human rights, electoral monitoring and economic control, counter-terrorism, combating trafficking in human beings, combating the illicit trade in small arms and light weapons, and border security and management.

Since the end of World War II and because of the bipolar world order, the ESA has been institutionally composed of two military organizations: NATO and the Warsaw Pact Organisation (hereinafter referred to as the "WPO"). Subsequently, since the fall of the Iron Curtain, the ESA has been influenced mainly by the post-Cold War developments themselves (i.e. the transition of the world order from bipolarity to near-unipolarity and now the attempts to establish multipolarity), the consequences of the terrorist attacks of 11 September 2001 in the US, and the process of reassessment by the European Union (hereinafter referred to as "EU") of its leading positions in the field of European security. The restructuring of the world order has led to the disappearance of the WPO on the one hand and the revival of some actors, such as the OSCE, on the other hand. At the same time, these changes have also affected new actors, such as the EU and its role in ensuring its security, and the gradual transformation of NATO concerning new challenges. The end of the Cold War enabled the NATO member states and the former WPO to sign the CFE in Paris in 1990. This paradigmatic agreement, which coincided in time, place and several actors with the signing of the CSCE Charter (also known as the Charter of Paris - the basis of the pan-European security paradigm) for the new Europe, marked a new stage in security

relations. Both agreements aimed to end the division of Europe, and both were based on the principles of mutual respect and indivisibility of security. The European Community was transformed from an economic community into a political union enshrined in the Maastricht Treaty of 1993. This ground-breaking treaty established the common foreign and security policy as one of the three pillars on which the newly created EU rested. NATO was forced to reassess its historical mission and rationale when there was no real military threat in the form of the WPO. It was a new situation that brought new challenges and changed NATO from a provider of deterrence and defence to an exporter of stability, i.e. a more intensive involvement in international crisis management. These tasks were the content of the New Strategic Concept, which was signed at the NATO Summit in Rome in 1990 (Cobaleda, 2020).

The concept of European security reflects the experience of the historical events that have taken place on the European continent and the subsequent integration process. It has succeeded in uniting enemies and conceiving a security model that guarantees stable relations between Member States, whether in the form of the EU integration grouping or NATO. The historical development of the European security system shows that security is not just an ideal; it is, above all, the construction of the positions of the state, the nation, and social groups corresponding to specific rules, relationships and a particular type of thinking. The primary objective of the European security system is to guarantee sustainable security within a stable and secure international environment in Europe (Nečas & Kollár, 2018). The current European security model results from the complementary and harmonized action of states, international organizations and international treaties, which determine the functional links, competencies and mechanisms of their mutual cooperation. These are the actions of elements of the UN, NATO, the EU and the cooperative international security organizations and OSCE structures; regional and sub-regional structures - the Central European Initiative, the Central European Free Trade Agreement, the Council of the Baltic Sea States and, of course, the system of bilateral and multilateral treaties between individual European countries within the framework of the Stability Pact; the system of politically binding documents in the military field and confidence- and security-building within the OSCE - the Code of Conduct on Political-Military Aspects of Security; the system of arms control and disarmament treaties (CFE), etc. (Budveselová, 2015).

The institutional pillars of the ESA (NATO, the EU and the OSCE) continue to play an important role. Still, they cannot address many challenges facing European security today. There is a lack of a relevant (unified) response to destabilizing circumstances such as climate change or the revisionist perceptions of the RU and US interests in consolidating its influence on the European continent. European security today is as complex and complicated as it was in the past. It is influenced by internal and external fundamental influences such as, for instance, the United Kingdom's nuclear deterrence, terrorist attacks in European cities, crises on Europe's periphery, from the invasion of Ukraine by a rising RU to the ongoing civil war in Syria and the resulting refugee crisis. It would seem that the days when the main threat to Europe was a nuclear war between the two superpowers (US and RU) are over and that Europe is no longer the scene of a nuclear holocaust (Galbreath, Mawdsley, & Chappell, 2019). However, the uncertainty of the use of nuclear weapons on the European continent has by no means disappeared. It is currently reinforced by the speech act of the RU representatives in relation to the UA, where there is a determination to use tactical nuclear weapons on the territory of the UA.
In the same way, securitization is used by the US in the form of nuclear retaliation. The insecurity experienced by the states of the European continent and their inhabitants affects global, regional and local communities. This is probably also due to the fear of history repeating itself, taking into account all the world wars that have historically taken place on the European continent (World Wars I and II, the Cold War), which were European in origin and had a global impact.

Authors Goda and Báňaiová (2018) describe the current US-EU and US-Russian and selected post-Soviet interactions as the worst since the end of the Cold War. This is a situation where the European security environment is negatively affected, there is a lack of adherence to existing agreements and treaties, and, to some extent, a common normative understanding of mutual interstate relations is disappearing. This has resulted, for example, in the violation of the Helsinki Final Act and the non-compliance with the cooperative elements of the functioning of the European arms control regime (the basic documents are CFE, the Open Skies Treaty and the Vienna Document on Confidence and Security Building Measures). Many of the above elements of cooperation have either lost their relevance, e.g. the obsolete but also disregarded CFE, from which the RU has withdrawn,

or the absolute basic principles of the agreements are being violated. The deterioration of relations can be dated back to the turn of the last decade, or to the Russian-Georgian war in 2008, or even earlier, to 2007, when then RU President Medvedev presented a revision of the European security architecture and criticism of the OSCE at the Munich Security Conference. The consequences are, for example, the annexation of the Ukrainian Crimea in 2014 by the RU, the destabilization of eastern Ukraine, and the invasion of Ukraine by the RU on 24 February 2022.

Based on the above description of European security, it is possible to agree with Schmitt's (2018) assertion that the European security architecture is a complex web of military alliances (such as NATO and the Collective Security Treaty Organization) and bilateral (or multilateral) military partnerships, economic and political organizations (such as the EU), as well as an arms control system of conventional and nuclear weapons. It also follows that no arms control or disarmament agreement (whether valid or not) can be considered in isolation, in isolation from the other pillars of the European security architecture.

3. Arms control and European security

Contrary to popular belief, arms control is not a straightforward solution but rather a potential means to bolster national security and promote strategic stability. The foundation of contemporary arms control theory can be traced back to the influential publication by Thomas Schelling and Morton Halperin, Strategy and Arms Control, released in 1961. In this seminal work, they define "arms control" as encompassing various collaborative military efforts between potential adversaries to diminish the probability, magnitude, and consequences of war and reduce the political and economic burdens associated with preparedness. Strategic stability can be effectively attained through arms control, making it the most crucial purpose for its implementation (Brooks, 2020). There is no universally accepted definition of the term arms control. Descriptions or definitions of the content of the term arms control have always been based on the objectives that states have or have had an interest in pursuing with those terms. Arms control is not considered an end state but is consistently used as part of a process aimed at national and international security and sustainable peace-building. The arms control process is seen as a means to achieve the goal of ensuring sustainable international security and reducing the likelihood of war to the lowest possible level (Dekker, 2001).

The Covenant of the League of Nations after World War I was the first ever international legal document that included a reference to arms limitation (Ondřej, 1999). The Geneva Conference in 1932-1934 was the second attempt to limit arms. However, the results of the conference demonstrated the states' disinterest in bridging the gap between national security and world ideals. It was confirmed that arms limitation was primarily a domestic political issue and only then a technical problem in the broader international sense (Kickova, 2010). Arms limitation or arms regulation on a global scale was first embraced after the end of World War II with the establishment of the UN (Ondřej, 1999).

The year 1959 was significant in relation to the international legal framework in arms limitation in that the first major arms limitation treaty was concluded in a particular area. This was the Antarctic Treaty, the main aim of which was to ensure that the Antarctic was used only for peaceful purposes (Ondřej, Mrázek, & Kunz, 2023). The first international legal framework for the regulation of nuclear weapons was aimed at protecting the environment from the harmful effects of nuclear testing (Čepelka, Šturma, 2003). It was a 1963 treaty concluded between the then USSR, the US and the United Kingdom called the Partial Test Ban Treaty (hereafter referred to as "PTBT") (see Table 1).

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Table 1. Selected arms control treaties

TREATY/AGREEMENT	MAIN FOCUS	SIGNATURE/ENTERED INTO FORCE
Open Skies Treaty	It commits Eurasian and North American Member States to reciprocate airspace and allow overflights by unarmed surveillance aircraft over their territories in order to enhance confidence and transparency in military exercises.	1992/2002 **(US – withdrew from the treaty in 2020)**
Treaty on a Nuclear-Weapon-Free Zone in Southeast Asia (Bankog Treaty)	Prohibits the testing, possession or transport of nuclear weapons in the region.	1995/1997
African Nuclear-Weapon-Free Zone (Pelindaba Treaty)	Prohibits the testing, possession or transport of nuclear weapons in the region.	1996/2009
Comprehensive Nuclear-Test-Ban Treaty	It prohibits all types of nuclear weapons test, i.e. including underground tests.	1996/**not yet in force (RU revoked its 2000 ratification in 2023)**
Central Asian Nuclear-Weapon-Free Zone (Semipalatinsk Treaty)	Prohibits the testing, possession or transport of nuclear weapons in the region.	2006/2009
Agreement on cluster munitions	Prohibits the use, manufacture, transport and storage of cluster bombs.	2008/2010
Treaty on the Prohibition of Nuclear Weapons	A total ban on nuclear weapons, including the elimination of their stockpiles.	2017/2021
Antarctic Treaty	It bans military use of Antarctica, including nuclear testing.	1959/1961
Treaty banning the testing of nuclear weapons in the atmosphere, in outer space and under water (PTBT)	It bans nuclear weapons testing in the atmosphere, in space and underwater, and permits nuclear weapons testing below the Earth's surface.	1963/1963
Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies (Outer Space Treaty)	Prohibition on the use of space for weapons testing or deployment, including exercises.	1967/1967
Treaty for the Prohibition of Nuclear Weapons in Latin America (Treaty of Tlatelolco)	It prohibits States Parties from acquiring and possessing nuclear weapons, as well as the storage and stationing of nuclear weapons of other States, and prohibits the testing of nuclear weapons.	1967/1968
Treaty on the Non-Proliferation of Nuclear Weapons	Prohibits the manufacture and import of nuclear weapons production facilities by non-nuclear-weapon states. Imposes restrictions on and elimination of nuclear weapons by nuclear powers. Recognizes the right to peaceful uses of nuclear energy.	1968/1970
Treaty on the Prohibition of the Emplacement of Nuclear Weapons and Other Weapons of Mass Destruction on the Bottom of the Seas and Oceans and in the Subsoil Thereof (Seabed Treaty)	Denuclearization of the seabed and ocean floor, prohibiting the use of the seabed as a means for the deployment of military weapons, including nuclear weapons incendiary devices.	1971/1972
Agreement on the prohibition of military or any other hostile use of means affecting the environment.	It prohibits the use of technologies that could alter the weather, the oceans, the ozone layer or the ecology.	1977/1978
Treaty concerning the activities of States on the Moon and other celestial bodies (Moon Treaty)	It obliges states to comply with international law on the use of space bodies. **It has not been ratified by any state that has a real space program.**	1979/1984
Treaty on a Nuclear-Weapon-Free Zone in the South Pacific (Rarotonga Treaty)	Prohibits the testing, possession or transport of nuclear weapons in the region.	1985/1986
Treaty on Conventional Armed Forces in Europe (CFE)	It sets limits on five categories of weapons in Europe, lowering the balance of power level.	1990/1992 **(RU – susp. implementation in 2007, withdrew from CFE in 2023)**

Source: Krejčí, 2021; Onderco, Jimenéz, 2021; Aalberque, 2023; Treza, 2023

The 1960s saw two significant developments in international security relations that influenced the international legal framework for arms control. The first event, i.e. the interest in negotiating nuclear arms control, was triggered by the shock of the aftermath of the so-called Cuban Missile Crisis. The first event convinced the US

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and the RU, after much discussion on arms control, that it was an absolute necessity in international security and peace assurance to reduce the risk of nuclear war breaking out. The first tangible result was the PTBT. These events were followed by the signing of the Outer Space Treaty and the Treaty on the Nonproliferation of Nuclear Weapons (hereafter referred to as " NPT"), which were the basis for further negotiations on treaties to limit or reduce strategic weapons (the so-called SALT, SORT and START treaties). The early 1960s is also referred to as the beginning of the nuclear arms control process. The second event was directly linked to Europe. It was the arms control interest in conventional forces that began to build up in the late 1960s. The second event was equally related to the crisis caused by the construction of the Berlin Wall in August 1961. The then German Chancellor Willy Brandt was convinced that if the US was going to reduce the risk of nuclear war breaking out by negotiating its control with the then USSR, the then NATO member states should simultaneously be concerned with reducing the likelihood of armed conflict between East and West in Europe. Selected US-Russian strategic stability treaties are presented below in Table 2. The above thesis has been a source in the negotiations between NATO and the WPO on conventional force reductions and talks on mutual and balanced force reductions in Europe (Brauch, Grimwood, 2014).

Table 2. Selected US-Russian strategic stability treaties

TREATY/AGREEMENT	MAIN FOCUS	SIGNATURE/ENTERED INTO FORCE
Anti Ballistic Missiles Treaty (AMB)	It limits the deployment of missile defence systems to two areas (so that they do not provide defence for the whole territory) and prohibits the development of missile defence systems for deployment in space.	1972/1972, **not in force since 2002 (terminated by the US in 2002)**
Interim Agreement on Certain Measures to Restrict Strategic Offensive Arms (SALT I)	Freeze the number of strategic ballistic missile launchers and submarines for a period of 5 years.	1972/1972
Strategic Offensive Arms Limitation Treaty (SALT II)	Limits the numbers of strategic bombers, cruise missiles, intercontinental missiles and other weapons.	1979/**did not enter into force (It has not been ratified).**
Treaties on the elimination of short and intermediate-range missiles (INF)	Eliminates and prohibits ballistic missiles and cruise missiles with a range of 500 to 5,500 km.	1987/1987, **not in force since 2019 (terminated by the US in 2019)**
Strategic Arms Reduction and Limitation Treaty (START I)	Reduces the number of strategic nuclear weapons by 30%.	1991/1994
Strategic Arms Reduction and Limitation Treaty (START I)	Reduces the number of strategic nuclear weapons.	1993/2000
START III Treaty Directive	Preliminary agreement on a treaty that would include a commitment to reduce strategic nuclear warheads to between 2,000 and 2,500 by 2007.	1997
Strategic Offensive Reductions Treaty (SORT)	It expects to reduce the number of operationally deployed nuclear warheads to between 1,700 and 2,200 by 2012.	2002/2003
Strategic Arms Reduction and Limitation Treaty (New START)	It expects to reduce the number of operationally deployed nuclear warheads to 1,550 and delivery vehicles to 700 (800 including reserves) by 2018.	2010/2011

Source: Krejčí, 2021; Crawford, Vu, 2021; Bell, 2020

The arms control architecture built during the Cold War has become a tool for political discourse on the transformation of the European security order. The decision to expand the membership bases of Western institutions, including NATO, has sidelined the antagonistic positions of the US and the RU. However, the negative side of the arms control architecture caused the RU to be politically marginalized in Europe, which made it unwilling to accept previously agreed limitations on its military posture. Any system, given both internal and external influences, needs reforms. The failure to establish democracy in the RU on the one hand, and the near unipolarity of the post-Cold War US-led system on the other, prevented the implementation of the necessary reforms to the arms control system. At the same time, the technological development of modern weapon systems in the last two decades has naturally exceeded the limitations that were part of the agreed norms

of the arms control system. Today, Europe's conventional arms control system has returned to where it started in the early 1970s. Amid the new strategic competition, many states are unwilling to take risks and give up even small concessions that might benefit adversaries. The future arms control system is no longer likely to seek to change the political order (security architecture) but to stabilize and manage the future status quo in Europe. A military balance in support of the status quo in Europe is possible given, for example, the growing role of strategic conventional weapons systems. This shift could provide linkages between conventional and nuclear weapons. If this were to happen, conventional arms control could again become crucial in ensuring the transformation of the European security order (Graef, 2021). The security situation across Europe could seriously deteriorate because Europe is heading towards a new division within the spheres of influence of US and RU power-political interests. The arms control mechanism achieved mainly during the Cold War, which is considered the basis for sustainable European security, is facing unprecedented challenges. The collapse of the arms control mechanism has a high potential to spark an uncontrolled arms race across Europe, with potential spillovers on a global scale (Rogov, 2012).

In the second half of the 20th century, Europe's security was directly linked to the strategic stability provided by the two nuclear powers - the US and the RU. The current European security architecture incorporates Cold War logic, namely arms control treaties between the US and the then USSR (now the RU) and post-Cold War multilateral agreements, including confidence-building agreements between former adversaries. These formal and informal rules exist to mitigate the so-called security dilemma (Kunertova, 2021). Dvorkin, Arbatov, and Oznobishchev (2012) report that the first mutually accepted general definition of strategic stability appeared in a June 1990 joint statement by the USSR and the US, several years after both states began using the term, each according to its interpretation. The new term replaced the non-binding principle of "equality and equal security". According to the 1990 Joint Statement, strategic stability was understood as a balance of strategic forces of the USSR and the US (or such a state in which the strategic relations of the two superpowers were) in which there was no incentive to carry out a nuclear first strike. It was declared that future agreements should ensure strategic stability by stabilizing the arms control of strategic offensive weapons and maintaining an appropriate ratio of strategic offensive and defensive weapons. The principles of stabilization included reducing the number of nuclear warheads on strategic delivery vehicles and giving priority to weapon systems capable of surviving a nuclear attack.

Crawford and Vu (2021) point out that the strategic arms control mechanism (meaning nuclear weapons) is currently in crisis or dysfunctional. The US and the RU have withdrawn from agreements that provided an international legal and control framework to control arms and ensure strategic stability. In 2002, the US withdrew from the 1972 ABM) Systems Limitation Treaty, and in 2007, the RU suspended implementation of the 1990 CFE and formally withdrew from the treaty in 2023. According to Dean and Forsberg (1992), the main benefit of the CFE was that it provided guarantees of stability and predictability in military relations in Europe. However, it also had other benefits. In many ways, it was a combined peace treaty for World War II and the Cold War. The CFE expressed in material terms the reconciliation between the Allies and Germany and between NATO and the former USSR. Another benefit of the CFE was the reduction of the number of major types of conventional armaments in the USSR successor states west of the Urals to one-third of their numbers in 1988. About economic indicators, the US, with immediate effect, permanently reduced its military presence in Europe by 50% to 150,000 members of its armed forces, thereby reducing the costliness of defence budget expenditures by $15 billion per year in the 1990s.

The US also withdrew from the 1987 INF on the Elimination of Short-and Intermediate-Range Missiles in 2019 and the Open Skies Treaty in 2020. The only US-Russian strategic arms control agreement that is still in force is the 2011 New Strategic Arms Reduction Treaty (hereafter referred to as "New START") (its extension was signed in 2021), which expires in 2026 (Crawford, Vu, 2021). Even though nuclear weapons are still the most dangerous legacy of the 20th century, many experts are exploring to find an answer to the question of whether there is anything more devastating than nuclear weapons today. New technologies could rival or even surpass the destructive effect of today's atomic weapons (Levi, O'Hanlon, 2005). These include emerging and disruptive technologies (artificial intelligence, autonomous weapon systems, hypersonic systems, space weaponization, next-generation communication networks, novel materials, etc.), missile defences, long-range conventional high-precision weapons, and cyber and cyberspace capabilities. In the face of deteriorating global international

security that negatively affects the peace of the world, humanity has, in a sense, returned to the logic of the 1955 Russell-Einstein Manifesto, which asserted that agreements reached in peacetime are not considered binding in a state of war. The manifesto most intensely debated two possibilities: either a way to abolish war would be found, or the end of humanity would occur. As Péczeli (2023) defined, these new capabilities blur the lines between nuclear and conventional warfighting doctrines and blend nuclear, space, cyber and conventional concepts. This multidomain strategic environment's complexity makes it more difficult to distinguish between stability and instability. "

The abolition of war between nuclear-weapon states is highly unlikely today, but confidence-building measures and arms control can reduce the likelihood of conventional conflicts breaking out and escalating into nuclear war (Lodgaar, 2019; Kavan, 2021). A report prepared by Perrin (2021) for the NATO Plenary assesses that the international legal framework for arms control currently relies only on the extended New START Treaty. This is the last remaining arms control treaty that fulfils its purpose of limiting strategic nuclear weapons possessed by the US and the RU. But a delicate balance keeps alive the broader complex of arms control agreements that emerged in the 1990s. The extension of the New START provides the international community with an opportunity to redraft the currently dysfunctional international legal framework for arms control and disarmament. Historically, it is a given that agreeing on a final version of an arms control treaty or agreement between the parties to the treaty has been addressed over more than a single five-year period. Given the evolution of international security, what has been building for more than half a century since the Cuban Missile Crisis could easily unravel in the next decade. The "new nuclear age" is likely a far more significant challenge than that which characterized the Cold War. Terem and Drotár (2021) argue that bilateral nuclear agreements have the potential to be the normative principle of the second nuclear age. Crucial, however, will be an agreement between the US and the RU on framing the goal of such an agreement. If it were, for example, an agreement on total nuclear zero, this could lead to nuclear disarmament at the regional (thought of at the European level) and later at the global level (achieving global nuclear parity and balance). The extension of the New START is based on the pragmatism of the parties and strategic thinking that the future threat has more contours of asymmetry, which will come from the so-called grey security zone where nuclear weapons, conventional advanced weapons systems and emerging and disruptive technologies will play a decisive role.

The abrogated INF was part of the European security architecture and played an essential role in consolidating the security dilemma. The arms control treaties and agreements that were concluded during and then after the Cold War created an interconnected international legal framework that provided transparency, a confidence-building tool, regulated relations between the parties and reduced to a minor level the likelihood that a military attack by a contracting party would outweigh the benefits over the negatives. It became a guarantee for reducing military capabilities in the post-Cold War era (Schaub, 2013). The demise of the INF has the potential, as Kunertova (2021) argues, to reinforce the need for increased weaponization by state actors in Europe and globally.

The abrogation of the INF removed from the international legal framework the control of a category of nuclear weapons that posed a direct threat to European security: short and medium-range missiles (300 to 5,500 kilometres). The annulment of the INF has allowed both the US and the RU to introduce that category of nuclear weapons into their arsenals, potentially destabilizing the security environment on the European continent. For example, the RU is concerned with deploying US short-to-medium-range conventional missile systems in European NATO member states. Specifically, the short flight time of such missiles (less than 20 minutes) from NATO member states would give the RU almost no time to detect them and take action to destroy them, increasing the likelihood of an incorrect response based on incomplete information. The presence of these types of missiles increases the probability that a regional conflict between the RU and the US could escalate - either inadvertently or due to miscalculation - and reach an imaginary threshold of triggering a nuclear conflict, with potentially devastating consequences for Europe (Bell, 2020). The nuclear arms control system, which emerged during the Cold War as an effort by the US and the then USSR to maintain trust and transparency in the field, is in crisis. The role of nuclear arms control after the end of the Cold War may be overstated. Still, it must be emphasized that it served primarily to consolidate both countries' nuclear weapons for their nuclear missions, not to reduce stockpiles. Overall, however, the positive contribution of arms control to preventing nuclear war and managing US-Soviet and US-Russian relations is indisputable and has had a significant positive impact on

stability and sustainable peace on the European continent. Europe's security has benefited from the gradual reduction in the numbers of both nuclear arsenals and the increased predictability guaranteed by the strategic arms control treaties. Advances in bilateral arms control have also promoted nonproliferation and disarmament goals (Kulesa, 2020; Kavan, Brehovska, 2016).

Europe has benefited from the existence of the INF and the New START and the maintenance of a bilateral dialogue between the US and the RU on strategic stability and arms control. The collapse of the INF, the war in Ukraine and the crisis in US-Russian and NATO-Russian relations are reviving the threat of the European continent becoming a deployment zone for additional Russian and potentially US weapon systems with nuclear capability. All European states and the EU have continued to support US-Russian arms control as part of their vision of a rules-based global order and as a measure through which power politics is restrained and multilateralism strengthened (Kulesa, 2020).

The ABM's demise definitively abrogated a pillar that had been in place for decades between the US and the RU and had fulfilled the crucial role of maintaining good bilateral relations between the actors. The situation opened up the theoretical possibility of developing unlimited capabilities for US and RU missile defence programs, regardless of whether they would be technically feasible, successful, or affordable. Moreover, the absence of a critical pillar to keep the missile defence balance in check has deprived the bilateral arms control and disarmament process between the US and the RU of a mechanism that could also provide some barter commodity in future arms control and nuclear disarmament system negotiations. Historically, bilateral nuclear arms control treaties have been a multiplier that has been conducive to sustaining arms race dynamics even during the Cold War. Therefore, it is not an exaggeration to state that without some of the significant treaty restrictions that were part of the US-Russian bilateral nuclear arms control agreements, such as those in the INF or the ABM, an arms race out of control could have become a reality (Kühn, 2021; Kavan, 2015).

The future arms control system is likely to be less about the number of launchers, nuclear delivery systems and warheads and more about limiting competing technologies for new offensive and defensive weapon systems. Arms control will also have to address the differences between the US, RU, and Chinese and other states' expectations for nuclear crisis management and escalation control. According to some experts, a "revolution in military affairs" based on new technologies and emerging and disruptive technologies could threaten the credibility of nuclear strategic stability based on past assumptions. These technologies threaten to disrupt the long-standing nuclear deterrence paradigm and alter the balance of power between the US, the ROK, and China (Cimbala, Lowther, 2022).

Conclusions

The international legal framework of arms control and disarmament is an institution that has a fundamental impact on sustainable international security and has become an integral part of public international law over its nearly 80 years of existence. The area of international law is most frequently associated with international politics and the relations between its actors. For this reason, the international legal framework of arms control and disarmament is, to a fundamental extent, conditioned by the interests of states in preserving the greatest extent of sovereignty and securing their existence. In the above context, Ondřej (1999) argues that international arms and disarmament treaties impose obligations on the parties that are particularly sensitive to the exercise of state sovereignty because they limit it. Limited state sovereignty results from a reduction in the level of armaments that affects the national security of the state actor. In this context, a workable international legal framework for arms control and disarmament is indispensable, mainly because armaments constitute a natural activity of the state actor, fulfilling the objective of securing the state's sovereignty. Therefore, it is probably an illusion to have a world without weapons, i.e. to want to achieve, for example, so-called conventional zero or nuclear zero. History still does not suggest that state actors want to renounce strategic military capability. Instead, based on post-Cold War European security, it seems more realistic to achieve an international legal framework for arms control that provides an acceptable guarantee of military balance at the regional level, i.e. sufficient military capability of a state actor to ensure its sovereignty. Historically, however, there has not been, nor is there likely to be, an international legal framework that can eliminate a state actor's use of weapons for any purpose other than the primary purpose of self-protection (i.e., ensuring security within its borders - ensuring

sovereignty). An example is revisionist state actors who associate the acquisition of foreign territory by military force with their primary purpose.

Just as European security is not static, neither is the correlation between a state actor's conventional and nuclear forces. It is a highly dynamic domain, according to Bruusgaard (2021), which is influenced by the subordination and superordination of elements. Conventional subordination can induce increased reliance on nuclear weapons, but some states are seeking to improve conventional capabilities to overcome this reliance. The aforementioned state of a state actor's adherence to conventional or nuclear forces may also reflect the functionality of the international legal arms control framework. The fact is that the international legal arms control framework ensuring a conventional military balance on the European continent has broken down. It was based on the Atlantic model of European security, given that the US is no longer a party to the CFE, the ABM, the Open Skies Treaty, or the INF. As a result, no prominent security actor can guarantee the continent's security to the extent that the US can do so. Given the antagonistic interests of the US and the RU in the relationship of the European continent, there is currently no legal framework on arms control that provides guarantees of stability and predictability in conventional forces in military relations in Europe. In the wake of the dysfunctional international legal framework concerning conventional forces on the European continent, strategic stability of nuclear weapons among the most crucial European security actors is maintained only by the last major treaty, i.e. the New START. In the second half of the 20th century, Europe's security was directly linked to the strategic stability (i.e. strategic nuclear weapons parity) provided by the two nuclear powers - the US and the RU. The current European security architecture embraces Cold War logic. Onderco and Smetana (2021) have determined the relevance in the nexus of the US nuclear deterrence strategy on the European continent, which is based on the premise that it deters an adversary (meaning mainly the RU) from a nuclear conventional attack against European NATO member states. The so-called European nuclear umbrella provided by the US that existed during the Cold War remains a critical element of NATO's nuclear deterrence strategy to this day. The nuclear umbrella in question can be strengthened in terms of military strategy due to the US withdrawal from the INF by deploying any number of non-strategic nuclear weapons on the European continent because an adequate international legal framework does not constrain such a course of action. The New START-style agreement between the US and the RU only applies to the actors mentioned above, or the deployment of non-strategic nuclear weapons by the US and the RU on the European continent has endemic limits. Given that the security insecurity experienced by the states of the European continent and their populations affects not only regional communities but also global ones.

Establishing an adequate international legal framework for arms control is and will be necessary in the future, particularly for the European continent. However, its creation and maintenance will be challenging to implement given the asymmetries that prevail in armaments (effectiveness and destructive power of conventional weapons systems compared to nuclear weapons, emerging and disruptive technologies, etc.). The asymmetry in nuclear weapons is also characteristic of the state actors that possess nuclear weapons on the European continent (France and the United Kingdom) and are not part of an adequate legal control mechanism that would build regional trust between the so-called Western states and the RU. It can, therefore, be assumed that once an acceptable framework is in place, the RU will be willing to reduce its nuclear arsenal. Future nuclear arms control regimes will thus have to abandon the so-called bipolar logic based on the principle that the US and the RU have comparable numbers of strategic nuclear weapons. The new arrangements will also have to take account of changing technological progress. Other factors that will influence the finalization of a possible future legal framework on armaments and disarmament are the increasing effectiveness of a nuclear first strike, the effectiveness of modern conventional weapons to turn off an adversary's nuclear arsenal, and the growing number of states possessing nuclear weapons. Disarmament treaties will be essential to establishing new verification regimes for nuclear arms control, the application of which will undoubtedly be a significant challenge.

The anarchy that prevails in international relations presents a picture that tends to lean towards the side that state actors will not be entirely willing to give up nuclear weapons shortly, and limiting them by legal agreement is also tricky. A factor could be that a conventional alternative to nuclear weapons will begin to exist. Taking into account the fact that European security is based on the Atlantic model, the European continent remains the theatre or stage where the interests of global actors will continue to assert themselves. For this reason, the

international legal framework should also be seen as an essential executive element for ensuring European security, reflecting the resulting architecture of congruence of actors' interests and military balance. However, the theoretical framework of the international legal framework of arms control and disarmament confirms that it is a very complex process from its very beginning. The bipolar world had a positive side. It forced the main actors of the time, the US and the USSR, to build strategic parity and a system of international legal framework to control it. Considering the current global security environment in which a new world order is being created, we can apply the bipolar analogy to the future European security architecture. There is a need to resolve the international legal framework for strategic nuclear weapons, which cannot be absent of state actors who possess such weapons. This will also ensure that if another state actor comes into the world, it will be able to become a party to the treaty. This analogy would pave the way for the establishment of an international legal framework also for modern conventional weapons, as was the case after the end of the Cold War. However, in this context, the first thing that needs to be done is to ensure an acceptable security environment on the European continent, for example, by ending the armed conflict in Ukraine with a peace treaty. However, the future of the international legal framework for arms control with nuclear or conventional weapons is contingent on a security guarantor with a global dimension, which is currently embedded in the Atlantic model and is highly likely to prevail for the next two decades. However, if European security is to move forward, it will be necessary to provide an alternative model to transatlantic European security. A European model in which the EU will play the role of a geostrategic actor is acceptable, also in light of the historical and developmental stages of the European continent. However, the concept mentioned above of European security will not be able to succeed without a balanced US presence. In the given constellation, however, the organization with a high potential to gain support across the entire European continent is the OSCE. Said concept does need time, but it is still more acceptable than hearing German Chancellor Olaf Scholz (Bunde, 2022) speak to members of the German Bundestag gathered for a special session on the morning of Sunday, February 27, 2022, three days after the start of the Russian invasion of Ukraine. "We are living through a watershed period," Scholz said, "And that means that the world then will not be the same as the world before." Or, as the Intelligence Unit Report (2022) assesses, the war in Ukraine could expand into a global conflict that pits the Russians against NATO member states. War poses a particular risk to NATO member states bordering Ukraine and the RU, which could be inadvertently drawn into the conflict. The RU could also target countries it perceives as supporting Ukraine, either by providing aid or enforcing punitive measures, and prepare its nuclear deterrent. Potential and existing NATO members such as Poland, Romania, the Baltic states, Finland, and Sweden are the most likely trigger points. Another potential flashpoint is Moldova. The consequences of a conflict of this magnitude would be devastating. The world economy would plunge into a deep recession with severe human implications and many casualties. Such a confrontation could take a nuclear form with disastrous consequences.

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COMPANIES' PERFORMANCE AND BEHAVIOUR RESPONDING TO CRISIS DURING COVID-19 PANDEMIC: A CASE STUDY OF THE CZECH REPUBLIC

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Abstract. The aim of the paper is to find out whether the behaviour of B2B and B2C enterprises differed in the pandemic period in terms of disruption, the extent of measures taken and the financial situation in the following period. To achieve the main objective, a questionnaire survey was conducted in Czech companies with a predominantly B2B or B2C business relationship. Two research questions were defined, which were answered by testing a total of 6 hypotheses. The parametric two-sample one-factor ANOVA and Pearson's Chi-squared test were used to test the hypotheses. The test results suggest that the correlation between the number of operation barriers and the level of disruption is more pronounced for B2C than for B2B. B2C businesses were more likely to use tools such as simplifying organisational structure or changing product offerings to combat the impact of pandemic. In contrast, B2B businesses used tools such as working from home and moving online to a greater extent. The correlation between the level of disruption and the use of remedial measures is only valid for the B2B group. The link between the measures taken and the economic situation after the pandemic was confirmed for both B2B and B2C businesses (to a greater extent). The survey results are valid only for B2B or B2C businesses in the Czech Republic. The results are limited to these measures only, other measures were considered irrelevant for the purpose of the study. The results are limited to the crisis period; results may differ in other periods.

Keywords: B2B; B2C; disruption; corrective action; economic impact of pandemic

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1. Introduction

The impact of the pandemic on businesses has been significant and businesses are currently having to adapt to the changing business environment. Businesses experience a reduction in revenue and profitability during a recession as consumers cut back on spending (Kacperska et al., 2021). The pandemic has caused significant supply chain disruption. Disruption is evident in businesses across size and sector differentials. The exploration of the degree of disruption in relation to the dominant business relationship (B2B, B2C) has been the subject of research in several papers, e.g. (Wani et al., 2022; Zahoor et al., 2022). Almeida et al., 2022 highlights the high level of disruption especially for service providers in the B2C sector (hotels, restaurants and others dependent on tourists).

Businesses have been forced to take a variety of measures to reduce the economic and other impacts of the pandemic. In particular, micro, small and medium enterprises have had to adjust their supply chain management plans (Khan et al., 2021, Navickas et al., 2022). Some companies have been forced to reduce staff, cut working hours or close down operations altogether. Businesses in different sectors have had to incur additional expenses related to health and safety standards, such as purchasing personal protective equipment and implementing social segregation measures (Almeida et al., 2022). The IT support of HR management is one of the key elements of long-term sustainable efficiency (Koman et al., 2023).

Businesses, including SMEs, have had to adjust their business and production processes to comply with social segregation rules. A significant number of businesses have been forced to move online, for example, to provide virtual services or sell goods or services online (Kacperska et al., 2021). Enterprises have expanded their supplier base, formed strong supply alliances and diversified their supply chain (Khan et al., 2021). In response to these difficulties caused by the pandemic and the crisis, some businesses are changing the way they operate or coming up with new strategies to help them adapt to the changes. A number of businesses have embraced digitization of processes or online sales. Process digitalisation has become a trend during the crisis and has managed to keep businesses active. An aspect of process digitization is automation, the use of digital platforms to support collaboration, communication and data exchange (Yordanova, 2021). Digital commerce appears to be the most effective norm for buying and paying during a pandemic (Akram et al., 2021). Companies may also find it harder to raise funds or financing, which may limit their ability to invest in expansion or keep operations running properly. Governments have put measures in place to assist affected companies, including compensation programs (Wong and Wong, 2021).

The effectiveness of individual measures to combat the economic impact of the pandemic is becoming a key issue for both the scientific research community and practitioners.

The aim of the paper is to find out whether the behaviour of B2B and B2C enterprises differed during the pandemic period in terms of disruption, the extent of measures taken and the financial situation in the following period (year). To achieve the objective of the paper, the following RQs were established:
RQ1: Is the link between barriers to operations and disruption during a pandemic influenced by the type of prevailing business relationship (B2B or B2C)?
RQ2: Is the link between disruption during a pandemic, the extent of action taken and the financial situation of the business in the following year influenced by the type of prevailing business relationship (B2B or B2C)?

2. Theoretical background

A business-to-business relationship (abbreviated as "B2B") refers to a business between two companies. This type of business is very common in practice, for example, the sale of goods to a retailer from a large corporation. "Business to consumer" (abbreviated as "B2C") refers to business-to-consumer trade, or the sale of goods or services to an end customer (Asipi and Durakovic, 2020). The emergence of e-commerce has also created "consumer to consumer" (or "C2C") trade taking place between individual consumers through online marketplaces or platforms. This is a one-off and occasional trade where the seller sets their own prices and terms of sale (Pei et al., 2021; Zhao et al., 2020). The commerce models have been discussed in detail by He and Zhang (2022), who argue that the B2B and B2C models separately may not be sufficient to address a firm's marketing needs and customer relationship management in a digital environment. As a result, they proposed a digital interactive platform that combines the B2B and B2C business models. Due to the different customers of B2B and B2C, these models have different priorities. The B2B model aims to establish lasting business partnerships (Haqquani et al., 2020). As a result, the main priority is often to produce goods and services that specifically meet the requirements of business clients, offer superior customer support and cultivate a long-term relationship with them. Business in the B2B model often involves multiple goods or services. In contrast, B2C commerce often focuses on providing a satisfying customer experience (Gligor et al., 2020). Customer satisfaction, brand reputation, and customer relationships are of the highest priority in B2C businesses. B2C businesses must expend resources to cultivate a loyal consumer base, offer quality assortments, and provide fast, convenient customer service (Xie and Zang, 2020; Világi, Konečný and Ruschak, 2022). B2B supply chains are typically longer and more complex than B2C supply chains (Nurhayati et al., 2023). Many actors are

involved in B2B supply chains, including suppliers, manufacturers, distributors and retailers (Anderson et al., 2022). This supply cycle of B2B and B2C businesses was most affected during the pandemic, leading to disruption of the value chain that shapes the ultimate value to the customer (Eisenreich et al., 2022). The disruption of normal operations due to pandemics has been addressed in a number of studies. The disruption of the value chain during a pandemic led to a slowdown in all business activities. Measures to prevent the spread of the disease caused supply and logistics problems due to travel restrictions and border closures. Many businesses had to find new sources of supply and strategies to ensure the availability of goods (Nagy-Bota et al., 2022). They had to adapt to new working practices, including managing operations remotely and working remotely, which meant a reduction in performance and efficiency (Martínez-Azúa et al., 2022). The changes included adjustments to marketing and sales strategies as customer wants and demands changed due to the pandemic (Hoekstra and Leeflang, 2020). Businesses were forced to implement new strategies to reach their customers, such as digital marketing and e-commerce (Subriadi and Wardhani, 2022). The impact of coronavirus has also exposed the fragility and vulnerability of supply chains (Fonseca and Azevedo, 2020). Supply chain disruptions resulted in delivery delays and shortages of goods (Duong et al., 2022). The epidemic led to a drop in demand, which exacerbated supply chain problems. Companies had to quickly adapt to the changing environment and change their supply chains to meet the new market demands (Bouanba et al., 2022). Thus, in order to increase productivity and reduce costs, the use of digital technologies such as automation and artificial intelligence has become widespread (Tam et al., 2022). In addition to diversifying sources of supply, improving visibility of supply networks and investing in risk management measures, the enterprise has also had to focus on developing more resilient supply chains (Dixon et al., 2021). Changing business processes due to pandemics is addressed in studies such as (Aday and Aday, 2020; Chowdhury et al., 2021). A number of companies faced low demand, which led to disruptions in production and supply chain (Aday and Aday, 2020; Chowdhury et al., 2021). Businesses had to adapt their business processes to new safety regulations, adjust their operations, including equipping workers with protective equipment and introducing social distance (de Oliviera Neto et al., 2022). To achieve flexibility and efficiency in a turbulent period, enterprises had to take a number of measures, such as adjusting production and distribution processes to meet changing demand (Kang et al., 2021), and introducing new digital practices (Gaspar and Ternai, 2020).

The main measures taken include, for example, adapting the organisational structure (model), changing the product offering, using home office (HO), increased marketing communication, moving online, accelerating digitalisation. A study (Conoscenti et al., 2022) highlights the benefits of adapting the organizational model in a health facility during a pandemic. The data collection was done in the form of a questionnaire survey and the data processing was done in the form of Chi-square statistical testing (Conoscenti et al., 2022). The relationship between the need for staff and the economic impact of a pandemic is discussed in (Gashi et al., 2021). Data collection was done through a questionnaire survey. The data processing was done in the form of Statistical Package for the Social Sciences (SPSS), specifically by using the descriptive data analysis (descriptives, frequencies, cross-tabulations) (Gashi et al., 2021). The study establishes that most of the company does not change the org structure but changes the service/product offering. Product portfolio customization is also the object of research (Beninger et al., 2022). The study states that the main impacts include impact on strategic priorities, change in product focus, changes in workload, among others. (Beninger et al., 2022). (González-Aleu et al., 2022) focuses on identifying business opportunities in a manufacturing company during a pandemic. Data collection was conducted through content analysis of market information for the company using competitors' annual reports, market trend analysis and free government trades. Data processing was done in the form of SWOT analysis and Hoshin Kanri et al. (González-Aleu et al., 2022) among others. The issue of HO during a pandemic period in terms of its impact on the level of stress in families is addressed in studies such as (Neocleous & McGregor, 2021). The research was conducted in the form of a questionnaire survey. Data processing was done using Descriptive Statistics, Independentt-Test, and One Way ANOVA were applied through SPSS. The study (Strakšienė et al., 2021) focuses on researching the possibilities of HO application in corporate practice during a pandemic. Data collection was conducted through a questionnaire survey and qualitative research (focus group). Data processing was done in the form of Statistical data analysis. Adaptation of marketing communication to achieve competitiveness is the object of research e.g. (Chemsripong, 2022). Data collection was done in the form of questionnaire survey. Statistical data analysis was done using reliability test with Cronbach's alpha coefficient, Paired Samples t-test, multiple regression analysis (Chemsripong, 2022). The link between pandemic and innovative marketing and innovation is discussed in (Amoah et al., 2021). Data

collection was done through interviews with managers and business owners. The effects of digital marketing for social network development during a pandemic are discussed in (Konhäusner & Seidentopf, 2021). Interviews with experts were used for data collection (Konhäusner & Seidentopf, 2021). Moving online as another potentially effective tool in combating the effects of a pandemic is addressed in several studies. For example, (Gîngioveanu Lupulescu & Zamfir, 2021) focuses on finding out how and where data and information can be exclusively searched online to gain business knowledge. All the data and information used for this study was obtained from the internet. (Gîngioveanu Lupulescu & Zamfir, 2021). (Velica Cârciumarescu et al., 2022) points out that teleworking should be maintained at an appropriate level in order to keep the productivity of employees unchanged under the given conditions after the last two years marked by the pandemic. The changing roles of online reviews due to the pandemic is highlighted by (Kutlubay et al., 2023). Data collection was conducted by surveying online reviews of 321 products at different times. The issue of accelerating digitalisation is becoming one of the key issues for achieving sustainable competitiveness in a crisis period. Digitization played a significant role in many areas of life during the COVID-19 epidemic. Digitalization has enabled employees and companies to work remotely and students to learn online (Zeverte-Rivza and Gudele, 2021; Kollmann and Dobrovič, 2022). In order to reduce the number of patients in hospitals and surgeries, the health sector introduced online ordering of medicines and online communication with doctors (He et al., 2020). People were also able to connect with friends, family and co-workers through digital platforms, which did not violate measures against the spread of coronavirus (Osler and Zahavi, 2022). Digitisation also enabled people to shop online during the pandemic, where they could order goods or services from anywhere (Gregoric et al., 2021). During the pandemic, digitization became an essential part of the functioning of B2B and B2C businesses. Digitalization has helped B2B and B2C companies to stay operational and competitive in the market (Birkie, 2021). By implementing digitalization, B2B and B2C companies can now automate processes, streamline operations and reduce costs (Johansen et al., 2020). It has also enabled these businesses to access new markets, improve performance and reach new customers (Shpak et al., 2020). In their research on digitalisation, the authors (López and Giusti, 2020) found that B2B companies are slower to develop an overall digital strategy compared to B2C companies. However, it should be emphasized that digitization alone is not the only factor for sustaining a company in the market during the Covid-19 pandemic. The issue of digital transformation and its impact on employee performance is addressed by (Bikse et al., 2021). A survey of opinions on the topic among employers in Latvia was used for data collection (Bikse et al., 2021). Already at the beginning of the 2020 epidemic, many businesses were closed due to coronavirus. Estimates from the Current Population Survey showed that between February and April 2020, the number of active businesses decreased by 22% (Fairlie and Fossen, 2021). In order to prevent a massive loss of businesses in the Covid-19 pandemic, governments have introduced compensation programmes to help businesses affected by the crisis (Honda et al, 2023; Pociute-Sereikiene et al., 2022). Financial damage due to the pandemic (financial damage) in enterprises of different sizes has been reported by (Gashi et al., 2021). The degree of damage to supplier-customer relationships is also discussed by (Gashi et al., 2021).

It is closest to the topic of this paper (Gashi et al., 2021). In Kosovo, research by (Gashi et al., 2021) examines both the financial impact of the pandemic on businesses and the extent of measures taken to combat the negative impacts of the pandemic (among the measures, the authors cite layoffs of employees, the need for new employees, changes in organizational structure, and changes in service/product offerings). In order to meet the objectives of this article, the research itself will be carried out similarly in the form of a questionnaire survey and statistical analysis methods will be used for data analysis.

Based on the literature review, it can be concluded that there is a gap in examining the degree of influence of external factors on the behaviour and performance of companies in the context of B2B and B2C business.

3. Research objective and methodology

The research questions for this article were stated as follows:
RQ1: Is the correlation between operation barriers to and level of disruption during a pandemic influenced by the type of business relationship prevailing (B2B or B2C)?

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RQ2: Is the relationship between disruption during a pandemic, the extent of action taken and the financial situation of the business in the following year influenced by the type of prevailing business relationship (B2B or B2C)?

To answer the RQ, a questionnaire survey will be conducted in Czech companies from different sectors. The sample will be drawn by non-probability sampling, based on voluntariness. The minimum return threshold for this research has been set at 200 enterprises. The enterprises will be selected based on voluntariness - i.e. random selection. The normality of the data will be ensured by similar sample sizes of the comparison groups (B2B and B2C), the maximum variance is set at 5 percent. Based on the established RQs and given the stated research design, six hypotheses have been established.

The questions of the questionnaire related to the research object of the article are defined as follows:
1) Type of business relationship. Answer options: B2B, B2C, other.
2) How were you doing in business before the crisis? Answer options: Business would be profitable, making a profit for its operations and the owner's daily life/ Business was becoming profitable, Stagnating/ Business was losing money.
3) Operation during a pandemic (at the most critical stage). Answer options: Closure of business/ Forced closure/ Suspension of business/ Change in existing established services/ Reduction in operations/ No change/ Business development.
4) Main obstacles for your business (What were the biggest obstacles for the operation of the business during the COVID-19 pandemic?) Response options (0-3 options could be selected): Breakdown of supplier relationships/ Breakdown of customer relationships/ Decline in demand for goods or services.
5) Did you take any measures; did you make any changes that helped the company to cope better with the "covid situation"? (select the main ones). Answer options (more than one type of measure could be selected): no measures were taken/ simplification of the organisational structure, optimisation of the number of employees, including management/ more efficient organisation of work (setting shifts, working from home) / change in the range of products and services/ acceleration of digitisation/ move to the online environment/ increased marketing promotion of the company, discount offers/ Other.
6) How do you assess the current situation of the company (situation as of October 2021)? Answer options: We are considering going out of business/ We are trying to recover but the situation is still uncertain, we have a number of problems/ We are almost recovered and are continuing with the business/ We are fully recovered and are continuing as before the pandemic/ We are fully recovered and are better off than before the pandemic/ The pandemic has not had a negative impact on the business.
Fig. 1 shows the structure of the empirical research.

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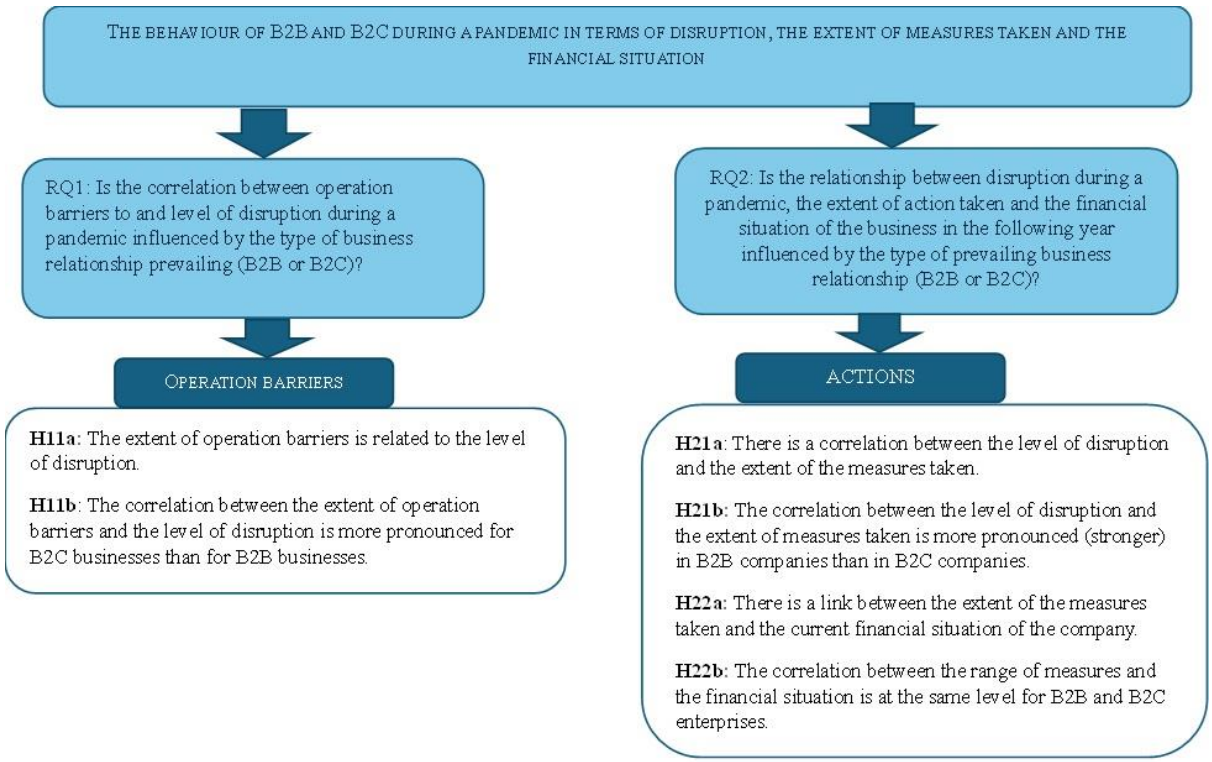

Fig. 1. Structure of the empirical research
Source: own

To answer RQ1, the following hypotheses were established.
H11a: The extent of operation barriers is related to the level of disruption.
H11b: The correlation between the extent of operation barriers and the level of disruption is more pronounced for B2C businesses than for B2B businesses.

In the first phase, H11a will be tested. If H11a is confirmed, then the context will be tested separately for B2B and B2C files, i.e., H11b testing.
The sample description for testing H11a and H11b is presented in Table 1.

Table 1. Sample description for testing H11a, H11b

Level of disruption			The extent of operation barriers			Sector	
A11: Closure of business, Forced closure, Suspension of business	B11: Change of existing services, Restriction of operation	C11: No change, Business Development	A12-all three	B12 - at least one of them	C12 - none of them	B2B	B2C

Source: own

The selected operations barriers include disruption of supplier relationships, disruption of customer relationships and a decline in demand for goods or services. The enterprises are then divided into three groups (the enterprise had none of the obstacles listed, the enterprise had only one of the obstacles listed, the enterprise had 2 or 3 of the obstacles listed).
To answer RQ2, 4 hypotheses were constructed:
H21a: There is a correlation between the level of disruption and the extent of the measures taken.
H21b: The correlation between the level of disruption and the extent of measures taken is more pronounced (stronger) in B2B companies than in B2C companies.
H22a: There is a link between the extent of the measures taken and the current financial situation of the company.

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H22b: The correlation between the range of measures and the financial situation is at the same level for B2B and B2C enterprises.
A schematic description of the sample for testing H21 and H22 is presented in the following tables 2 and 3.

Table 2. Description of samples for testing H21a, H21b

Level of disruption			Scope of the measures taken			Sector	
A11: Closure of business, Forced closure, Suspension of business	B11: Change of existing services, Restriction of operation	C11: No change, Business Development	A22: no measures	B22: 1-2 measures	C22: 3 or more measures	B2B	B2C

Source: own

Table 3. Description of samples for testing H22a, H22b

Scope of the measures taken			Financial situation as of October 2021			Sector	
A22: no action	B22: 1-2 measures	C22: 3 or more measures	A23: Negative impact	B23: Neutral impact	C23: Positive impact	B2B	B2C

Source: own

The negative impact on the financial situation of the company (group A23) is defined by the answers: We are thinking of going out of business; We are trying to recover, but the situation is still uncertain, we have several problems.

Neutral impact on the financial situation of the enterprise (group B23) is a summary of the responses The pandemic did not have a negative impact on the enterprise.

The following answers have a positive impact on the financial situation of the enterprise (group C23): We have almost recovered and are continuing to do business; We have fully recovered and are continuing as before the pandemic; We have fully recovered and are better off than before the pandemic.

Hypothesis testing will take place in several stages.
In the first stage, the responses will be filtered. Only responses from respondents who indicated a B2B or B2C sector will be included in the final file. Responses from respondents who work in both groups (B2B and B2C) will be excluded from the sample.

In the following second stage, hypotheses H11a (there is a link between the selected operation barriers and traffic disruption) and H11b (the link between the selected operation barriers and traffic disruption is more evident for B2C than for B2B) will be tested to answer RQ1: How did the pandemic disrupt normal traffic for B2B compared to B2C? Testing will be conducted using a one-factor ANOVA tool. H11a testing will be followed by H11b testing. Normality of the data will be ensured by a similar sample size, with an allowable difference of 5 percent. The significance level will be set at 5 percent.

During the third stage, hypotheses will be tested, focusing on measures taken to combat the economic impact of the pandemic. After testing the association between the level of disruption and the use of the measures, the whole population will be tested (H21a). If hypothesis H21a is confirmed, testing will be carried out on the B2B and B2C population separately (H21b). In addition, testing of the link between the measures taken and the financial situation at the time of completing the questionnaire will be carried out. If confirmed (H22a), this will

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be followed by testing the link for the B2B and B2C files separately (H22b). Testing will be carried out using Pearson's Chi-squared test. The significance level will be set at 5 percent.

4. Results and discussion

A total of 251 enterprises participated in the survey. After selection of relevant respondents (omitting enterprises that confirmed both B2B and B2C business relationships), 209 enterprises remained. The survey was conducted in October 2021 in Czech enterprises. 102 enterprises confirmed a B2B business relationship. 107 enterprises were classified as B2C. Is the correlation between operation barriers and level of disruption during the pandemic influenced by the type of prevailing business relationship (B2B or B2C)?

The distribution of responses regarding the level of disruption at the most critical stage and the main operation barriers is presented in Table 4.

Table 4. Structure of relevant responses regarding the extent of obstacles and level of disruption

	B2B	B2C
Level of disruption during a pandemic		
Restrictions	50	48
Closure	15	31
Unchanged	37	28
The extent of operation barriers		
No	50	51
1 yes	40	47
2-3 yes	12	9

Source: own

According to an initial analysis of the data, it can be concluded that businesses in the B2C sector appear to be more susceptible to the negative effects of the pandemic. On the flip side, the main barriers to operations listed are present in both sectors to approximately the same extent. The results of the H11 testing are presented in Table 5 below.

Table 5. Results of H11 testing

ANOVA test	H11a: association between selected operation barriers and the level of disruption - total				
	Df	Sum Sq	Mean Sq	F value	Pr (>F)
transformation.operation.pandemic	2	15.77	7.884	12.75	0.00000602
Residuals	206	127.39	0.618		
H11b: The correlation between selected operation barriers and level of disruption B2B					
	Df	Sum Sq	Mean Sq	F value	Pr (>F)
transformation.operation.pandemic	2	7.82	3.911	5.309	0.00645
Residuals	99	72.39	0.737		
H11b: The correlation between selected operation barriers and level of disruption B2C					
	Df	Sum Sq	Mean Sq	F value	Pr (>F)
transformation.operation.pandemic	2	8.91	4.456	8.697	0.000322
Residuals	104	53.29	0.512		

Source: own

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In the H11 testing, the association between the number of traffic bottlenecks and traffic disruption (at the most critical stage) was confirmed (hypothesis H11a was confirmed), both for the whole population and within each sector (B2B, B2C). Hypothesis H11b is therefore confirmed. The second RQ was defined as follows: Is the link between the disruption during the pandemic period, the extent of the measures taken and the financial situation of the company in the following year influenced by the type of business relationship prevailing (B2B and B2C)? The distribution of responses of respondents in the B2B and B2C groups regarding the degree of application of the measures is presented in Table 6 below.

Table 6. Uptake of measures to combat the impact of the pandemic for B2B and B2C

Tag	Responses	B2B	B2C
A1	no measures	39	40
A2	simplification of the organisational structure, optimisation of the number of employees, including management	10	16
A3	setting shifts, working from home	40	29
A4	change in product/service offering	12	20
A5	Acceleration of digitisation	13	18
A6	move to an online environment	23	21
A7	increased marketing promotion of the company, discount offers	7	16

Source: own

According to the primary data, it is evident that businesses in the B2C sector have made greater use of the following tools to combat the impact of the pandemic: simplification of the organisational structure, change of service offerings, acceleration of digitalisation, increased marketing promotion. In contrast, businesses in the B2B sector made greater use of tools such as working from home and moving online.
The distribution of responses in the H21a and H21b testing is shown in Figure 2.

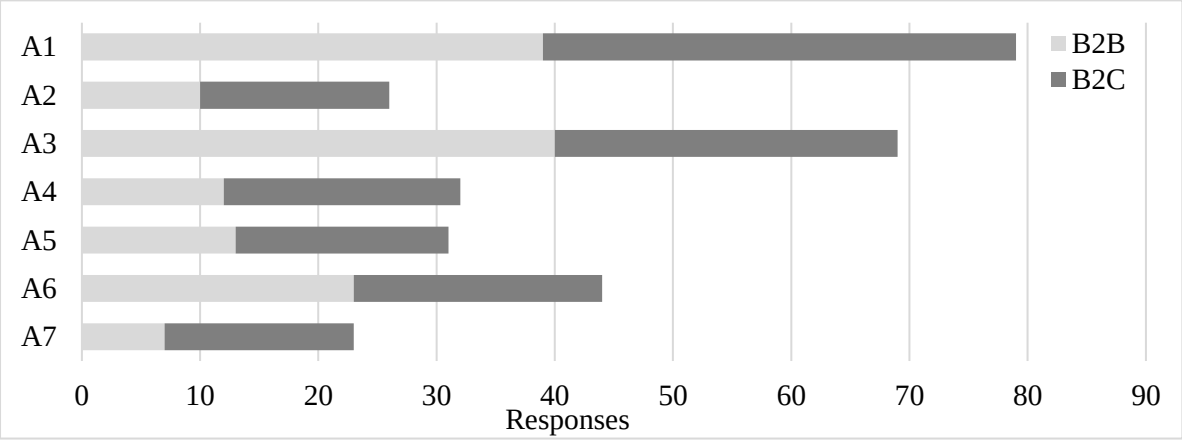

Figure 2. Measures taken to combat the economic impact of the pandemic
Source: own

The results of testing H21a and H21b are presented in Table 7.

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Table 7. Results of testing H21a, H21b

ANOVA test	H21a: association between level of disruption and use of measures - total				
	Df	Sum Sq	Mean Sq	F value	Pr (>F)
classification.measure	2	4.39	2.1948	4.339	0.0143
Residuals	205	103.69	0.5058		
H21b: relationship between level of disruption and use of measures- B2B					
	Df	Sum Sq	Mean Sq	F value	Pr (>F)
classification.measure	2	2.97	1.4846	3.319	0.0403
Residuals	99	44.29	0.4473		
H21b: relationship between level of disruption and use of measures- B2C					
	Df	Sum Sq	Mean Sq	F value	Pr (>F)
classification.measure	2	2.43	1.2139	2.251	0.11
Residuals	103	55.53	0.5392		

Source: own

H21a testing confirmed the link between the level of disruption (at the most critical stage) and the use of remedial measures. Hypothesis H21a was confirmed. Testing of H21b showed that the association was only valid for the B2B group, and the association was not confirmed for B2C. Hypothesis H21b was confirmed. The second half of the hypotheses (H22a, H22b) focused on testing the link between the measures taken and the financial situation after the pandemic.
The results of H22 testing are presented in Table 8.

Table 8: Results of testing H22a, H22b

Pearson's Chi-squared test results, H22ab			
file	X-squared	df	p-value
Full file (B2B and B2C)	21.288	4	0.0002776
File B2B	14.803	4	0.05128
File B2C	10.052	4	0.03957

Source: own

In testing H22a, the association between the measures taken and the economic situation after the pandemic was confirmed (the number of measures taken improves the economic situation of the company after the pandemic). It can therefore be concluded that hypothesis H22a was confirmed. Another result of the testing is the finding that for B2C sector enterprises the association between the measures taken and the resulting economic situation is greater than for B2B sector enterprises. Hypothesis H22b is rejected (the association between measures and financial situation after the pandemic is not at the same level).

Disruption of business operations due to pandemics has been the subject of several studies. For example, according to (Gashi et al., 2021), the pandemic caused extensive damage in a wide range of businesses. According to our own research, it can be concluded that there is a direct proportionality between the number of barriers to traffic and disruption (the more barriers, the stronger the level of disruption). This conclusion follows the results of (Migheli, 2022) on the variation in the extent of traffic bottlenecks in different EU cities. It can be concluded that the link between the extent of bottlenecks and traffic disruption is more pronounced for B2C

than for B2B businesses. This result is broadly expected, given the larger number of barriers (Verheyen & Kołacz, 2022) and the greater reliance on direct sales (Verheyen & Kołacz, 2022) of B2C sector firms.

A direct correlation was also confirmed between the level of disruption (at the most critical stage) and the use of corrective measures. Thus, the results of our own research are consistent with those of (Gashi et al., 2021). According to (Gashi et al., 2021), the impact of a pandemic on commercial enterprises is quite high, due to the numerous disruptions to operations. Therefore, businesses have tried to implement a few measures (change in organizational structure, change in portfolio or services, change in marketing activities, etc.). The importance of using HO during a pandemic is confirmed, for example, by (Strakšienė et al., 2021). Own results also confirm the link between COVID-19 and the use of innovative marketing, which was the object of research (Amoah et al., 2021). The importance of using digitalisation as a measure to combat the impact of the pandemic is in line with the findings of (Bikse et al., 2021), which emphasises that the process of digitalisation is progressing at a faster pace due to, among others, the impact of the pandemic. The results of our own research suggest that when dividing businesses according to the predominant type of business relationship (B2B or B2C), the association between the level of disruption and the use of remedial measures is only valid for the B2B sector. This can be explained by the fact that B2C businesses may have had the centre of gravity of operational barriers in areas such as secondary insolvency, lack of employees, lack of protective equipment, areas that were not included in the survey. We can also assume that B2Bs are more flexible in implementing measures in times of crisis.

The correlation between the measures taken and the financial situation in the following year was confirmed (the financial situation of the company improves with the number of measures taken). For enterprises in the B2C sector, the link between the measures taken and the resulting economic situation is stronger than for enterprises in the B2B sector. Thus, the results are indirectly related to the findings of (Gashi et al., 2021) on the opportunities for creative solutions in product implementation and finding new ways of delivering goods in times of pandemic.

Conclusions

The main objective of this paper was to determine whether the behaviour of predominantly B2B and B2C businesses differed during the pandemic in terms of disruption, the extent of action taken and the financial situation in the following year.

This objective was fulfilled with the help of primary quantitative research, and most of the examined relationships were confirmed. The research showed that B2C businesses were more affected by disruption of business operations in relation to traffic barriers. On the other hand, it was found that only for companies from the B2B sector there is a direct link between disruption of business operations and the use of corrective measures. Even more surprising is the conclusion that, although the measures taken during the pandemic proved to be economically efficient for both sectors, the measures had a greater economic impact for B2C businesses. Based on the results of the study, several recommendations can be made for the target segment. Continuous measurement of the performance of the various measures introduced should be a priority for companies. A stronger sensitivity to the measures put in place to reduce the negative impact of the pandemic is evident in enterprises with a predominantly B2C business relationship. Thus, B2C companies can be advised to use the range of recommendations mentioned to combat the negative impact of the crisis. B2B businesses can be characterized by a stronger association between the economic situation during the pandemic and the number of measures introduced. B2B enterprises should be able to link the introduction of individual measures to the effect since their introduction.

The research results have some limitations. The research itself focuses mainly on B2B and B2C businesses in the Czech Republic, so the results cannot be fully applied to other business entities (businesses providing products to B2B and B2C markets simultaneously, B2G) or other territories. The results are limited to these measures only, other measures were considered irrelevant for the purpose of the study. The results are limited to the crisis period; results may differ in other periods.

The results of the study suggest some directions for future research. The first potential direction for future research is a more detailed exploration of the impact of individual measures. Another important issue is to determine the effects from individual measures based on the dynamics of the economic situation before-during-post pandemic. For the purpose of this paper, the sample was taken from enterprises that operate simultaneously in the B2B and B2C sectors. Thus, as part of a more comprehensive research, it would be appropriate to include these enterprises, as well as B2G enterprises, in the research. A final direction for future work could be to conduct a repeat survey to compare responses in the crisis and post-crisis periods with the identification of dynamic values.

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EMPLOYMENT RELATIONS IN THE CIVIL SERVICE FOR MORE SUSTAINABLE DEVELOPMENT: A CASE OF THE SLOVAK REPUBLIC*

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Abstract. In the article in question, we deal with selected issues related to employment relations in the civil service. We point out the hybrid (dual) nature of the subject of these relations; when the work side is regulated by the norms of labour law, the functional side is regulated by the norms of administrative law. We note that the rights and obligations of the subjects of these relationships are aimed at implementing the work process and the realization of the power functions of the state, i.e. at the immediate implementation of state power. We present employee relations in the civil service as relations of a public law nature, which have some characteristic features typical for relations in the field of public law. Regarding the method of legal regulation of these relations, we take the position that these relations are characterized by a combination of methods of legal regulation. Considering the legal nature of these relationships, we consider it justified by the legislative separation of these relationships from other employment relationships subject to the general labour law regime. This article analyzes the involvement of the institute of Public and State Service in achieving sustainable development goals and discusses the possibilities of managing sustainable development processes. Based on research, the authors proposed de lege ferenda for more effective legislation in public administration for sustainable growth of the Slovak Republic.

Keywords: public and state service; employee relations; legal regulation of the state service; object and content of the legal relationship; public law nature

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JEL Classifications: M12, K31, O10, J26, J28

1. Introduction

The incorporation of the Institute of Public and State Service into the legal order of the Slovak Republic (hereinafter referred to as the Slovak Republic) transformed the public and state service into a form corresponding to the proportions of the current democratic of the state, changed the legal status of public and civil servants in a fundamental and substantial way, but also created important and necessary prerequisites for a high-quality and error-free process of exercising executive power in the state. The current issue of today, requiring a solution is the search for ways to adapt public and state service to the rapidly changing social conditions, increase their prestige and social recognition, and reduce the lagging of the public and state service behind the corporate and private sphere.

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Corresponding with the above is the current issue of permanent improvement of the legal regulation of the public and state service, including employment relations, to correspond to the conditions of the current democratic state. It is also required by the current development of our society, especially the permanent need for compatibility of our legal order with the legal order of the states of the European Union (hereinafter referred to as the EU), as well as the effort to integrate into the traditional, European legal culture. The concept and legal regulation of public and state service in the conditions of a democratic state must be based, unlike the period before 1989, on the changed role of the state, on the qualitatively new position of the public sector in our society, and the principles of the market economy. At the same time, it must correspond and be comparable with modern legal regulations of public and state service in other democratic countries, especially in EU countries. As a real existing social and societal reality, public and state service must be legally guided. Due to certain specificities, public and state service legal regulation requires adequate and special legal regulation.

Employee relations in the civil service represent a homogeneous but also a particular group of legal relations, which has an autonomous, independent status in the system of legal relations of citizens' participation in the work process. Compared to other employment relationships, certain peculiarities and specificities appear in them; the mentioned relationships have some common characteristic features.

The framework legal regulation of the civil service is currently created in the Slovak Republic by the following legal regulations:

- the law no. 55/2017 Coll. on civil service and on amendments to certain laws;
- the law no. 73/1998 Coll. on the state service of members of the Police Force, the Slovak Information Service, the Prison and Judicial Guard Corps of the Slovak Republic and the Railway Police, as amended;
- the law no. 346/2005 Coll. on the state service of professional soldiers of the Slovak Armed Forces, as amended;
- the law no. 200/1998 Coll. on the state service of customs officers, as amended;
- the law no. 315/2001 Coll. on the Fire and Rescue Service, as amended;
- the law no. 151/2010 Coll. on foreign service as amended

Statistical reflection of the development of the number of employees of the public administration of the Slovak Republic for the years 2020 to 2023 is presented below in Figure 1 and Figure 2.

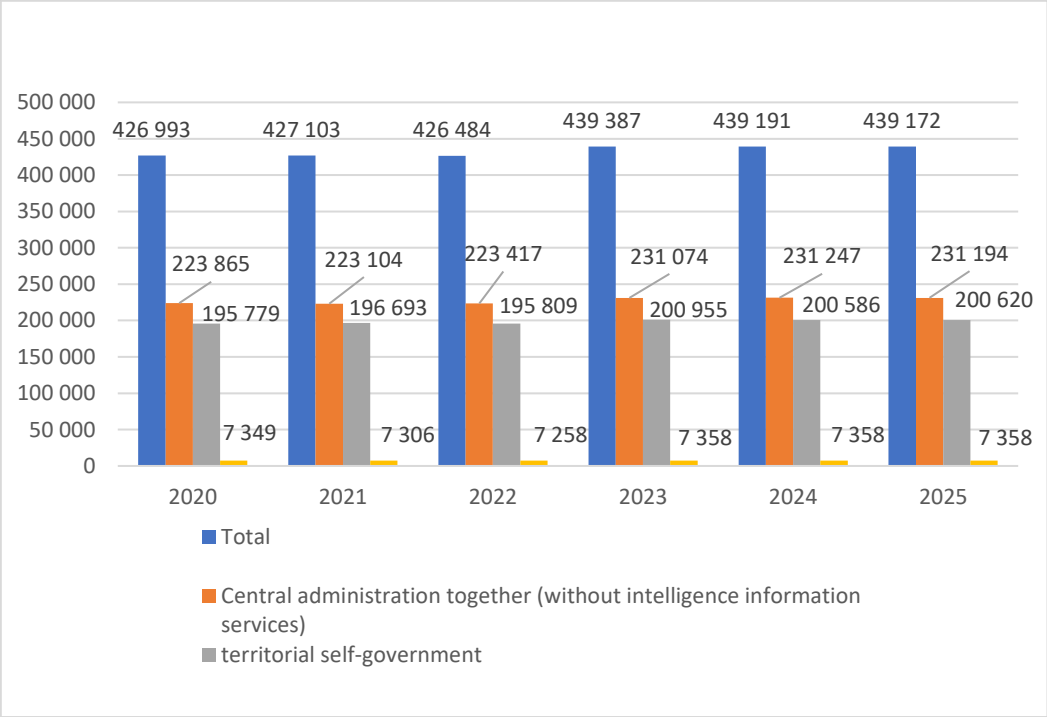

Figure 1. Development of the number of employees of the public administration of the Slovak Republic for the years 2020 to 2023 and the assumption of development until 2025

Source: Ministry of Finance of the Slovak Republic, Public administration budget for the years 2023 to 2025, p.72 https://www.mfsr.sk/files/archiv/44/Hlavna-kniha.pdf

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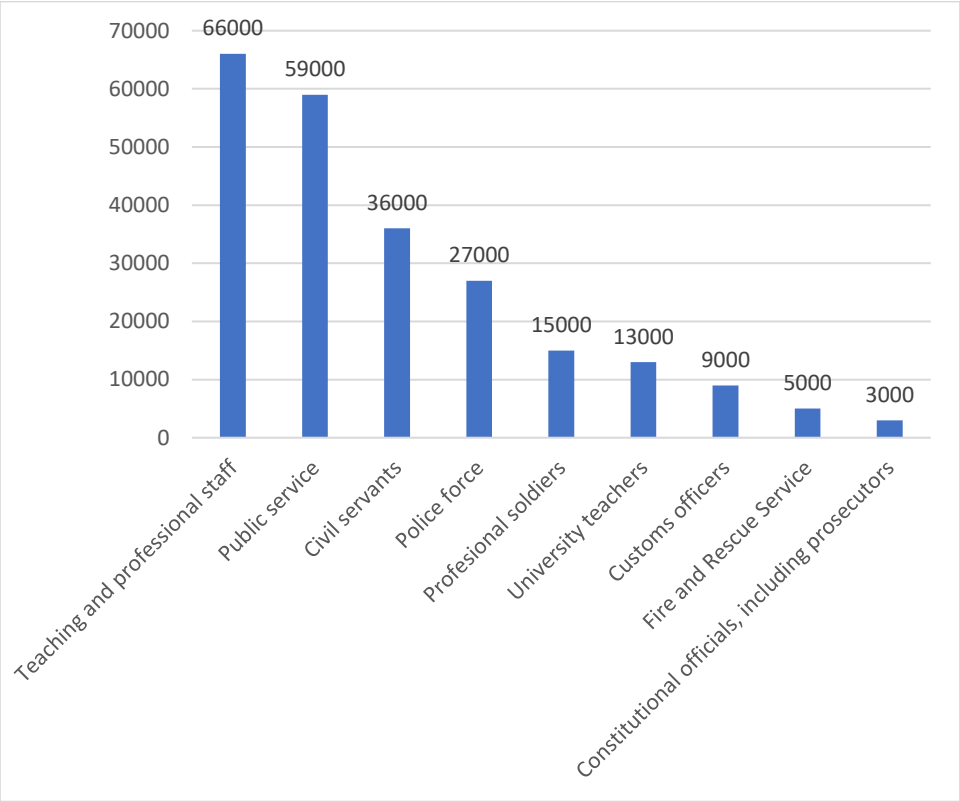

Figure 2. Number of employees in the public sector of the Slovak Republic in 2023
Source: Ministry of Finance of the Slovak Republic, Public administration budget for the years 2023 to 2025, p.76
https://www.mfsr.sk/files/archiv/44/Hlavna-kniha.pdf

The subject of the regulation of the aforementioned laws is legal relations in the performance of civil service. According to the aforementioned laws, the state service means the performance of tasks of the state administration or the performance of state affairs under the conditions established by law for members of the Police force, professional soldiers, members of the Fire and Rescue Service, customs officers, the term state service according to the relevant laws is understood as the performance of tasks resulting from a specific the mission of these entities (Cooper & Kaplan, 1999; Kabat, 2017). The content of the performance of the state service is the rights and obligations of the state and the civil servant, resulting from the performance of the state service or related to the performance of the state service.

For the purposes of the aforementioned laws, state service also means:
• performance of tasks of the state administration or performance of state affairs in accordance with the criteria established by law,
• performance of the tasks of the Police Force by a police officer in a service office,
• performance of the tasks of a professional soldier,
• performance of the tasks of the Customs Administration, management, organization, the performance of professional training of customs officers, the service of customs officers in the service office,
• the performance of the tasks of the Fire and Rescue Service by its members in the service office,
• the performance of the tasks of a civil servant in the field of foreign state service.

Civil service is performed in a civil servant relationship, a civil servant relationship, or a service relationship. For the purposes of the aforementioned laws, a civil servant is a natural person who performs civil service in the relevant branch of the civil service.

From the point of view of the systematic organization, the mentioned civil servant relations belong to the system of legal relations of employees of the state apparatus; these relations have their own autonomous legal regulation and are legislatively separated from labour law relations arising on the labour market.

Currently, employment relations in the civil service, unlike the previous legal status, are built on new legal foundations, as they are based on some principles of service pragmatics adapted to current conditions; they are conceived as relations under public law, constituted with the state. They are mainly based on the career system of the civil service; as a rule, they are constructed as lifelong relationships, lasting even after the end of active service; civil service relationships create the necessary legal basis for the professional, objective and independent performance of the civil service.

Many authors analyzed the problems mentioned above. The Handbook of Public Administration is a landmark publication, the first to provide a comprehensive and authoritative survey of the discipline. The Handbook provide a complete review and guide to past and present knowledge in this essential field of inquiry. A dominant theme throughout the Handbook is a critical reflection on the utility of scholarly theory and the extent to which government practices inform the development of this theory (Peters & Pierre, 2014).

The book "The Next Public Administration" explores public administration in the past, present and future, critically reviewing the modernization of public management reform. It reasserts public administration as an integral component of democratic governance and fosters a state-citizen relationship – considers issues associated with management, governance, and democracy, covers core public administration concepts and their evolution through time, etc. (Peters & Pierre, 2017).

The Introducing Public Administration (9th edition) provides the conceptual foundation - the most critical issues in the field of public administration using examples from various disciplines and modern culture. This unique approach captivates and encourages us to think critically about the nature of public administration today: new sections on careers in public service, whistleblowing and public employee dissent, networks and collaboration across organizations, social innovation, managerialism and productivity improvement, Big Data and cloud computing, collaboration and civic engagement, and evidence-based policy and management (Shafritz et al., 2016). The book "Public Administration: Concepts and Cases" offers a unique and highly regarded framework in which conceptual readings are paired with contemporary case studies that reflect real-world examples of administrative work and new thinking and developments in the field (Stillman, 2009).

Other authors analyze some aspects of employment relations in the civil service in some European countries, the legal status of public authorities and employer, the activities of public institutions, the impact of public administration on sustainable development (Prusák, 1997; Cooper & Kaplan, 1999; Stillman, 2009; Peters & Pierre, 2014; Škultéty & Kaššák, 2014; Schwab, 2016; Shafritz et al., 2016; Urbancová & Hudáková, 2017; Peters & Pierre, 2017; Kabat, 2017; Pylypenko & Lytvynenko, 2017; Dalenogare et al., 2018, Ibarra et al., 2018; Kuril, 2018; Filipová et al., 2019; Bai et al., 2020; Müller et al., 2021; Tugui et al., 2022; Pysmak et al., 2021; Sidak et al., 2021; Habib, 2022; Yermachenko et al., 2023; Ivanová & Žárská, 2023; Labunska et al., 2023; Crain et al., 2023; Timotius, 2023).

This paper aims to conduct scientific research of terminus technicus "civil service", its most important institutes and competencies, as well as labour relations within the civil service, and based on the analysis of scientific knowledge about the current de lege lata legislation, to offer the authors' conclusions and prepare proposals de lege ferenda.

Based on the primary goal, the authors set sub-tasks: 1) to determine the main pillars of the effective and proper functioning of the civil service in the Slovak Republic to ensure sustainable growth, 2) to set the managerial foundations for the effective functioning of labour relations in the civil service in Slovakia (decent work in the

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civil service in correlation with the principle of modern public good administration), 3) analyze the legal status of state and public administration entities with the aim of effective and sustainable realization of the public interest, 4) prepare proposals de lege ferenda to improve the functioning of the state administration in Slovakia.

2. Research methods

For scientific research of the article's subject, we used the following scientific methods: observation, analysis, synthesis, comparison, abstractions, generalizations, induction, and deduction. The observation method helped us to systematize existing knowledge within the current state of the problem. It represented the theoretical and methodological basis of this scientific article.

The scientific method of analysis we had used for the process of thought division of the researched problem – the civil service, into individual parts, elements, features, contradictions and their research to reveal their essence; the task of the analysis was excluding from the whole mass of facts and contexts the main, essential, necessary ones that can shed light on the causes of the occurrence and course of the investigated event, its essence.

Synthesis – we used it to discover the connections between the allocated elements, features, opposites, their connection, and subsequent reproduction of the investigated event with their essential features and relationships.

Synthesis makes it possible to monitor the relationships between facts and the nature of the interrelationships between them and reveal the causes, functional dependence, sequence of stages, or tendency of the development of employment relations. We used a method of comparison for the process of great importance in clarifying the processes of change, development, and the examined relationship, revealing the tendencies and patterns of its development.

Abstractions method – when researching a specific phenomenon, it is necessary to study it step by step, one page after another and temporarily leave the other pages aside, abstract from them: identifying desirable and undesirable elements in the public sphere.

The generalizations method helped us analyze the general connection of real objects and phenomena, the unique and common relationship in all real events. The induction was used to draw general scientific conclusions based on the evaluation of basic scientific data. Deduction helped us start from general assumptions and apply them to individual general or partial conclusions and other scientific methods.

3. Subject and content of employment relations connected with the performance of civil service

Assessing the legal qualification of civil service relations requires paying due attention to the subject and content of the legal relations in question. The work of civil servants carried out in their employment relationships represents the performance of work for another for an equivalent. This is a connection between the owner of the labour force and the owner of the equivalent, whereby the labour force of one subject is used for remuneration by another. In employment relations during the performance of state service, similar to labour law relations, the work performed has the character of dependent work, which means that it is carried out with a certain personal and economic dependence on the employer (Peters & Pierre, 2014). A civil servant does not work for himself but must strictly follow the employer's instructions as part of his dependence (Kabat, 2017). At the same time, work performance also takes place under conditions of economic dependence, i.e., the civil servant works for remuneration, which is the primary source of ensuring his means of existence. According to the applicable legislation, a civil servant is entitled to an official income and benefits in kind for the work performed (Peters & Pierre, 2017). The adjustment of salary requirements for civil servants is categorical, resulting from the relevant law's mandatory provisions, except for the personal allowance as an incentive component of official income (Sidak et al., 2021).

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However, the performance of work activities in the subject of state employee relations needs to exhaust the content of the subject of these relations fully. It is characteristic of the subject of employment relations connected with the performance of state service that, in addition to the behaviour consisting in the performance of work, another typical behaviour of its subjects also appears in the subject of these relations, namely the behaviour consisting in the immediate professional exercise of state power (Shafritz et al., 2016). Thisvior of a state employee in state employee relations cannot simply be subsumed under the concept of carrying out work activities. Vice versa, it is necessary to understand these terms in a specific differentiation since, in our opinion, there is a qualitative value difference between them.

In his employment relationship, a civil servant acts as a practical executor of state power, directly participates in ensuring the power functions of the state, and carries out a specific state activity with regard to its function, content and nature (Bai et al., 2020). Based on the above, we take the position that it is impossible to identify and differentiate between the terms performance of work and exercise of state power. The opposite opinion represents a narrowed, not a full-fledged, only partial understanding of the subject of employment relations connected with civil service performance (Stillman, 2009).

Concurrence in the behaviour of its subject - the civil servant - is typical for the subject of civil servants. The subject of state employee relations includes the behaviour of subjects of two types: the implementation of work activities and state power (Cooper & Kaplan, 1999). To regulate the indicated dual kind of behaviour in the subject of employment relations connected with the performance of the civil service, the cooperation of the norms of several legal branches, most often the norms of labour and administrative law, is necessary (Pysmak et al., 2021).

In the context of employment relations in the civil service, in addition to the rights and obligations associated with work, we also find other elements, namely elements associated with the performance of the function, that is, rights and obligations related to the immediate exercise of state power, which is often regulated by special regulations and, as a rule, they do not belong to labour law, but to other legal branches. Administrative relations, vis-à-vis other external entities, are not relations in which the employee acts as a subject himself. Still, his position is that of a subject of a particular administrative body with management or decision-making authority (Dalenogare et al., 2018). This quality results from the function with which he was entrusted. Thus, it is derived from state power. This means that an employee in an employment relationship in which he is authorized to perform administrative actions outside of the executive body acts in a dual capacity, namely as an employee using his workforce (his abilities), but also as a state authority on whose behalf he acts (Sidak et al., 2021).

For employment relations in the civil service, it is characteristic that the employment relationship "accompanies" the service and management relationship (Habib, 2022). Employee relations in the civil service have additional content, elements associated with the performance of the function, rights and obligations associated with the practical implementation of state power, compared to employment relationships arising on the labour market. The state "lends" civil servants the right to act in relation to the external sphere on behalf of the state and gives their actions the quality of administrative acts enjoying special authority and protection. The position of a civil servant is derived from state power and its functional place; it represents the position of a state entity endowed with the authority to manage, decide, or control (Pylypenko & Lytvynenko, 2017). In his employment relationship, a civil servant acts both as an employee who uses labour power and as a state body, as a practical executor of state power while also acting on behalf of the state (Ibarra et al., 2018). These so-called functional relations and the rights and obligations pertaining to their content also belong to the content structure of employment relations in the civil service. The state-employee relationship in the civil service cannot be reduced only to an "employee" relationship, i.e., to a relationship with the state as an employer. A civil servant fulfils not only labour law obligations but also administrative obligations as he performs his activities on behalf of the state and fulfils the tasks of the state.

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4. The public law nature of employment relations in the civil service

In the past, under the conditions of consistent enforcement of the concept of uniform labour relations, differentiation of employment relations was allowed only to a limited extent, usually where it was socially desirable (Ivanová & Žárská, 2023). Special status and particular preferences outside the uniform framework were applied only to civil service types with special interests (police officers, soldiers) (Prusák, 1997).

In the changed, new social conditions, when the concept of uniform employment relations has already been overcome, the necessary differentiation of employment relations has begun. It was considered essential to replace it with a new concept that would be based on new conditions, i.e., on the changed role of the state, on the new position of the public sector in our society (Labunska et al., 2023), on the qualitative difference between employment relations in the civil service and labour law relations arising on the labour market (Kuril, 2018).

Currently, employment relations in the civil service are legislatively separated from other employment relations; their regulation is fully autonomous, and they are conceived as public law relations with the employer subjectivity of the state, which represents a legal situation that is common in the legal systems of other democratic states as well. The concept of employment relations in the civil service is primarily based on the career system of the civil service, which assumes the subordination of employees to the labour law employment regime. The public law nature of employment relations in the civil service is primarily due to specific features of these relations, distinguishing them from other labour law relations arising on the labour market. The essence of the public law concept of employment relations in the civil service, related to the application of the public law employment regime, lies in the superiority of the state as an employer entity in regulating the legal status of civil servants (Crain et al., 2023).

The characteristic features in the public law nature of employment relations in the civil service are manifested result from the very nature of these relations, in which the performance of the civil service is realized. The public law features of employment relations associated with civil service performance are in direct correlation with the nature of the tasks performed in legal relations (Müller et al., 2021). They are primarily (Kuril, 2018):

a) Form of creation – individual legal act
This is one of the classic signs fulfilling the public law character of these relationships. Employee relations in the civil service are constructed as relations arising under public law by the decision to appoint and assign a civil servant to a specific systemized official position, the holding of which involves the completion of a certain agenda, the scope of which is usually determined in the internal service regulations. The legal relationship between a natural person and the state should not be based on the principle of bilateral legal acts (i.e. contracts) but must be established by appointment (Prusák, 1997; Sidak et al., 2021).

b) The state as an employer entity
Another element strengthening the public-law character of employment relations in the civil service is the restoration of the employer subjectivity of the state. The legal relationship of a civil servant should be established with the state and not only with a legal entity. Employee relations connected with civil service performance must be established with the state; the state is also the bearer of subjectivity in labour law. The relevant laws on civil service expressis verbis develop the state as the employer entity. The dominant feature of such a relationship is that the natural person performs activities for the state and is obliged to maintain unconditional loyalty to the state. The state in the position of the employer entity is suitable in legal relations of this type since stricter centralism in management is applied in them and the related greater dominance of the employer. As a rule, the state body in which the civil servant performs state service (service office) acts on behalf of the state. However, this may not always be the case, as another solution is also possible when the office entrusted with the administration of the personal affairs of a particular circle of civil servants acts on behalf of the state (personal office).

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c) Stability of employment relations in the civil service
Public employment relations in the civil service differ from those in the labour market by their permanence and fundamental irrevocability. The increased level of duties associated with the system of necessary restrictions is compensated, among other things, by the guarantee of the stability of the employment relationship (Škultéty & Kaššák, 2014; Urbancová & Hudáková, 2017).

d) Mandatory regulation of rights and obligations
The nature of rights and obligations and the mandatory nature of their regulation is another characteristic of the public law nature of these relationships. The behaviour of subjects of employment relations in the civil service established by mandatory legal norms is binding and unchangeable, which cannot be changed or excluded by the expression of their private will; the realization of the rights and obligations contained in mandatory legal norms is carried out exclusively in the manner established by the legal regulation (Schwab 2016). The rights and obligations of civil servants are set normatively and cannot be the subject of contractual arrangements.

e) Legally guaranteed service and salary procedure
The predominance of the state in regulating employment relations in the civil service presupposes the employee's subordination to the public law regime, which also means securing primarily public (state) interests. On the other hand, to a greater or lesser extent, such a legal regime must also reflect the interests of civil servants. The legal regulation of employment relations in the civil service imposes certain, increased demands on civil servants not only during the performance of the service but also outside of it. Certain categories of civil servants are allowed, based on the law, certain restrictions also in the field of human rights (e.g. participation in political life) (Škultéty & Kaššák, 2014).

f) Regulation of the civil service in the form of special laws
The fact that the legal regulation of the civil service is fully autonomous, independent of the legal regulation of other employment relations, especially those arising on the labour market, also strengthens, to a certain extent, the public law nature of employment relations in the state service (Dalenogare et al., 2018). Considering that employment relations in the civil service are under public law, it is evident that they should be regulated outside the framework of labour law, as it is in developed democratic states. The legal regulation of employment relations in the civil service is, in the form of special laws, justified by the unique nature of these relations, which results from the peculiarities of the performance of tasks.

g) Method of resolving disputes
While relations according to private law regulations are based on the fact that no private will is placed higher than another, in employment relations in the civil service, as in public law relations, superiority and subordination prevail in the position of subjects, the mentioned characteristic feature of these relations is also expressed in the specific way of resolving disputes (Shafritz et al., 2016).
In the event of a dispute about the content and scope of authorizations and obligations arising from the civil service relationship between its subjects, these are resolved by the authorized service authority (superior) with the relevant decision and only then by the court.

Disciplinary responsibility comes to the fore in employment relations in the performance of state service even more prominently than it does in labour law relations arising on the labour market. It follows from the mission of employment relations in the civil service, from the peculiarities of performing tasks in the civil service, and from the relations of superiority and subordination in the civil service. The importance of the institute of disciplinary responsibility is also related to the observance of official discipline, in the sense of the summary of official duties arising for a civil servant from the relevant law on civil service, as a violation of official discipline (official duties) can be the basis for the application of disciplinary responsibility, (but in certain circumstances also material or criminal liability) (Stillman, 2009). Provisions on disciplinary responsibility are an integral part of the relevant legislation for individual groups of civil servants. Disciplinary responsibility in the civil service ends with the termination of the relevant employment relationship forming its legal basis; that is, disciplinary responsibility lasts until the subordination ceases.

5. The method of legal regulation in employment relations in the civil service

For our purposes, we will be based on a significantly simplified concept of the term in question. We will understand the method of legal regulation in the civil service as a method of legal regulation in which the position of the subjects of the legal relationship is manifested, as well as the dispositive or mandatory nature of the legal regulation.

The emergence of employment relations in the civil service is not accompanied by an unequal position of the subjects of these relations in the arrangement of their mutual relations; in this context, the relationship of superiority and subordination does not apply because, in the position in which they are about each other, one cannot unilaterally impose his will on the other (e.g. in the form of binding instructions) (Tugui et al., 2022). Neither of the subjects of the relationship under consideration can unilaterally establish the obligation of the other subject, nor can they authoritatively enforce the fulfilment of the obligation of the other subject within this relationship. On the other hand, it cannot be left unnoticed that the autonomy of the subjects' will is, to a certain extent, limited by the coercion of the regulation (Kuril, 2018).

An employment relationship in the civil service cannot be established against the will of a citizen or an applicant for admission to a civil service relationship, but only with his consent (Yermachenko et al., 2023). The issuance of a decision on admission to the civil service is always preceded by the applicant's request for admission to this legal relationship. In this context, we note that the relevant laws on the civil service (provisions regulating the creation of the civil service relationship – author's note) cannot be interpreted statically, in isolation, without internal connections and interdependence with other law provisions. On the contrary, it is necessary to understand them in a certain complexity of assessing the whole problem. On the other hand, however, it cannot be denied that the mandatory provisions of the relevant civil service laws, also in connection with the creation of employment relationships in the civil service, limit the discretion in the legal proceedings of the subjects of these relationships (Peters & Pierre, 2017).

Formally, according to the law (de jure), the difference between a unilateral act and a contract is indisputable, but in reality (de facto), it disappears. The arrangement of mutual relations between subjects of employment relations in the civil service (employment relationship) during the realization of rights and obligations, i.e. during the duration of the employment relationship, has a different quality (Prusák, 1997). The nature of the activity carried out by a civil servant in an employment relationship requires a high degree of "disposal authority" of the employer with a considerable degree of subordination of the civil servant (this is especially the case in the "so-called armed" civil service – author's note). In state employee relations (in the service relationship), during its course, during the realization of the mutual rights and obligations of its subjects, the elements of equality of subjects and contractual features are significantly weakened. On the contrary, the elements of superiority and subordination prevail, and the power dominance of one of the subjects of this relationship is applied (Timotius, 2023). In the currently valid legal regulation of employment relations in the civil service, we also find other legal institutes in which the supremacy of the employer (the state) is applied in the regulation of the legal status of civil servants during the duration of their employment relationship (service discipline, disciplinary authority, service time, rest time, salary and other requirements of civil servants, conditions of service of civil servants, etc.) (Peters & Pierre, 2017). In all declared legal institutes of employment relations in the civil service, there is an unequal position of the subjects of these relations, elements of superiority and subordination prevail, and freedom of contract in the sense of private law is significantly limited (it is replaced by the precise determination of conditions in legal relations), administrative decisions are applied, the administrative law method of legal regulation prevails (Kuril, 2018).

The valid legal regulation of the termination of employment relationships in the civil service is based on the permanence and irrevocability of these relationships after the civil servant has been included in the permanent civil service after fulfilling the prescribed requirements. The application of the definitive means that the employment relationship in the civil service can be terminated unilaterally at the initiative of the employer, possibly only for qualified reasons concerning the person of the civil servant. At the same time, the existing legal regulation of the civil service respects the constitutional enshrining of basic human rights, applying the principle that the citizen has freely and voluntarily decided to become a participant in this relationship; therefore,

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he cannot be fairly required to perform this activity against his will, and consequently, it must be possible to unilaterally terminate this relationship at the initiative of a civil servant.

The relevant legal regulations of the civil service exhaustively define individual types of termination of civil service relations. In our opinion, they reflect the intermingling of elements of a public and private nature. On the one hand, protective and social elements; on the other hand, equality in the status of subjects consists in the possibility of ending their mutual relationship, from one side or the other (from the side of the employee and the employer). A unilateral expression of will aimed at ending the civil service relationship on the part of the civil servant (dismissal) can be carried out by the subject of this relationship at any time, with practically no restrictions, subject to compliance with the substantive and procedural requirements set forth in the law. The legal effects of this unilateral legal act will occur regardless of the will of the other entity (employer). A civil servant may be dismissed by a unilateral legal act at the employer's initiative, only for the reasons exhaustively set forth in the law, also in compliance with the substantive and procedural requirements set forth in the law. The legal effects of dismissal occur regardless of the civil servant's will. However, the employee is provided with increased protection in connection with the dismissal (for some reasons specified in the law) through the legal institution of the prohibition of dismissal in cases worthy of special attention.

The relevant civil service laws also allow for an agreement on terminating the civil service relationship. In our opinion, at the end of employment relationships in the civil service, equality in the position of subjects is applied to a certain extent, resulting from the same legal possibility of causing the termination of these relationships at will. The presented ways of ending employment relationships in the civil service (release, dismissal) are unilateral legal acts in the sense of private law, characterized by the freedom of disposition of their subjects. The assumption of correctness does not characterize them; the provisions on the invalidity of legal acts must be applied to them. The termination of employment relationships in the civil service is not controlled by the superiority and subordination of its subjects, nor does one of the subjects, in this case, have a position of power over the other; the termination of these relationships is bound by legal norms to private law acts, elements of the private law method of legal regulation are applied here. In addition to the elements of a private law nature, there is also the undoubted existence of public law elements, primarily protective and social elements, manifested in the protection of the civil servant against dismissal in situations where it is not possible to terminate the employment relationship by a unilateral legal act on the part of the service body. The interference of the mentioned public law elements of a protective and social nature results from the necessity of protecting the civil servant.

Decent work (as the 8th UN Sustainable Development Goal) in public service means that everyone can get a productive job that provides fair employment, job security and social protection for families, and better prospects for personal development and social integration.

Only decent work (ex lege employment relations) in the civil service in correlation with the principle of modern public good administration can ensure not only the permanent development of the state of Sr, but also the effective continuation of building the rule of law.

6. Conclusion

Based on the above, we reach the following conclusions regarding employment relations in the civil service:

The subject of employment relations in the civil service has a dual construction; it consists on the one hand of the behaviour consisting in the performance of the work of the labour force bearer for remuneration and, on the other hand, of participation in the immediate exercise of state power by the subjects of these relations towards the outside world. The legal regulation of two types of behaviour in the subject of these relations has a hybrid nature; that is, the norms of labour law regulate the work side, and the norms of administrative law regulate the functional side. The rights and obligations of the subjects of these relations are directed, on the one hand, to the realization of the labour process (work activity) and, on the other hand, to the realization of the power functions of the state, i.e. to the immediate realization of state power.

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The rights and obligations of the subjects of these relations, forming the content of the mentioned legal relations, are regulated by several legal branches. Not only labour law standards are sufficient to regulate them, but also constitutional law standards, and even more often, administrative law standards. From this point of view, one can talk about compound or combined legal relations. An expression of the public law nature of employment relations in the civil service is the existence of some characteristic features of these relationships; otherwise, features are also typical for relations in the field of public law. Employee relations in the civil service are established with the state as an employer; they are usually created by a decision (individual legal act) on accepting a citizen into a state-employee relationship. However, the issuing of a decision is always preceded by a citizen's request for admission to the aforementioned legal relationship, which indicates the intermingling of labour law and administrative law elements in this area.

In the course of the implementation of rights and obligations resulting from employment relations in the civil service, the unequal status of the subjects of these relations is manifested, and relations of superiority and subordination prevail. Contractual freedom is considerably limited; it is replaced by a categorical definition of the rights and obligations of subjects, and compulsory legal regulation is applied. Employee relations in the civil service are relations of increased rights and obligations of the subjects of these relations compared to the general level of rights and obligations of citizens. This fact is compensated by some advantages, primarily a legally guaranteed payment and service procedure, the institute of finality, and some other compensatory provisions.

An expression of public law of employment relations in the civil service is also their special, autonomous regulation, which is, to a decisive extent, independent from the legal regulation of other employment relations. The connection to the Labor Code is applied only through delegated authority (§ 171 the law no. 55/2017 Coll. on civil service and on amendments to certain laws). The relationship of superiority and subordination, that is, the public law nature of these relationships, also corresponds to the method of resolving disputes, which are decided by the relevant superior, i.e. the service body and only then the court.

Disciplinary responsibility, as a special type of legal responsibility, is one of the prominent, typical and characteristic features of employment relations in the civil service, completing their public law nature. The application of disciplinary responsibility is one of the significant legal means associated with the consistent implementation of the rights and obligations of the subjects of these relationships. Disciplinary responsibility in employment relations in the civil service is fundamentally of an intra-organizational nature; it is applied within these relations, and only persons in a certain organizational relationship with this organization are subject to it. It is an expression of relations of superiority and subordination; the termination of the state-employee relationship also ends its application. Non-respect of conditions determined by law or violation of obligations in employment relations in the civil service by a civil servant does not have the nature of a private law delict and, therefore, is not and cannot be the subject of private law sanctions, but of public law sanctions. Disciplinary measures, such as sanctions for violation of service discipline in employment relations in the civil service, represent sanctions of a criminal nature, which are not aimed directly at removing the harmful consequences of a disciplinary offence. Their application does not interrupt the violation of official discipline, nor does the entity violating discipline not force itself to behave in accordance with the requirements of discipline. The imposition of disciplinary measures is aimed primarily at individual or general prevention. Regarding the method of legal regulation in employment relations in the civil service, we take the position that a combination of methods of legal regulation characterizes these relations. In connection with the creation of state employee relations, equality is applied in the position of the subjects of these relations. However, the autonomy of the parties' will is limited by the mandatory nature of the legislation. This is about blending elements of private law and public law methods of legal regulation.

During the implementation of mutual rights and obligations, during the duration of the state-employee relationship, superiority and subordination prevail in the position of subjects; the public law method of legal regulation is applied here. It is characteristic of the termination of employment relationships in the civil service that there are elements of a private law nature but also of a public law nature. We consider it correct and necessary that employment relations in the civil service are legislatively separated from employment relations subject to the general labour law regime.

Based on the theory of law, the theory of public administration management of democratic countries and the de lege lata analysis, we can state that: 1) we note that the original main objective and partial objectives set out in this scientific article have been achieved. The unique feature of the article is the scientific research of employment relations in state and public administration in correlation with the 8 main goals of the UN (decent work) for ensuring the continuous development of the Slovak Republic in correlation with the principle of modern public good administration; 2) we propose de lege ferenda to streamline the functioning of civil (state and public) service in the Slovak Republic to enshrine in the law no. 55/2017 Coll. on civil service and on amendments to certain laws: a) especially decent work in the civil service in correlation with the principle of modern public good administration, b) enshrine the responsibility of the statutory public and state body for failure to achieve the decent work.

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THE MOBILE ECONOMY: EFFECT OF THE MOBILE COMPUTING DEVICES ON ENTREPRENEURSHIP IN LATVIA*

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Abstract. The article aims to establish the impact of the use of mobile devices on business success in Latvia. The authors consider income of the enterprise for the last year, volume of sold products/services, volume of exported products/services, profitability of the enterprise for the last year, as well as a change in the market share of the enterprise for the last year as variables for business success. Despite the fact that the market share of mobile devices in Latvia comprises only 38.43%, the authors determined a weak linear relationship between variables for business success and the majority of different mobile technologies used on mobile devices. The authors study such mobile technologies as mobile access to e-mail, mobile version of the website, messenger groups for solving business tasks, SMS marketing, mobile access to company resources, advertising, management of production processes, payments of company bills from a mobile phone, equipment of a company transport system with location data transmission systems, and a company's mobile application. The authors come to the conclusion that entrepreneurs underestimate both the use of a mobile version of the website and augmented reality technologies.

Keywords: mobile computing devices; entrepreneurship; Latvia

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JEL Classifications: M10, M15, M21, O32, O33, O52

1. Introduction

Internet economy being a new economic and social model (Afuah and Tucci, 2000; Afuah, 2012), enables fast real-time, synchronous and asynchronous interaction between people and businesses and provides unlimited scope of access where anyone can use the Internet anywhere in the world. The value of the Internet and its products increases as more users connect to it - the value of a network is equal to the square of the number of its users (Metcalfe, 2013), and the number of users grows exponentially (Reed, 2001). The Internet-based product distribution channel replaces old channels, alleviates time constraints, increases transparency and access to information; it has infinite virtual capacity; it is cheap, open, easy to use, increases productivity, and optimises business processes (Hempell, 2006, Jovanovic and Rousseau 2005, Clarke, Qiang, and Xu 2015; Shao et al.,

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2022). Bresnahan and Trajtenberg (1995) believe that internet technologies spread to most sectors, improve over time, and complement other forms of promotion. Manyika, Chui, Bughin et al. (2013) view the Internet as a set of network technologies capable of changing lifestyles and business practices, disrupting existing economic and social structures, and creating new ones. Therefore, the Internet brings forth new types of companies, new business models, and plays a crucial role in the ways of organizing, coordinating, and conducting social and economic activities. Rehman and Nunziante (2023) and Fulgenzi et al. (2024) find that the Internet economy positively and significantly impacts total factor productivity across the European regions. Information technologies have revolutionised business (Sabherwal and Jeyaraj, 2015; Zvirgzdiņa and Skadina, 2018; Stecenko and Stukalina, 2022; Lee et al. 2023; Wided, 2024), trade (Ahmed and Le, 2020; Dinu et al., 2022; Wen et al., 2023), investment (Ilmudeen, 2021; Shen et al., 2022; Wu et al., 2023).

Mobile computing devices (smartphones, computers, and tablets) are essential tools for business which are not limited by time and place. Wireless networks connect mobile computing devices via the Internet (Hoang et al., 2011). Today, a vast network has already been established to support handling an enormous amount of information (Khder et al., 2008, 2013). Twenty years ago, some researchers and professionals were not very enthusiastic about mobile business success. They accessed mobile technologies as “the toy" for certain social groups – for example, teenagers, the rich, or executives (Al-Qirim, 2003; Feng et al., 2006). Nowadays, mobile phones facilitate the growth of digital transactions and contribute to an Internet economy (Faqih and Jaradat, 2015; Ahn, 2020). Nowadays, mobile phones facilitate the growth of digital transactions and contribute to the Internet economy (Haldar et al., 2023). Al-Zoubi's (2024) research results show the annual distribution of 1404 papers published on economic development and the digital economy in the Web of Sciences Database Core Collection from 2000 to 2023. During this period, there was a remarkable yearly growth rate of 30.78%. While the study of this subject began in the early 2000s, the number of published works was very small until 2017. There has been a notable upswing in scholarly attention since 2019, demonstrating the growing significance and acknowledgment of this discipline.

By the end of 2021, more than 27.1 billion devices were connected to the Internet, which equates to over 3 devices for every inhabitant of the planet (CISCO, 2021), 5.22 billion people or 66.6% of the world population use mobile devices (Data Report, 2021). 15% of adult Americans are “smartphone-only” Internet users, which means that they do not have at home broadband access but instead have a smartphone (Pew Research Centre, 2021). Approximately half of the web traffic worldwide is attributed to mobile devices. In the first quarter of 2023, mobile devices (excluding tablets) accounted for 58.33% of global website traffic, consistently fluctuating around the 50% mark since the beginning of 2017 and eventually surpassing it in 2020. Due to weak infrastructure and financial constraints, many developing digital markets skipped the desktop internet phase entirely and transitioned directly to mobile internet through smartphones and tablets. India is a prominent example of the market, with a significant number of online users primarily focused on mobile devices. Mobile application downloads worldwide were 255 billion in 2022 (Statista, 2022). The market share of desktop computers, mobile devices, and tablets in Europe in 2023 is 45.64%, 51.89%, and 2.48%, respectively (Statcounter GlobalStats, 2023a). In 2023 in Latvia, the market share of desktop computers, mobile devices, and tablets comprises 60.66%, 38.43%, and 0.91% respectively (Statcounter GlobalStats, 2023b). Therefore, it is impossible to underestimate the impact of mobile devices on business. This research aims to examine the impact of mobile device usage on business success in Latvia.

2. Methodology

The use of mobile devices in business is theoretically based on the connection between the dissemination of knowledge and economic prosperity (Chavula, 2010; Anyanwu, 2012; Asongu et al., 2016b). Neoclassical models of economic development recognize technologies as a form of public goods and services that are entirely exogenous to existing economic systems. New economic development models are based on the neo-Schumpeterian and endogenous approach (Howells, 2005). According to new models of economic development, technological progress is a product of the participation of "human capital" (see Romer, 1990). Romer (1990) argues that technology can be both endogenous and exogenous at the same time. Rosenberg (1972) asserts that the extent to which new technologies are utilized for production purposes is crucial for

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ensuring economic development. The abovementioned theories align with contemporary literature on the relevance of knowledge dissemination in entrepreneurship (Acs et al., 2013; Hayter, 2013; Ghio et al., 2015). Therefore, mobile devices are used on the Internet to expand the dissemination of knowledge, which aligns with neoclassical models of economic growth regarding sources of innovation (Abramowitz, 1986; Bernard & Jones, 1996; Kwan & Chiu, 2015). The creation and dissemination of knowledge complement each other in innovative production (Kwan & Chiu, 2015).

Talar (2014) established that the Internet economy contributes to the creation and development of new industries, transforms traditional sectors of the economy according to new principles, and adds value based on widespread network usage. It utilizes the Internet as an open platform to engage all stakeholders in innovative and economic activities, fostering the development of network technologies and thereby aiming for further advancements in the Internet and new online technologies. The Internet and its associated technologies are continuously evolving, and its users are constantly increasing. The use of business data storage and important documents in mobile network computing within cloud computing has made data efficiently accessible in remote locations (Vakil et al., 2012). Distributed computing has become a catalyst for innovative progress in the field of data transmission, expanding the capabilities of business architecture in many business domains. Other business models have transformed the transportation industry by connecting end-users and service providers (Kenney et al., 2015). The cloud-based business model has transformed the hotel and apartment booking industry. Businessmen can make important management decisions based on feedback from end-users (Song et al., 2018). Businesses can scale efficiently by expanding their structure and capabilities as they grow. Using universal applications, business clients, shoppers, or end-users can quickly access services and products online. The Internet has turned business into a portable endeavour. Thanks to mobile applications, various services are available anytime, anywhere, and on any device. The use of universal applications expands the scope of business and provides better insights into market demand. Email allows organizations to quickly transmit and send these records to remote locations beyond the office. Capello et al. (2023) examined the growth of the digital service economy across European regions, highlighting the transformative patterns that are reshaping the business landscape. Ding et al. (2021) investigated the intricate relationship between the digital economy, technical innovation, and high-quality economic growth, exploring its geographical and mediation effects.

To achieve the research goal, in May-June 2023, the authors surveyed Latvian entrepreneurs. A total of 252 entrepreneurs were interviewed. The survey was conducted in the primary languages spoken in the regions: Latvian and Russian. The planned sampling design for the type of selection is combined with the non-repetitive method, and the sampling method is stratified based on the primary research directions. The survey was conducted using the technique of interviewing via telephone and a questionnaire available for online completion on the Internet. The authors applied the following methods for data processing: frequency analysis, correlation analysis, and factor analysis.

The enterprises under survey are divided by types of activities as follows:

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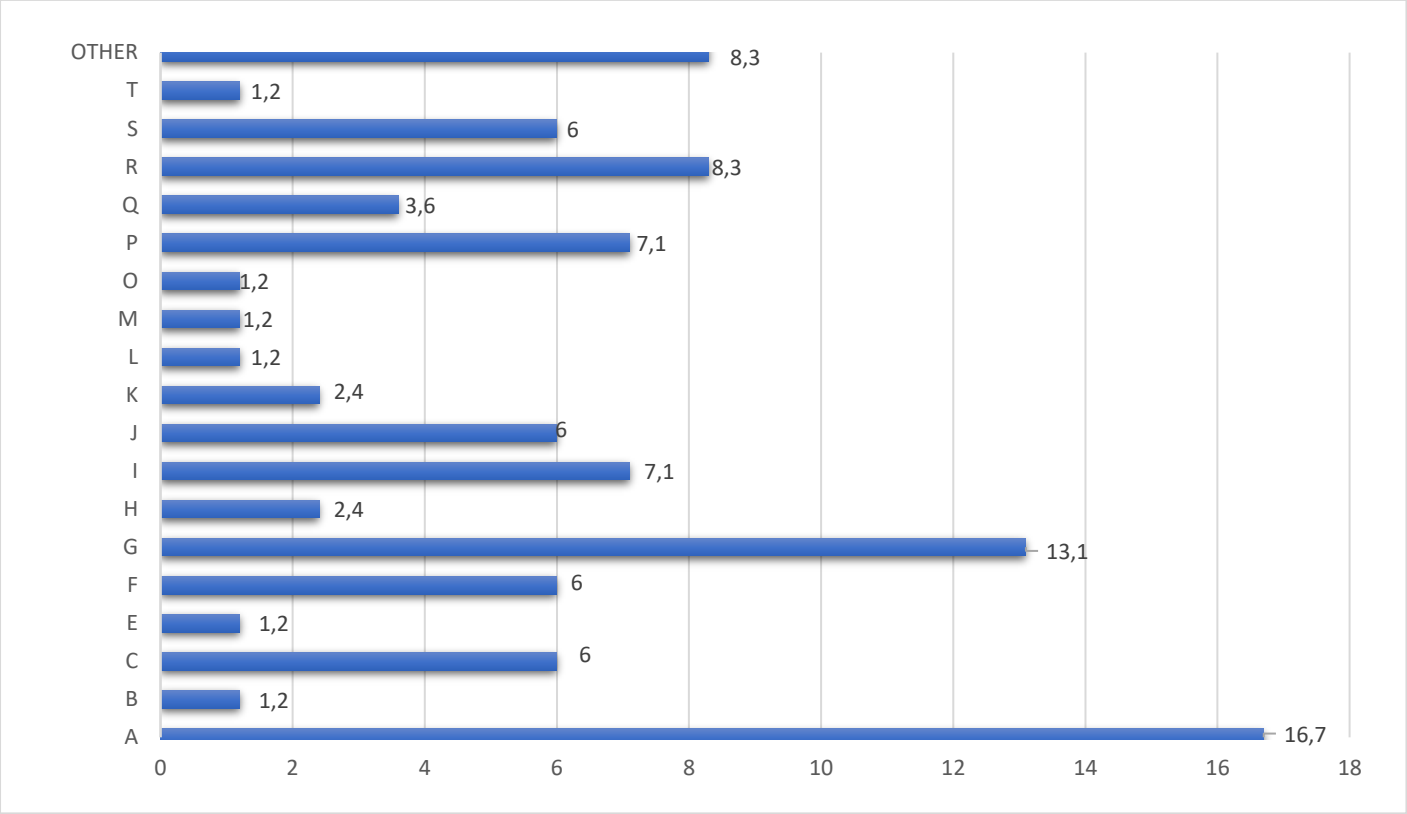

Figure 1. Types of activities of the enterprises under survey.
Source: authors' calculations based on survey data (n=252, 2023)

Note: (A) Agriculture, forestry, fish industry, (B) Mining industry and quarrying, (C) Manufacturing industry, (D) Electric energy, gas industry, heat supply and air conditioning, (E) Water supply; upkeep and rehabilitation of wastewater and waste, (F) Construction, (G) Wholesaling and retailing; automobile and motorbikes repair, (H) Transport and storage, (I) Accommodation and catering services(hotels, etc.), (J) Information and communication services, (K) Finance and insurance activity, (L) Real estate, (M) Professional, scientific and technical services, (N) Administration and servicing offices, (O) Public administration and security; mandatory social insurance, (P) Education, (Q) Health and social care, (R) Arts, entertainment, and recreation, (S) Other services, (T) Household activities as employers; production of goods for own use and provision of services in individual households.

The largest percentage of surveyed enterprises are engaged in agriculture -16.7%, 13.1% work in wholesaling and retailing; automobile and motorbikes repair, 8.3% are engaged in the sphere of arts, entertainment, and recreation, 7.1% in education, and 7.1% in accommodation and catering services. The survey covered all types of entrepreneurial activities in Latvia.

The authors found that among the surveyed enterprises, 29.8% have been operating for 1-5 years, 22.6% have been operating for less than 1 year, 20.2% have been in operation for more than 20 years, 14.3% have been operating for 6 - 10 years, and 13.1% have been in business for 11 - 20 years. Among the surveyed enterprises, 54.8% have fewer than 10 employees, 26.2% have 10 – 49, 9.5%have 50 - 249 employees, and 9.5% have more than 250 employees.

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3. Results and discussion

The median annual turnover of the surveyed enterprises is 17,500 euros, and the mean (average) annual turnover is 1,700,742 euros. In the past year, the revenue of the surveyed enterprises changed as follows: 46.4% experienced a decrease, 31% remained unchanged, and 22.6% saw an increase.

The change in the profitability of the surveyed enterprises is as follows: 40.5% experienced a decrease, 36.9% remained unchanged, and 22.7% saw an increase. The change in the volume of products sold and services provided by the surveyed enterprises is as follows: 22.1% experienced a decrease, 32.1% remained unchanged, and 35.7% saw an increase.

The change in the volume of exported products/services is as follows: 29.8% experienced a decrease, 45.2% remained unchanged, and 25% saw an increase. The change in market share for the surveyed enterprises is as follows: 36.9% experienced a decrease, 39.3% remained unchanged, and 23.9% saw an increase.

Table1. Use of mobile technologies and devices (smartphones, tablets, etc.) in business in the context of digitization in the last few years (%).

Use of mobile technologies and devices	never	rarely	medium	often	always
Mobile access to e-mail	8.3	25	17.9	10.7	38.1
Mobile version of the website	15.5	17.9	19	19	28.6
Messenger groups for solving business tasks	8.3	26.2	19.1	20.2	26.2
SMS marketing	13.1	21.4	22.7	19	23.8
Mobile access to company resources (databases, etc.)	13.1	25	14.3	23.8	23.8
Company has developed its own mobile applications	31	22.6	16.6	17.9	11.9
Advertising targeted for use on mobile devices	23.8	19	23.8	17.9	15.5
Mobile devices for managing production processes	17.9	27.4	20.1	17.9	16.7
Payments of a company bills from a mobile phone	13.1	17.9	23.7	16.7	28.6
Equipment of a company transport system with location data transmission systems	16.7	21.4	17.8	26.2	17.9
Own mobile application	26.2	21.4	19	16.7	16.7
Augmented reality technologies	38.1	13.1	20.3	20.2	8.3
Possibility to purchase (order, pay, choose a delivery method) your products or services through mobile	17.9	14.3	25	10.7	32.1

Source: authors' calculations based on survey data (n=252, 2023)

It has been found that 38.1% of entrepreneurs always use mobile devices for email, while 8.3% do not use mobile access to email at all. 32.1% of entrepreneurs use the possibility to purchase (order, pay, choose a delivery method) products or services through mobile, but 17.9% never use this option. 28.6% of entrepreneurs have a mobile version of the website and always use it, while 15.5% never use it. 28.6% of entrepreneurs make payments for their businesses using a mobile phone, while 13.1% have never done this. 26.2% of entrepreneurs always use messenger groups to solve business tasks, while 8.3% never use them. 23.8% of entrepreneurs always use SMS marketing, while 13.1% never use it. Therefore, the above-described ways of using mobile technologies are the most popular among entrepreneurs.

The least popular actions for entrepreneurs are the use of augmented reality technologies (8.3% always use, 38.1% never use) and the development of their own mobile applications (16.7% always use, 17.9% never use). It is interesting to note that 23.8% of enterprises never use advertising oriented to be used on mobile devices (only 15.5% always use it). According to the authors, there is a potential to use mobile devices more for managing production processes (17.9% never use them, while 16.7% always use them). Additionally, they suggest equipping company transportation with location data transmission systems (16.7% never use them, 17.9% always use them). It is possible that these ways of using mobile technologies are not in high demand for small businesses.

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As a result of the survey, the authors also established the subjective assessment by entrepreneurs of the degree of impact of mobile technologies on specific aspects of business in the context of digitization in the last few years.

Table 2. Degree of influence of mobile technologies on specific aspects of business in the context of digitization in the last few years (%)

Degree of influence of mobile technologies on specific aspects of business	negative influence	no influence	positive influence
Productivity of employees	21.4	31	47.6
Resources saving (including time)	25	19	56
Communication with clients	10.7	27.4	61.9
Communication with suppliers	17.9	25	57.1
Remote interaction with the company information systems, equipment, and products by employees	21.4	27.4	51.2
Development (or adaptation) of products and services for use by customers on mobile devices (purchase, payment, delivery)	15.5	35.6	48.8
Effectiveness of marketing	15.5	27.4	57.1
Effectiveness of advertising	25.1	26.1	48.8
Efficiency of decision-making	17.8	29.8	52.4
Customer awareness about products and services	13.1	28.5	58.4
Execution of business processes	20.3	21.3	58.4
Number of clients	21.5	32.1	46.4
Number of sales	19.1	33.2	47.7
Internal costs	22.6	38.2	39.2
Satisfaction of employees	19.1	26.2	54.7
Introduction of new products and services	19.1	38.1	42.8
Number of employees	21.4	42.9	35.7
Number of IT employees	28.5	42.9	28.6
Remote employees	22.6	35.9	41.5

Source: authors' calculations based on survey data (n=252, 2023)

Evaluating the degree of influence of mobile technologies on business processes and other characteristics (in entrepreneurs' opinion), it can be stated that a certain share of entrepreneurs believe that this influence is negative. 28.5% of entrepreneurs believe that the use of mobile technologies leads to an increase in the number of IT employees and results in internal costs (22.6%) and negatively affects the company resource saving (25%). 25.1% consider advertising with the use of mobile technologies to be ineffective. 21.4% believe that the use of mobile technologies has a negative impact on labor productivity. Additionally, 21.4% of entrepreneurs believe that remote interaction of employees with the company information systems, equipment, and products is ineffective and even has a negative impact. Therefore, it can be concluded that a certain share of entrepreneurs may have a limited competence in mobile technologies and may be hesitant to use them in their business activities. However, a significant share of entrepreneurs assesses the impact of mobile technologies on certain aspects of business positively. So, 61.9% believe that mobile technologies have a positive impact on communication with customers, while 57.1% think that mobile technologies have a positive impact on communication with suppliers. 57.1% consider marketing to be effective, and 48.8% appreciate the effectiveness of advertising using mobile devices. 58.4% consider the use of mobile technologies in business processes to be effective and believe it increases employee satisfaction (54.7%). According to 51.2% of entrepreneurs, remote interaction of employees with the company information systems, equipment, and products through mobile technologies also has a positive impact on business. Considering the market share of mobile device usage in Latvia at 38.43% (compared to 51.89% in the EU), the subjective assessment of the impact of mobile technologies on business is quite optimistic.

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If we analyze the correlation between entrepreneurs' assessments of the impact of mobile technologies on business and objective business results, there is a positive linear relationship between changes in revenue at the enterprise and the degree of assessment related to communication with customers (Spearman correlation coefficient 0.187, p-value<0.01), communication with suppliers (Spearman correlation certificate 0.153, 0.01<p-value<0.05), remote interaction of employees with company information systems, equipment, and products (Spearman correlation coefficient 0.223, p-value<0.01), development (adaptation) of products and services for mobile device use (Spearman correlation coefficient 0.154, 0.01<p-value<0.05), customer awareness about products and services through mobile technologies (Spearman correlation coefficient 0.180, p-value<0.01), execution of business processes (Spearman correlation coefficient 0.145, p-value<0.01), number of clients (Spearman correlation coefficient 0.146, p-value<0.01), number of sales (Spearman correlation coefficient 0.159, p-value<0.01), employee satisfaction (Spearman correlation coefficient 0.240, p-value<0.01), introduction of new products and services (Spearman correlation coefficient 0.203, p-value<0.01), and remote employees (Spearman correlation coefficient 0.126, 0.01<p-value<0.05).

There is a positive linear relationship between changes in the profitability of enterprises and entrepreneurs' assessments of the impact of mobile technologies on resource saving (Spearman correlation coefficient 0.161, 0.01<p-value<0.05), communication with customers (Spearman correlation coefficient 0.285, p-value< 0.01) and suppliers (Spearman correlation coefficient 0.176, p-value<0.01), remote interaction of employees with company information systems, equipment, and products (Spearman correlation coefficient 0.174, p-value< 0.01), development of products and services for mobile device use (Spearman correlation coefficient 0.247, p-value< 0.01), marketing efficiency (Spearman correlation coefficient 0.132, 0.01<p-value<0.05), decision-making promptness (Spearman correlation coefficient 0.132, 0.01<p-value<0.05), customer awareness about products and services (Spearman correlation coefficient 0.254, p-value< 0.01), execution of business processes (Spearman correlation coefficient 0.178, p-value<0.01), number of clients (Spearman correlation coefficient 0.176, p-value<0.01), number of sales (Spearman correlation coefficient 0.255, p-value< 0.01), internal costs (Spearman correlation coefficient 0.179, p-value< 0.01), employee satisfaction (Spearman correlation coefficient 0.263, p-value<0.01), introduction of new goods and services (Spearman correlation coefficient 0.239, p-value<0.01).

The analysis reveals positive linear relationship between changes in the volume of products sold/services provided in the last year and entrepreneurs' assessments of the impact of mobile technologies on employee productivity (Spearman correlation coefficient 0.171, p-value<0.01), resource saving (including time) (Spearman correlation coefficient 0.152, 0.01<p-value<0.05), communication with clients (Spearman correlation coefficient 0.200, p-value<0.01), remote interaction of employees with company information systems, equipment, and products (Spearman correlation coefficient 0.170, p-value< 0.01), customer awareness about products and services (Spearman correlation coefficient 0.165, p-value< 0.01). Number of sales also correlates with the change in the volume of products sold (Spearman correlation coefficient 0.170, p-value<0.01); employee satisfaction correlates with the change in the volume of products sold (Spearman correlation coefficient 0.207, p-value<0.01).

Changes in the volume of exported products or services during the last year correlate with entrepreneurs' assessments of the degree of impact of mobile technologies on employee productivity (Spearman correlation coefficient 0.132, p-value<0.01), resource saving (Spearman correlation coefficient 0.165, p-value<0.01), communication with clients (Spearman correlation coefficient 0.152, 0.01<p-value< 0.05), development of products and services for mobile device use (Spearman correlation coefficient 0.211, p-value<0.01), promptness of decision-making (Spearman correlation coefficient 0.156, 0.01<p-value<0.05), customer awareness about products and services (Spearman correlation coefficient 0.128, 0.01<p-value<0.05), number of sales (Spearman correlation coefficient 0.213, p-value<0.01), employee satisfaction (Spearman correlation coefficient 0.151, 0.01<p-value<0.05), and introduction of new products and services (Spearman correlation coefficient 0.198, p-value<0.01).

Change in the market share correlates with entrepreneurs' assessments related to the impact of mobile technologies on resource-saving (Spearman correlation coefficient 0.167, p-value<0.01), marketing efficiency (Spearman correlation coefficient 0.138, 0.01<p-value< 0.05), advertising efficiency (Spearman correlation

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coefficient 0.190, p-value<0.01), number of sales (Spearman correlation coefficient 0.140, 0.01<p-value<0.05), employee satisfaction (Spearman correlation coefficient 0.220, p-value<0.01), and introduction of new products (Spearman correlation coefficient 0.212, p-value<0.01).

Table 3. Correlation analysis of the impact of mobile technologies on business results in Latvia (2023)

	How your company' s income changed in the last year	How volume of products sold/services provided changed in the last year	How the volume of exported products/services changed in the last year	How the profitability of your company changed in the last year	How the market share of your company changed in the last year
Mobile access to email	0.251**	0.130*	0.139*	0.240**	0
Mobile version of the website	0	0	0	0	0
Messenger groups for solving business tasks	.165**	.151*	.124*	.173**	.172**
SMS marketing	.194**	.135*	.229**	.216**	.237**
Mobile access to company resources (databases, etc.)	0	0	.269**	.162*	.220**
Advertising targeted for use on mobile devices	.142*	.132*	.192**	.210**	.275**
Mobile devices for managing production processes	.178**	.167**	.106	.173**	.181**
Payments of company bills from a mobile phone	.310**	.151*	.203**	.315**	.284**
Equipment of a company transport system with location data transmission systems	.221**	.213**	.192**	.187**	.166**
Own mobile application	.227**	.285**	.162*	.195**	.251**
Augmented reality technologies	0	0	0	0	.131*
Possibility to purchase (order, pay, choose a delivery method) your products or services through mobile	.140*	.173**	.273**	.202**	.184**

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).
Source: authors' calculations based on survey data (n=252, 2023)

The table reflects the results of a correlation analysis between the following variables: the use of mobile technologies and business results in Latvia. In most cases, there is a weak positive linear relationship, with the exception of the correlation with business results being only the presence of a mobile version of the website and the use of augmented reality technologies (the exception being their impact on changes in market share – Spearman correlation coefficient 0.131, 0.01<p-value<0.05). Certainly, the use of augmented reality technology and custom mobile applications by entrepreneurs is very limited (as seen in Table 1). However, mobile website versions are relatively common but still do not have a significant impact on changes in a company's income, sales volume, export changes, profitability, or market share.

4. Conclusions

The least popular actions among entrepreneurs in Latvia are the use of augmented reality technologies and the development of their own mobile applications. It appears that there is a potential for greater use of mobile-oriented advertising as well as the management of production processes and equipping company transport with location data transmission systems.

The most popular actions among entrepreneurs in Latvia involve mobile access to email, the possibility to make mobile purchases (order, pay, select delivery methods) of products and services, mobile payments for company

bills, mobile website versions, and the use of messaging groups for business purposes, as well as SMS marketing.
Despite the lower market share of mobile devices in Latvia – 38% compared to the European average of 52%, the use of mobile devices still has a positive impact on business in Latvia.

According to the assessments provided by entrepreneurs, the most positive impact of mobile technologies is observed in the following areas: communication with customers and suppliers, marketing effectiveness, customer awareness of products and services, execution of business processes, number of customers and sales, development or adaptation of products and services for mobile device usage, and effectiveness of advertising.

A weak positive linear relationship has been established between the following variables: *objective changes in enterprise income* and the degree of assessment by entrepreneurs for communication with customers, communication with suppliers, remote interaction of employees with company information systems, equipment, and products, development (adaptation) of products and services for mobile device use, customer awareness about products and services through mobile technologies, execution of business processes, number of customers, number of sales, employee satisfaction, introduction of new goods and services, and remote employees.

A weak positive linear relationship has been established between *changes in the profitability of the enterprise* and the degree of entrepreneurs' assessments of the impact of mobile technologies in various areas. These areas include the impact of mobile technologies on resource-saving, communication with customers and suppliers, remote interaction of employees with company information systems, development of products and services for mobile device usage, marketing effectiveness, decision-making promptness, customer awareness, business process execution, number of customers, number of sales, internal expenses, employee satisfaction, and introduction of new products and services.

A linear positive relationship has been established between *changes in the volume of products/services sold in the last year* and entrepreneurs' assessments of the impact of mobile technologies on various aspects of their business. These aspects include the impact of mobile technologies on employee productivity, resource-saving, communication with customers, remote interaction of employees with the company information systems, employee satisfaction, and customer awareness. Additionally, number of sales correlates with changes in the volume of products/services sold, while employee satisfaction correlates with changes in the volume of products sold.

The change in exported products or services over the last year correlates with entrepreneurs' assessments of the impact of mobile technologies on employee productivity, resource-saving, communication with customers, development of products and services for mobile device usage, decision-making efficiency, customer awareness products and services, sales volume, employee satisfaction, and the introduction of new products and services.
The change in market share correlates with entrepreneurs' assessments of the impact of mobile technologies on resource-saving, marketing efficiency, advertising effectiveness, sales volume, employee satisfaction, and the introduction of new products.

The authors believe that the use of a mobile website version and augmented reality technologies have the potential to impact businesses in Latvia positively.

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SUSTAINABLE PRACTICES AND THEIR DRIVING FACTORS IN MICRO, SMALL AND MEDIUM ENTERPRISES (MSMEs)*

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Abstract. Practising sustainability is no longer a new phenomenon in today's business world. However, many micro, small and medium enterprises (MSMEs) face various challenges in exercising sustainable practices. In addition, the stakeholders' roles in driving their sustainable practices still remained unknown. Therefore, this study was conducted to determine sustainable practices exercised by MSMEs and the driving factors of sustainable practices. This study employed a qualitative research method in which a semi-structured interview was performed with 12 micro and small manufacturing MSMEs. The participants were selected using the purposive sampling method. Based on the interview findings, it concluded that MSMEs practised three aspects of sustainability, namely environment, social and governance, although they practised sustainability in different ways and to different extend. Regarding the driving factors of sustainable practices, it concluded that stakeholders such as government, owners and customers played a crucial role. Specifically, the government played a significant role by providing various financial and non-financial support. The owners of MSMEs were able to initiate sustainability practices by sharing their sustainable beliefs among employees. Customers could also spark sustainable practices in MSMEs due to their changed preferences towards environmentally friendly products. The implications of this study include supporting the current sustainability model, shedding light on the importance of stakeholders in driving sustainable practices, and providing new insights into developing strategies for sustainable practices.

Keywords: business; drivers; stakeholders; sustainability

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1. Introduction

The concept of sustainability development was introduced by the World Commission on Environment Development (WCED) in 1987, which refers to "meeting the needs of the present without compromising the ability of future generations to meet their own needs". Then, the United Nations (UN) introduced the 17 Sustainable Development Goals (SDGs) in 2015 as part of the 2030 Agenda for Sustainable Development. The achievement of these 17 SDGs is essential in transforming the world through terminating poverty, preserving the environment and enhancing people's quality of life (United Nations, n.d.).

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The global discourse on sustainable development has reckoned a paradigm shift in Malaysia's business operations. For instance, the Malaysian Budget 2024 has integrated sustainability into economic policies (The Star, 2023). In addition, the government also planned to launch a framework on environment, social and governance (ESG) standards by the end of 2023 to assist local companies in transitioning into a low-carbon and renewable energy economy (Bernama, 2023a). Micro, small and enterprises (MSMEs) are considered the backbone of the Malaysian economy because they make up 97.4% of the total business establishment, contribute to 38.4% of gross domestic production (GDP) and employ 48.2% of the workforce in the year 2022 (DOSM, 2023). Therefore, it is time for MSMEs to transform into sustainable enterprises because they play a crucial role in the overall sustainability landscape and achieving 17 SDGs.

However, the adoption of sustainable practices is mainly exercised by large and listed corporations in Malaysia. As for MSMEs, their sustainability performance is still low due to a lack of understanding of the significance of sustainability, such as ESG (Bernama, 2023b). True, sustainable practices needs to be improved and addressed in SMEs especially in emerging markets (Das et al., 2020). Moreover, many MSMEs also believe that their actions would not significantly affect the natural and social environment (Neto et al., 2017). Undoubtedly, MSMEs are facing unique challenges in adopting sustainable practices. Specifically, resource constraints, limited access to information, and a lack of awareness often hinder the integration of sustainable initiatives into their business models. Therefore, the following research question was established:

Research question 1: How do MSMEs practice sustainability in business?

In addition, MSMEs received very little guidance or motivation from their stakeholders in practising sustainability. Stakeholders are those interested in a business; they influence the operations of companies, including sustainable practices. However, many existing studies of enablers of sustainable practices have neglected the role of stakeholders. Furthermore, there is a noticeable gap of how stakeholders can effectively influence and encourage sustainable practices within MSMEs. Understanding the role of stakeholders in steering MSMEs towards a more sustainable trajectory is essential. Therefore, this research aims to address this gap by comprehensively examining the roles of various stakeholders in fostering sustainable practices among MSMEs. Specifically, the following research question was developed:

Research question 2: How do stakeholders act as drivers of sustainable practices in MSMEs?

This study is significant because it highlights sustainable practices that MSMEs exercise. It also sheds light on key stakeholders' role in driving sustainability practices and developing sustainability strategies and initiatives among MSMEs. Furthermore, it provides new insights regarding the significant role of MSMEs stakeholders in encouraging sustainable practices among MSMEs, which helps develop innovative governance structures that prioritize stakeholder representation and participation in sustainability decision-making.

2. Literature Review

2.1 Sustainable Practices in Business

Sustainable development is "development that meets the needs of the present without compromising the ability of future generations to meet their needs" (WCED, 1987:8). It was then integrated into business operations. Several years later, the term Triple-Bottom-Line, also known as TBL or 3BL, was first introduced by John Elkington in 1994 to describe business strategies that incorporate sustainable values. The idea was then expanded into the "3P formulation", which incorporates profit, planet and people (Elkington, 2004). The concept of sustainable development is then frequently explained using TBL. In 2004, the United Nations released a report entitled "Who Cares Win", which mentioned about three aspects of ESG in business. Businesses nowadays are urged to embrace ESG because it is considered a must but not a choice (Byrne, 2023). TBL and ESG are closely related because they are designed to promote sustainable business practices. Furthermore, the 17 SDGs can only be achieved with the help of the three components of TBL or ESG. Thus, practising sustainability in business means integrating the TBL or ESG concepts in business activities.

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Sustainable practices adopted by MSMEs vary across different firms. Indeed, as Caldera et al. (2018) mentioned, the actual meaning of the term sustainable business practices is still unclear in the daily operations of the business. Thus, they further characterized sustainable business practice for SMEs under three themes: environmental stewardship, process excellence, and sustainability-oriented culture. Meanwhile, Nor-Aishah et al. (2020) and Hanaysha et al. (2022) measured the sustainable performance of SMEs in a holistic manner, which consisted of three aspects known as economic, environmental and social sustainability. In some other previous studies, researchers focused on the adoption of "lean and green thinking" in achieving efficiency in production and reducing waste (Caldera et al., 2019), implementation of "lean thinking" in directing business firms towards sustainability practices (Franco & Rodrigues, 2021), application of "lean-green operations" in new product development for efficiency (Oliveira et al., 2022), green manufacturing practices and green innovation for corporate sustainable performance (Al-Hakimi et al., 2022), sustainable product and process design, sustainable waste disposal management, sustainable human resource management and local community development (Mitra, 2023) and, performing sustainable manufacturing practices which focused on using economically-sound processes to reduce negative environmental impacts in products production (Ali & Johl, 2023). It could be said that although many organizations have adopted sustainable practices, there remains no uniformed reporting standard and measurement of sustainable performance in which firms measure different things and report in different ways (Byrne, 2023; Ribeiro, 2023). Undoubtedly, this has confused businesses.

Therefore, since there is no uniform definition of sustainable practices, no clear guidelines on what is considered sustainable practices and what is not and different researchers measured dimensions of sustainable practices differently, this study regards any practices that are closely related to TBL and ESG are deemed as sustainable practices, regardless of their level or degree of practice.

2.2 The Stakeholder Theory

Edward Freeman presented the concept of stakeholder in the middle of the 1980s. Stakeholders can be defined as persons or groups that have the potential to influence or be impacted by an organization's aims; they are also individuals or groups that are critical to an organization's survival and success (Freeman, 1984). A company's stakeholders can be classified as internal or external. Groups or persons actively participating in an organization's administration, such as managers, staff members, and owners, are considered internal stakeholders. On the other hand, external stakeholders are indirectly involved in an organization's activities but are not directly connected to its management. Meanwhile, Bonetti et al. (2023) categorized stakeholders into six components: employees, customers, suppliers, community, investors/shareholders and government agencies.

Stakeholder theory has been used in previous studies to examine the sustainability performance of firms. For instance, Buallay (2022) created a theoretical framework which combined the theories of stakeholders, legitimacy, and political economy. According to Chen et al. (2023), a company's value for sustainability is determined by how much its stakeholders value it. In addition, Bonetti et al. (2023) mentioned that stakeholder participation was critical to the success of sustainability reporting. The United Nations study "Who Cares Win" also discussed the roles that stakeholders, such as managers, directors, investors, etc., play in enticing companies to adopt sustainable practices (Byrne, 2023). As a result, it is feasible to apply stakeholder theory to sustainable performance, and stakeholder participation is essential.

Effective management will result from taking into account the stakeholders' needs that fall under a business's purview (Soonsan, 2017). It is vital to acknowledge the firm's substantial stakeholder participation to influence the organization's choice. From the standpoint of MSMEs, however, alternative stakeholder engagement strategies that are appropriate for MSMEs should be used. According to Ho (2023), many stakeholders within the ecosystem may motivate MSMEs to maintain sustainable compliance, including vendors, customers, and business partners.

Caldera et al. (2019) stressed that the involvement of both internal and external stakeholders was crucial for implementing sustainable business practices successfully in SMEs. They further found that owner and top management, employees, customers, society and government played an influential role in enabling

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manufacturing SMEs to adopt sustainable practices. Nor-Aishah et al. (2020) mentioned that owners or leaders of SMEs play a significant role in driving sustainable practices in firms; thus, they should equip themselves with relevant skills to achieve sustainable performance. In addition, other stakeholders such as employees, customers and the community should play a complementary role in supporting the owners or leaders in accomplishing sustainable performance.

3. Research Methodology

This study adopted a qualitative research approach. Specifically, a personal interview was conducted because it was highly effective in generating a list of topics within a domain (Guest et al., 2017).

3.1 Subject

The sample of this study was the owner-managers of MSMEs that practice sustainability. As mentioned in the previous section, due to the absence of a uniform definition of sustainable practice, this study regarded it as any practice that was closely related to TBL or ESG, regardless of its degree of practice. The sample was selected through a non-probability method; the purposive sampling technique was employed because selected participants were deemed the best source of information (Patten & Newhart, 2018). The eligibility criteria of sample selection were: (1) MSMEs registered in Malaysia Commission of Company; (2) operated in the manufacturing sector; (3) exercised sustainable practices. There were 12 participants identified and selected. The profiles of the participants are presented in Table 1:

Table 1. Profiles of participants

Firm	Nature of business	No. of full-time employees	Years of operations
A	Food processing	6	4
B	Food manufacturing	20	8
C	Food processing	10	3
D	Food manufacturing	17	10
E	Used palm oil processing	8	12
F	Kitchenware manufacturing	15	7
G	Cosmetics manufacturing	25	9
H	Apparel manufacturing	28	6
I	Furniture manufacturing	15	18
J	Apparel manufacturing	16	4
K	Souvenir manufacturing	6	10
L	Food manufacturing	13	7

Source: Authors' own research

3.2 Data collection and analysis

The data was collected through semi-structured interviews. This is because it is the most commonly used type of interview in which an interview protocol is established in advance; it has a less rigid flow of interviews and allows more useful information to be collected (Patten & Newhart, 2018). The interviews were performed in March 2023 in Klang Valley, Malaysia. They were done through telephone and physical methods. Subsequently, the data was analysed using the thematic approach suggested by Braun and Clarke (2006) due to its flexibility and its ability to identify, analyse and report patterns or themes within data. The six steps of the thematic approach applied in this study were: (1) familiarized with data; (2) generated initial codes; (3) searched for themes; (4) reviewed themes; (5) defined and named themes and; (6) produced reports.

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4. Results and Discussion

4.1 Results

This section presents and discusses the results of the interview. Specifically, Table 2 delineates the responses from participants pertaining to sustainable practices they exercised. Based on the interview, sustainable practices could be categorized into three main themes, namely environmental, social and governance.

Table 2. Sustainable practices implemented by MSMEs

Dimension	Firm	Sustainable Practice
Environmental	A	▪ Implement zero-waste policy
	B	▪ Implement zero plastic policy ▪ Use bio-degradable and recycled materials in product packaging
	C	▪ Use bio-degradable materials in product packaging
	D	▪ Use easy-to-dispose materials in product packaging ▪ Recycle of waste
	E	▪ Prevent pollution through reducing the disposal of used palm oil
	F	▪ Produce eco-friendly products ▪ Implement energy-saving policy
	G	▪ Use natural raw materials ▪ Use bio-degradable materials in product packaging
	H	▪ Install solar panel ▪ Use electric-saving appliances
	I	▪ Use recycled materials ▪ Implement zero-waste policy
	J	▪ Recycle of waste ▪ Implement a waste management policy
	K	▪ Use non-toxic materials
	L	▪ Reduce production waste ▪ Use bio-degradable materials in product packaging
Social	A	▪ Provide jobs to retirees ▪ Donate to the misfortunes
	B	▪ Donate regularly ▪ Commit to employee safety and health
	H	▪ Employ single mothers
	I	▪ Donate to charity bodies ▪ Employee training and development
	K	▪ Employ disabled people
Governance	B	▪ Adhere to product safety standards
	C	▪ Have a set of production rules and regulations
	I	▪ Implement a risk management policy

Source: Authors' own research

The environmental dimension of sustainability is related to the impacts of business activities on the natural environment (OECD, 2001). As mentioned by Husted and de Sousa-Filho (2017), it involves a process of environmental management to reduce environmental impacts. All the firms interviewed in this study expressed that they practised environmental sustainability. In particular, five firms focused on the concept of 3Rs: reduce, reuse and recycle. The interview also revealed that four MSMEs emphasized on using bio-degradable materials in their business operations. Biodegradable materials can decompose naturally within a few months or a few years; examples are such as paper-based or wood-based materials. It was great to find that five firms have established and implemented environmental policies regarding waste management and green management.

The social aspect of sustainability can be described as a concern pertaining to the well-being of employees and communities (Gimenez et al., 2012). There were five firms involved in this study that practiced social sustainability. Due to the small size and scarce resources of the firms that participated in the interview, their social sustainable practices were centred around providing donations and job opportunities. MSMEs normally face financial constraints and tight budgets alas, three firms in this study donate regularly to society's

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misfortunes. It is also worth mentioning that two enterprises employed needy people, such as single mothers and people with disabilities.

The governance dimension of sustainability involves the firm's structure, operations and corporate governance practices (Husted & de Sousa-Filho, 2017). Regarding governance sustainability, three firms stressed that they established and implemented rules and regulations to ensure that their business operations were safe and adhere to industrial standard and that their employees were well taken care of. It was regretted that the number of firms that practised governance sustainability was too low; perhaps it was due to the lack of systematic operations and management systems in MSMEs. However, it marked a good start for encouraging more firms to be involved in governance sustainability.

Table 3. Driving factors of sustainable practices

Stakeholders	Driving factors	Narrative from interview
Government	Support	1. "For my business, government grant has helped us a lot and contributed to our sustainable practices … the financial assistance that we received has helped us to improve our operations towards a more sustainable production process." 2. "The main factor for my business to be sustainable is the financial incentive such as a low-interest loan that we received from the governmental agency ... We used the fund for upgrading our operational tools and equipment to renewable energy, such as using a solar panel." 3. "Practicing sustainability is a must now … government has encouraged businesses to do so… Incentives provided by government is another motivational factor." 4. "Government support became my main reason for sustainable practices… I attended the seminars and training courses organized by governmental agencies. They gave me various ideas for reducing waste and using alternative pro-environmental raw materials." 5. "Government support and the sustainability movements made by government … the local authority has organized many activities related to sustainable development such as recycling, charity and green programs. Those programs have allowed me to implement sustainability in my business." 6. "Although my business doesn't need to report its sustainable performance, the government has started to promote the importance of being sustainable through seminars, campaigns and social media … the government is serious in supporting sustainable business practices." 7. "I attended a seminar organized by SME Corp, where I learned about green business and its importance to the country's development. From there, I decided to adopt sustainable practices." 8. "Government has promoted sustainable business practices to us … the government has encouraged us to be sustainable through many efforts and initiatives. Some of these initiatives have made my business adopt sustainable practices."
Owner	Belief	1. "I believe that how top management, such as CEO or manager, perceive sustainability contributes a lot to sustainable practices in this company … my management team and I believe that sustainability is a must-do in today's business world." 2. "As the sole owner of this business, my own belief and intention drove me to practice sustainability … I think it is time for me and my business to contribute back to my society and do something good to our mother earth." 3. "I believe that natural resources are gifts from God, and I need to take care of them. God flourished us with an abundance of resources, and we should cherish them and make sure that our future generations can use them also." 4. "I am aware of various earth issues, and am strongly concerned about those issues as well. This made me exploresustainable practices when I started my business, and developed sustainable policies in my business." 5. "I came from a poor family … I can be what I am today because I received various kinds of help from many people … I believe that it is my responsibility to help the misfortunate and give back to society." 6. "I love to share whatever I know with my workers. I do share with them the importance of a business to be sustainable … I believe that business must not harm the wharmwe live in."
Customer	Preferences	1. "Customers nowadays acknowledge eco-friendly products … their awareness of sustainability caused my business to produce products sustainably." 2. "Market demand is important ... there are growing opportunities in the market for green and environmentally friendly products due to increasing customer demand." 3. "Market demand … the current trend in the market is green and environmentally friendly products. Customers are going for those products ... I need to change my way of producing the products to adhere to the green production process." 4. "In my business, our customers are becoming more demanding. Nowadays, they are not only looking for products that have good quality … but also environmentally friendly products… we have to change our production process to suit their preferences."

Source: Authors' own research

Table 3 summarises the interview results in regard to stakeholders' driving factors of sustainable practices. As Freeman (1984) mentioned, stakeholders are essential in determining the direction and operations of firms. The interview revealed that three stakeholders of MSMEs were critical in driving them to practice sustainability: the

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government, the owner and the customer. Specifically, eight firms mentioned that they were affected by the government in practising sustainability. They further delineated that they practised sustainability due to financial and non-financial support provided by various governmental agencies. The financial support included financial incentives and low-interest loans. Meanwhile, non-financial support included training courses, seminars, programs and campaigns.

Six owner-managers expressed that their own beliefs drove them in practicing sustainability in their businesses. They explained that their beliefs and religious beliefs drove them to practice sustainability. In addition, they also mentioned that they shared their beliefs with employees in order to share knowledge about sustainability with them and gain support from them.

The customer was found to be another stakeholder who played an essential role in driving MSMEs to exercise sustainable practices. There four firms that explained that they practised sustainability because customers' demand drove them. As they mentioned, customers' preferences have changed over the years; they prefer to buy environmentally friendly products. Therefore, MSMEs must adopt sustainable practices in their operations to meet the customers' requirements and suit their tastes.

4.2 Discussion

Figure 1 summarises the findings of this study. It identified three major categories of sustainable practices among MSMEs; similar to their larger counterparts, sustainable practices of MSMEs also centred around the three aspects of environment, social and governance.

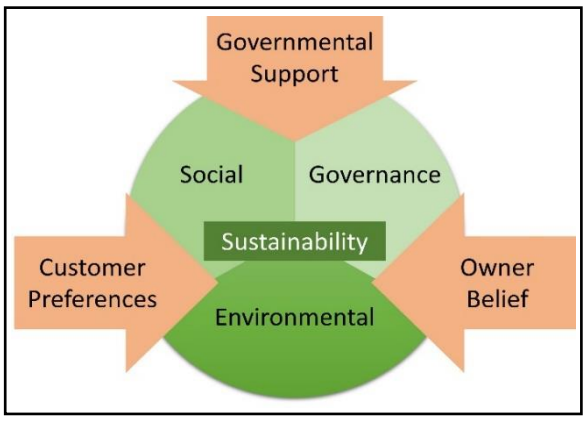

Figure 1. Sustainable practices and their drivers in MSMEs of Malaysia
Source: Authors' own research

It is worth mentioning that the aspects of environment, social and governance supported the ESG principles. In addition, the findings were in agreement with the description of environmental, social and governance sustainability delineated by Husted and de Sousa-Filho (2017) and Gimenez et al. (2012). It found that environmental sustainability was the most frequently practised sustainability, followed by social and governance. This could be caused by most MSMEs being aware of environmental sustainability. There were only a small number of enterprises that practised governance sustainability; perhaps they were MSMEs and lacking sufficient operational and monitoring systems. The findings also disclosed that MSMEs in this study emphasized sustainability, although they were relatively small compared to large organizations. However, their degree of practice and types of sustainable practices were rather different and difficult to measure or assess. In other words,another word firms were practising different types of sustainability in their business, and the extent of practice was also different. Therefore, measuring or assessing their sustainable performance remained a significant challenge.

In terms of stakeholders' roles, although Bonetti et al. (2023) have identified six categories of stakeholders, this study found that only three were significant in affecting the adoption of sustainable practices among MSMEs. The government was found to be the primary driver of sustainable practices. The other external stakeholders were customers. Meanwhile, the owner was the only internal stakeholder which drove MSMEs to adopt sustainable practices. Although not all stakeholders were playing a role in influencing sustainable practising in MSMEs, the findings supported Bonetti et al. (2023), Chen et al. (2023), Nor-Aishah et al. (2020) and Caldera et al. (2019), whereby the importance of stakeholders should not be neglected. The findings indicated that governmental support was crucial because it provided many financial and non-financial supports through its various agencies. MSMEs not only obtained the relevant information and knowledge from those agencies but also accessed financial assistance for implementing sustainable practices. As operations of MSMEs were closely related to the personal beliefs of their owner-managers, owners' beliefs that were held and shared by the owner-managers did affect the adoption of sustainable practices. The employees would be able to accept and practice sustainability if the owners werespread the information about sustainable practices around the employees. A critical agenda for business survival is to meet the customers' preferences. Changed market trends and customers' tastes have undoubtedly driven the MSMEs to embark on sustainability management to satisfy their customers.

5. Conclusions

This study was performed with the aim of determining sustainable practices exercised by MSMEs and driving factors of sustainable practices in MSMEs. In answering the first research question, it concluded that MSMEs practised sustainability in three aspects: environment, society and governance. However, their sustainable practices varied from one to another and were practised to different extend. As for the second research question, it concluded that the driving force of governmental support (both financial and non-financial) was playing a prominent role, followed by owner's belief and customer demand.

The implication of this study is two-fold. Literally, it supports the current sustainability model, which consists of environmental, social, and governance elements. It also enriches the stakeholder theory by identifying key stakeholders who are critical in driving MSMEs towards sustainability. Practically, it provides new insights into sustainability practices that are relevant and suitable to be exercised by MSMEs. It also highlighted the importance of different stakeholders' roles in encouraging sustainable practices, which further helps develop assistance, governance structures and marketing strategies for MSMEs. This study is also significant in supporting relevant Malaysian governmental policies such as the National Energy Transition Roadmap (NETR) and17 Big Bolds in the MADANI economy by expediting sustainable principles in MSMEs.

There are several limitations in this study. For instance, the sample size of this study was limited, and the participants were only MSMEs from the manufacturing sector. In addition, the methodology employed was qualitative, using semi-structural interviews. Therefore, future studies should increase the sample size and extend to MSMEs from other sectors. Moreover, a quantitative method can also be adopted to validate the model, which could significantly contribute to novelty of research.

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PERCEPTION OF HYBRID THREATS BY STUDENTS OF SELECTED UNIVERSITIES AND BUILDING EFFECTIVE RESISTANCE AGAINST THEIR EFFECTS *

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Abstract. The issue of hybrid threats is an ongoing topic that resonates with the professional and the lay public. More and more in the scope of professional discussions, we come across the definition and specification of circumstances in which the significant signs of hybrid threats are discussed and the threat they pose to society are pointed out. The study reflects the need to know and specify the understanding of "hybrid threats". It presents the results of a survey that was conducted to determine how students of two universities in the Slovak Republic (the Police Force Academy in Bratislava and the Faculty of Management, Economics and Business of the University of Prešov in Prešov) perceive and whether they even know the term "hybrid threats" itself. A significant moment in the orientation of young people to security aspects is knowledge of the definition of this term among young students who are preparing for a profession and who will form the future of the international community. Therefore, only a precise specification of the concept and a definition of the distinct elements for building effective resistance to hybrid threats at the national and international level, specifically in individual countries, will help us maintain a sense of security among individual members of society. The content of the study is constructed to fulfil the primary goal, which is to determine and present the perception of the concept of "hybrid threats" among university students, as well as to present elementary concepts associated with the issue of hybrid threats and a selected element supporting resistance to hybrid threats at the national level – strategic communication. The proposed findings are based on quantitative and qualitative research conducted within the national project "Increasing Slovakia's resilience to hybrid threats by strengthening public administration capacities" and reflect on the current needs of the security environment at both the national and international levels. The research was conducted between May and September 2023 to obtain quantitative and qualitative indicators.

Keywords: security; hybrid threat; strategic communication; security; national security; threat

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1. Introduction

Along with the development of technologies, society and the individuals in it are also developing, as are security threats that bring instability and uncertainty. In recent years, the discussion over security has dealt with the issue of hybridity, including using terms such as *hybrid conflict*, *hybrid war*, *hybrid challenges* or *hybrid threats*. Hybridity is often used in varying contexts and is approached mainly from a military point of view (Filipec, 2022). The contexts associated with the destabilization of internal security are related to new forms and methods of threats, which condition the need for more effective activities to prevent and avoid them. Knowledge of the concept of "hybrid threats" is critical in solving the issue of endangering an environment with the help of innovative forms of action. Hybrid threats existed in the world's security environment in the distant past; they still exist today and will continue to exist. The essential element is that their form changes and develops; it is vital to perceive new phenomena in this context. The complexity of disinformation and other hybrid threats requires an examination of their nature and main pillars, which are the actors, domain and individual parts of the use of particular hybrid tools (Kulik, 2022).

The authors of the study present essential facts that are proof of the understanding of hybrid threats among the community of young people – university students who are interested in building a safe domestic and international environment. The presented research is one of the activities conducted in the context of the national project "Increasing Slovakia's resilience to hybrid threats by strengthening public administration capacities", the results of which were also presented in other studies prepared by the authors (Korauš et al., 2023). Within the scope of investigating hybrid threats, it is important to stress that the term *hybrid threats* is broad. It brings a whole scale of significant individual connections, ultimately creating national and international security threats. Building the resilience of countries to hybrid threats already needs to be done at the national level through various types of training and courses, as well as through direct teaching at universities focused on protecting society's security. The European Union faces many crises and risks that endanger its security and existence. Some endanger individual citizens' lives; however, they all cause many people to feel anxious and uncertain about the future (Kinnvall, Manners & Mitzen, 2020). The main aim of the current study is to formulate and present the research results to make the building of society's resilience to hybrid threats more efficient at both the national and international levels. Such research conducted about hybrid threats is one way to help effectively build the resilience of security environments against hybrid threats. The relevant connecting of theoretical knowledge, applied experience, and quantitative and qualitative indicators brings the necessary value in effectively building the country's resilience to hybrid threats (Korauš et al., 2024).

The study is processed through the use of scholarly methods, i.e., analysis, synthesis, deduction, generalization, quantitative and qualitative processing of relevant knowledge and through the use of knowledge stemming from application in practice, which has helped the authors to clearly and with certainty define the critical facts associated with the perception of hybrid threats among students at universities focused on security protection at the national and international levels. Its application in practice is a summary of essential facts that supplement the theory and thus create a complex of valuable and justified facts (Laca, 2022). The authors also devoted themselves to research to define the specific element of building resistance to hybrid threats at the national level because hybrid threats reflect a significant change in the nature of international security. This change tends to increase feelings of uncertainty and, historically, social unrest, all the more so because hybrid threats are complicated and ambiguous, as confirmed by research already conducted and presented in several other studies (Hoffman, 2010). The partial research also undertaken to process the presented study is a part of research whose task is to clearly define specific but broader connotations associated with hybrid threats and their impact on society.

The essential circumstances that condition the understanding and perception of hybrid threats are built on the awareness of the basic facts and intrinsic elements that cause the emergence, development and impact of hybrid

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threats on state security. Therefore, the perception of issues related to hybrid threats is conditioned in countries by understanding and realizing the need to maintain security and prevent any threats that may impact security. When conducting the guided interviews with students who participated in the research, it became evident that the basic concepts linked with hybrid threats were, at certain moments, unclear to them. For this reason, the authors decided to focus the research on the specification of selected elementary terms.

The qualitative research was focused on a critical review of professional literature, which helped the authors define the essence of the concept of hybrid threats. A grounded definition of the term was necessary because the interpretation and understanding by the respondents/students were often incorrect or insufficient. The reason is that the primary characteristic of the term *hybrid threat* indicates that it cannot be perceived only one-dimensionally. It is strategically vital for state security because hybrid threats represent a whole set of activities. In analyzing and assessing possible risks and threats arising in society, the main goal is to determine the probability of the threat, assess its potential impact and predict the duration of that impact on society to evaluate its dangerousness and a way for its effective elimination. As we discovered during guided interviews, students often confuse and perceive specific terms differently.

That can be understood under the term *hybrid threat*, which is mainly a method or way a confrontation, conflict, or fight is conducted. This method of conducting a conflict between two subjects represents a broad, complex, adaptive and integrated combination of the specific means subsequently mentioned. Based on this, hybrid threats can be defined as a set of coercive and subversive activities, conventional and non-conventional, military and non-military (Svoboda & Svítil, 2019), which state and non-state entities can use in a coordinated, joint manner to achieve specific goals. This is all done without a formal declaration of war and below the threshold of the usual reaction – it is difficult to intervene against them because they avoid or even employ the existing, valid legislative framework. For this reason, too, they are challenging, even impossible to strike in some cases, and the actors who carry them out are not always easily identifiable; therefore, it is difficult to take action against them and to carry out any reaction to their activities (Wigell, Mikkola & Juntunen, 2021; Draskovic et al., 2021).

Hybrid threats are mainly carried out through activities characterized by the centrally controlled intelligence and information activities of non-state actors, including paramilitary groups, or the deployment of the armed forces of a state actor without designation. These specified activities may begin before any military operations are openly declared, which is why they are dangerous. The aim of hybrid threats is also to polarise society and bring uncertainty into society, thereby undermining the legitimacy, trustworthiness and effectiveness of state institutions and the democratic constitutional order. Hybrid threats harm the security interests of states exposed to them. The significant number of political initiatives to combat hybrid threats themselves emphasize the need to develop a whole-of-society approach to this issue and the need for subsequent, effective development of a systematic and purposeful approach (Pamment, 2020).

Hybrid threats in and of themselves are nothing new in world history. Only the extent, method and scale of hybrid threat tools combined and coherently utilized by hybrid threat actors to achieve a strategic goal can be considered new (Cullen & Wegge, 2021). The individual elements of a mixed campaign may not necessarily even be illegal or represent a threat. The danger lies in their sophisticated combination, which simultaneously looks to obscure the true purpose of their individual goals. These facts indicate an ongoing need to research and develop the perception of hybrid threats in society.

Another phrase we examined during the research and where we found specific connections with the perception of the nature of hybrid threats among students is the *hybrid strategy*. Therefore, a hybrid approach is vital in conducting a conflict between two subjects, and its meaning determines how such a conflict occurs. Hybrid strategies, i.e. the circumstances of what and how hybrid threat actors want to achieve, are based on high adaptability, and the attackers

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adapt the choice of means used to the weak points of a particular target state (Beckman & Rosenfield, 2008). The specific state is primarily responsible for identifying these weak points – the domains a hybrid threat actor could use. Based on the above, students who may become public administration employees or participate in legislation creation must perceive these facts.

Hybrid conflicts increase ambiguity, complicate decision-making and slow the coordination of effective activities within the defence and protection of the state. The characterization and definition of hybrid threats are not universal since their status, which exists at national and international levels, is ever-changing. Therefore, it is essential to always pay heed to all current circumstances that threaten state security and thus also to hybrid threats and their connection with the state's resilience to them (Apostol, Cristache & Năstase, 2022).

2. Theoretical background

The attention focused on the issue of hybrid threats depends on several circumstances that condition the elements related to the concept and the dangers identified and emerging from hybrid threats. In connection with this, we will subsequently point out other primary starting concepts related to the examined issue. The international security environment, as has been mentioned, is changing and developing, and the development and progressivity of hybrid threats are directly related to this. While presenting the research results in this study, we have already mentioned the phrase *security environment* several times. Still, we needed to define the term *security* itself, and its perception needed to be more obvious even among the student sample.

Even if we do not realize it, security is a daily part of our lives. A person regularly makes decisions based on subjective and objective factors so that he feels secure and that nothing threatens his immediate existence. Although security is not among the most basic human needs, the feeling of security and certainty does help define a person's degree of freedom and the extent to which he is limited in his actions by various external factors. We distinguish between objective and subjective security based on these external factors. In the case of objective security, we are speaking about the absence of any risks that would threaten the values of individuals or states; subjective refers only to a specific actor who has no feeling of fear (Report on the Security of the Slovak Republic for the year 2015).

The concept of security is not clearly defined; however, it can be stated that security is a highly complex and multidimensional phenomenon with many areas and aspects. One of them is international and national security. Security has never been clearly characterized, so many definitions of the term and its content exist. In general, security is a state when the given actor (be it an individual, the state or another actor) does not feel danger or immediate threat. It must be stated that different countries understand the concept of security differently (Nordhaus, Oneal & Russett, 2012), which is why the perception of hybrid threats is also different.

The primary term that indicates the complexity and multidimensionality of the perception of hybrid threats is *internal security*, which can be defined as the sum of internal security conditions, legislative norms and measures by which the state ensures democracy, economic prosperity and the safety of citizens, as well as the enforcement of legal and moral standards. Internal security is a condition in which threats to the state and its interests from within are reduced to a minimum, and the state has created a sufficient legal environment, institutions, resources, forces, means and mechanisms for handling potential crises. This also includes the society's level of democracy, economic prosperity, protection of citizens and the application of legal norms, the provision of which is one of the essential functions of the state (Analysis of the Development Tendencies of the Internal Security of the Slovak Republic and the Resulting Risks and Threats to the Slovak Republic 2010).

In characterizing the basic terms, we stress terms such as *danger*, *conventional* and *unconventional conflict*, *and military* and *non-military conflict* because while carrying out this research, we came across vague definitions that

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affect the perception of the essence of hybrid threats. These relevant terms were a crucial element in knowing the theoretical definitions of the issue. Still, they were also essential for the research participants because understanding the basic terms supports the perception of the danger of such hybrid threats.

An important concept associated with hybrid threats is danger. In this context, we note that danger is a potentially harmful physical event, phenomenon or human activity that may cause loss of life, property damage, social and economic disruption or environmental harm. We can thus refer to anything that has the potential to cause harm or damage as a danger. The test for determining whether a thing, object or substance represents a security risk consists of verifying to what extent this subject meets the four stated qualifications, namely tangibility (collision potential), mobility (closure potential), interaction and explicitness (Dziundziuk et al., 2022).

World societies have identified conventional military conflicts since ancient times. Such conflicts destabilized individual countries and the world as a whole. Conventional military conflict at present has significantly higher political, financial, human and moral costs, which is why more and more state and non-state actors rely on non-military means to avoid formally declaring war. With the parallel use of coercive and subversive activities and conventional and unconventional methods, such as hostile propaganda, support of extremism, the use of national or religious communities dissatisfied with their position in society, support of criminal activities and attacks on critical infrastructure, the targeted society can be destabilized and weakened, so that it is more easily influenced or, in extreme cases, less resistant to the use of conventional military force (Rinaldi et al., 2022).

In the context of the above, it is necessary to characterize a conventional armed conflict, which represents a type of armed conflict in which the individual parties use conventional weapons, i.e. all weapons except those of mass destruction, nuclear, biological and chemical weapons, while fighting openly on land, in the air or at sea. The forces of both warring parties are clearly defined and organized. The basic aim of conventional warfare is to weaken or destroy the enemy's armed forces, occupy territory and disrupt its ability to continue to wage conventional warfare. Combat operations conducted in line with the international law of war, defined by the Hague Convention, the Geneva Conventions and other documents, where the rights of prisoners of war and civilians are respected, are usually considered conventional conflicts (Leader Maynard, 2019). Conventional warfare is carried out using conventional weapons and tactics on the battlefield between two or more states in open confrontation. The forces on each side are well-defined and battle with weapons primarily aimed at the opposing army. In contrast, unconventional conflict includes several forms and tools whose aim is to weaken a specific state or society through hostile propaganda, support of extremism, use of national or religious communities dissatisfied with their position in the society, support for criminal activities, attacks on critical infrastructure or the use of cyber-attacks in a conflict between two entities (Tvaronavičienė et al., 2020; Ștahovschi, 2023).

With traditional, conventional, formal and accepted methods and tools, but also with the use of modern technologies, a whole line of states, state-sponsored actors and non-state actors attempt to achieve their political or economic goals in an open or hidden manner in a coordinated manner across the entire range of instruments of power. The relevance of threats capable of causing significant financial losses due to disruption, damage to the functioning of essential functions of the state or services that are necessary for the normal functioning of the state and society is increasing (Mumford & Carlucci, 2022), as is the readiness and ability of various actors to promote their interests at the expense of others. This development is driven by the changing nature of power and influence, when mutual dependence, technology and their interconnections give states new opportunities to influence their competitors, all without regard to international rules or national laws. Based on the above, internal security is disturbed. Apparent disproportions arise, which lead to gaps in internal security and, thus, more evident damage—ensuring internal security conditions the need for knowledge and perception of hybrid threats among university students who are to be faced with carrying out and providing internal security on a theoretical as well as a practical level because the understanding and perception of hybrid threats by members of society, as well as by various state

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entities, the media and the like, differ significantly. Hybrid threats have a cross-sectional, multi-institutional nature and fall under the competence of several state authorities. Thus, they must be dealt with based on specific and targeted knowledge. Resilience depends significantly on the perceptions of the young generation (Spalova & Mikula, 2023; Rudenko et al., 2023). There is still a lack of research in this area, and this research contributed to filling this gap.

3. Research Methodology

The goal of the research carried out herein was to point out the definition of elementary terms associated with the issue of hybrid threats, as well as to specify their essence, examine the level of knowledge of the term itself and the contexts associated with them among full-time and part-time students of two Slovak universities at all levels of study, and to define one of the effective elements for building resistance to hybrid threats – strategic communication. We set these goals based on knowledge acquired and identified during the research.

The relative independence of the perception of hybrid threats within the system of security threats at the global level is defined by the purpose and goals, which are fulfilled and achieved mainly through specific methods and means. It is clear from practice that the accurate picture of hybrid threats is, in most cases, developed retrospectively from detecting the consequences of the events that caused them. However, the effective application of unambiguous elements conditioning the perception of hybrid threats when fulfilling and seeing specific tasks associated with building resilience to hybrid threats forms a particular exception because, in their implementation framework, specific activities and circumstances may be reflected and identified even in the present. The mentioned situation arises when hybrid threats are neutralized, and resistance to them is prepared.

The focus of the study of the participants of the conducted research is constructed mainly so that during the study, they devoted themselves to the current security conditions related to the relevant links to the justified contexts of threats and dangers that occur in the security environment. The subjects that our selected students completed during their university studies are adapted to the level of criminal law, security and the applied needs of national and international security. It is essential that studying the perception of our chosen issue is addressed at the national and international levels because, as we have already mentioned, hybrid threats and their impact on security have a global character.

The presented research stem was conducted between May and September 2023 through questionnaires and guided interview results. The questions for the questionnaires and guided interviews were formulated and adapted to direct needs, following our previous research and appearing to be the most exposed. A classified research methodology was thus constructed and aimed at deriving basic hypotheses. The findings in verifying the hypotheses will subsequently be used in further research to present the declared issue of hybrid threats.

The hypotheses were formulated to reflect the theoretical and practical experience that the authors have and so that their results benefit both theory and practice. With the presented hypotheses, we achieved solutions that helped us bridge the identified problems between theory and observation. The hypotheses were clearly and succinctly formulated such that they were verifiable, and their result brought clear conclusions in association with the cyclical nature from the theory to the definition of the hypothesis, then to the verification of the hypothesis, and finally to the enrichment of the theory, but also practice in the studied area.

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- H1: Knowledge of elementary terms connected with the issue of hybrid threats is critical in building Slovakia's resilience to hybrid threats.
- H2: There is a significant relationship between the gender of the respondent and the perception of the concept of hybrid threats at the selected significance level $\alpha = 5\%$.
- H3: There is a significant relationship between the level of study of the respondent and the perception of the concept of hybrid threats at the chosen level of significance $\alpha = 5\%$.
- H4: There is a significant relationship between the respondent's form of study and the perception of the concept of hybrid threats at the chosen significance level $\alpha = 5\%$.
- H5: One of the effective elements of building Slovakia's resilience to hybrid threats is strategic communication.

The cyclical process of establishing and verifying hypotheses and subsequent use of knowledge in practice conditioned the study's specific summarising and theoretical construct. The knowledge from scholarly research is a clear and distinct indicator of the focus and definition of particular curricula at selected universities so that they respond promptly and purposefully to national, international or global security threats. Specifically, the wording of curricula and the focus on individual subjects' final assessments are necessary to declare the topicality and structural nature of threats that affect internal and external security.

We think that the improvement of specific curricula also conditions the effectiveness of the education provided to university students because priority plausibility and the justification of true statements means that these statements are controllable by using various arguments, reasons and evidence (Čentéš & Beleš, 2023). Using arguments and reasons that confirm and allow checking the correctness of decisions and conclusions is a binding rule, for example, in a criminal trial. Verifiability is a characteristic feature of knowledge used in criminal proceedings (Lisoň & Vaško, 2020). Confirming or justifying the correctness of any statements, decisions and conclusions using arguments and facts is one approach to building effective resistance to hybrid threats.

3. Result and discussion

For the needs of the presented study, we differentiated the research results according to the constructed content. The empirical part of the research was conducted as part of a pilot survey, preliminary research, own research and drawing conclusions. The pilot survey was conducted in the form of a questionnaire in May 2023; then, our research was carried out from June to August 2023, and the conclusions of the conducted research were formulated and constructed in September 2023.

Hypothesis H1 was verified as part of the theoretical definition of the issue and the processing of the results of guided interviews with university students. These were also presented in a previous text when we confirmed the first hypothesis because knowledge of the elementary concepts associated with the issue of hybrid threats is crucial in building Slovakia's resilience to hybrid threats. Only based on knowledge, clear specification and identification is it possible to understand and perceive the issue of hybrid threats with a clear primary goal, namely building resistance to their effects. Knowing elementary concepts is essential because this is the only way members of society can acquire a factual basis for further action and perception of the danger of hybrid threats. The subject of knowledge of hybrid threats is identifying all fundamental concepts and contexts.

We subsequently proceeded to present the results of verifying hypotheses H2, H3, and H4.

According to Table 1, the research sample comprised 252 men and 400 women. In analyzing the defined hypotheses, we set *StupenS* (Degree of study) and *FormaS* (Form of study) as the relevant input variables. The research sample

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consisted of students from two selected universities in the Slovak Republic. A more detailed analysis of the research sample from the viewpoint of three relevant input variables is presented in Table 1.

	Summary Table for all Multiple Response Items Totals/percentages based on the number of respondents Multiple identical responses were ignored				
	N=652 Gender	StupenS	FormaS full-time form of study	FormaS part-time form of study	Row Totals
Count	male	bachelor's study	58	40	98
Column %			43.94%	33.33%	
Row %			59.18%	40.82%	
Table %			23.02%	15.87%	38.89%
Count		master's study	72	60	132
Column %			54.55%	50.00%	
Row %			54.55%	45.45%	
Table %			28.57%	23.81%	52.38%
Count		doctoral study	2	20	22
Column %			1.52%	16.67%	
Row %			9.09%	90.91%	
Table %			0.79%	7.94%	8.73%
Count		Total	132	120	252
Table %			52.38%	47.62%	100.00%
Count	female	bachelor's study	92	14	106
Column %			41.82%	7.78%	
Row %			86.79%	13.21%	
Table %			23.00%	3.50%	26.50%
Count		master's study	126	144	270
Column %			57.27%	80.00%	
Row %			46.67%	53.33%	
Table %			31.50%	36.00%	67.50%
Count		doctoral study	2	22	24
Column %			0.91%	12.22%	
Row %			8.33%	91.67%	
Table %			0.50%	5.50%	6.00%
Count		Total	220	180	400
Table %			55.00%	45.00%	100.00%

Table 1. Description of the research sample

Source: Own research

In the context of research on hybrid threats, we asked ourselves a basic research question: How do the respondents, university students, perceive the term *hybrid threats*? From this primary research question, we also derived a secondary question: *Is there a difference in the perception of the concept of hybrid threats in terms of gender, degree or form of study?*

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Based on these research questions, we established three basic research hypotheses:
H2: A significant relationship exists between the respondents' gender and the perception of the concept of hybrid threats at the chosen level of significance $\alpha = 5\%$.
H3: A significant relationship exists between the respondents' degree of study and the perception of the concept of hybrid threats at the chosen significance level $\alpha = 5\%$.
H4: A significant relationship exists between the respondents' form of study and the perception of the concept of hybrid threats at the chosen significance level $\alpha = 5\%$.

As the basic analysis method for these hypotheses, we selected correspondence analysis, a multivariate statistical method. The first find of interest in the analysis of the first research hypothesis is that up to 21.779% of respondents did not even register the concept of hybrid threats. From these, 11.111% of the men and 28.500% of the women. 13.191% perceive hybrid threats as a coordinated political virtual activity aiming to destabilize another country's political system; 20.635% of the men and 8.500% of the women favoured this option. Another option within the research tool was the perception of hybrid threats as a coordinated activity to destabilize democracy in another country. This answer was selected by 9.509% of respondents (8.730% of the men and 10.000% of the women). 38.957% of respondents selected various activities that employ disinformation and fake news to cause panic in another country, with 42.857% of the men and 36.500% of the women choosing this option. Hybrid threats such as coordinated military activity whose aim is to disrupt the political system of another country, a coordinated disinformation campaign aimed at undermining trust in the political elites of another country, and coordinated economic activity aimed at destabilizing the economic system of another country were selected by approximately the same percentage of respondents, at the level of about 5%. If we analyze the first research hypothesis, then based on the achieved level of significance $p = 0.000$ ($\chi2 = 43.507$, $df = 6$), it is possible to accept the conclusion that the gender of the respondent is related to the perception of hybrid threats at the chosen level of significance of 5%. We provide more detailed results in Figure 1. If we accept the result of the analysis of the first hypothesis as valid, then using the correspondence map, the preference from the point of view of gender can be monitored, as well as the perceived concept of hybrid threats. It is evident from Figure 1 that men understand the concept of hybrid threats mainly as a coordinated political virtual activity aimed at destabilizing the political system in another country and a coordinated disinformation campaign focused on undermining trust in the political elites of another country. On the other hand, women perceive the concept of hybrid threats above all as a coordinated activity whose goal is to destabilize democracy in another country, coordinated military activities whose aim is to disrupt the political system of another country, coordinated economic activities whose goal is to destabilize the economic system of another country, and up to 28.500% of women do not register this term as an issue. The respondents' perceptions of hybrid threats as diverse activities using disinformation and fake news to cause panic in another country have an interesting position, where both men (42.857%) and women (36.500%) preferred this option.

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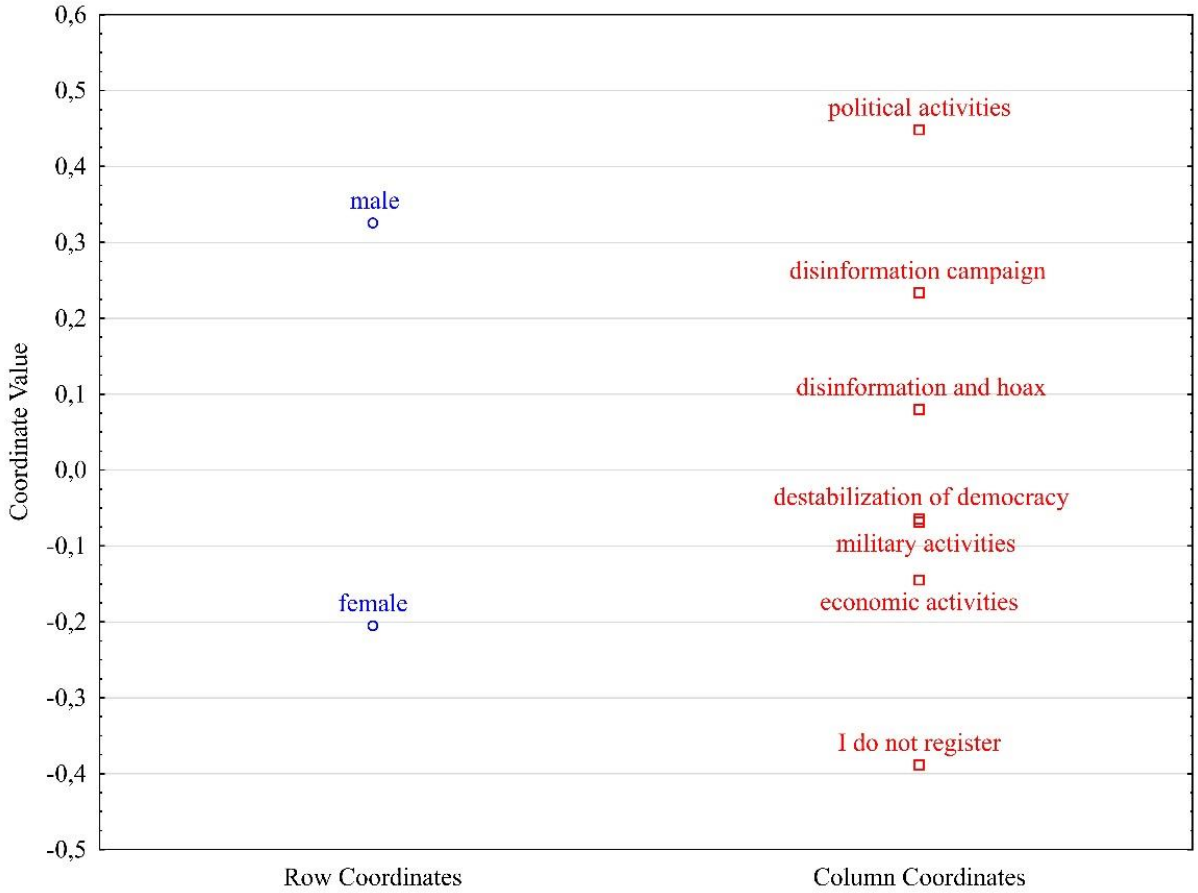

Picture 1. Correspondence map of the analysis of the first research hypothesis

Source: Own processing according to the available scientific literature

The second research hypothesis relates to the relationship between the respondents' degree of study and their perception of the concept of hybrid threats. The largest representation of the perception of hybrid threats among the respondents was the perception of hybrid threats as diverse activities using disinformation and fake news as a means to cause panic in another country. As mentioned above, this option was selected by 38.957% of all respondents. From the total number of 204 students at the bachelor's degree level (hereinafter referred to as Bc), 37.255% chose this option; from the 402 master's degree students (hereinafter referred to as Mgr), 37.313% chose this option, and from the 46 doctoral students (hereinafter referred to as PhD) 60.859% chose this option. The concept of hybrid threats is not registered by 21.779% of all students, and 26.471% of Bc students, 21.393% of Mgr students but only 4.348% of PhD students chose this option. A total of 13.190% of respondents perceive hybrid threats as a coordinated political virtual activity whose aim is to destabilize the political system in another country, with 14.706% of Bc students, 12.935% of Mgr students and 8.696% of PhD students selecting this option. Another aspect from the viewpoint of frequency of occurrence was assigning the concept of hybrid threats to the possibility that it is a coordinated activity whose aim is to destabilize democracy in another country. This option was chosen by 6.863% of Bc students, 10.448% of Mgr students and 13.043% of PhD students. From these findings, we can state that as the level of study increases, respondents attach greater importance to this option. Hybrid threats are perceived by 5.882% of Bc students, 5.970% of Mgr students and 4.348% of PhD students as a coordinated economic activity aimed at destabilizing the economic system of another country. In this context, we see a relatively balanced assessment, regardless of the respondents' study level. Of relative interest is the perception of hybrid threats as a

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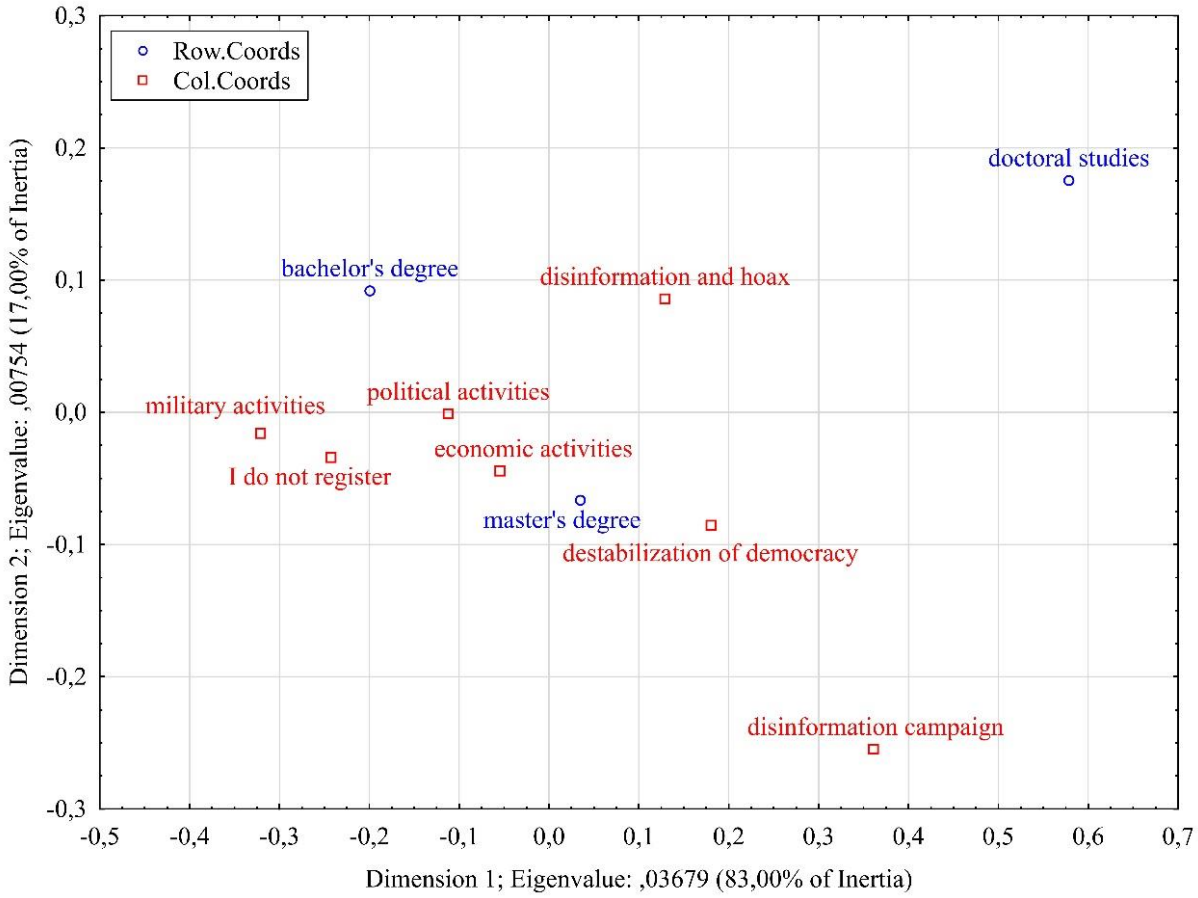
coordinated disinformation campaign whose goal is to undermine trust in the political elites of another country, where only 1.961% of Bc students, 6.965% of Mgr and 8.696% of PhD students chose this option. If we analyze the second research hypothesis on the basis of the achieved significance level of p = 0.0041 ($\chi 2$ = 28.9002, df = 12), it is possible to accept the conclusion that the degree of study of the respondent is related to the perception of hybrid threats at the chosen significance level of 5%. We present more detailed results in Picture 2.



Picture 2. Correspondence map of the analysis of the first research hypothesis

Source: Own research

From Picture 2, it is evident that undergraduate students perceive hybrid threats primarily as diverse activities using disinformation and fake news to cause panic in another country. Master's students give priority to the understanding of hybrid threats as coordinated economic activity aimed at destabilizing the economic system of another country (5.790%), coordinated activity aimed at destabilizing democracy in another country (10.448%), coordinated political virtual activity aimed at destabilizing the political system in another country (12.936%), coordinated military activity aimed at disrupting the political system of another country (4.975%), and 21.393% of master's students do not register hybrid threats at all.

The third research hypothesis relates to the relationship between the respondents' form of study and their perception of the concept of hybrid threats. This input variable, the form of study, was selected to compare students aged 19 to 24 (22.30 years) who do not have work experience with part-time students, who are older on average (31.15

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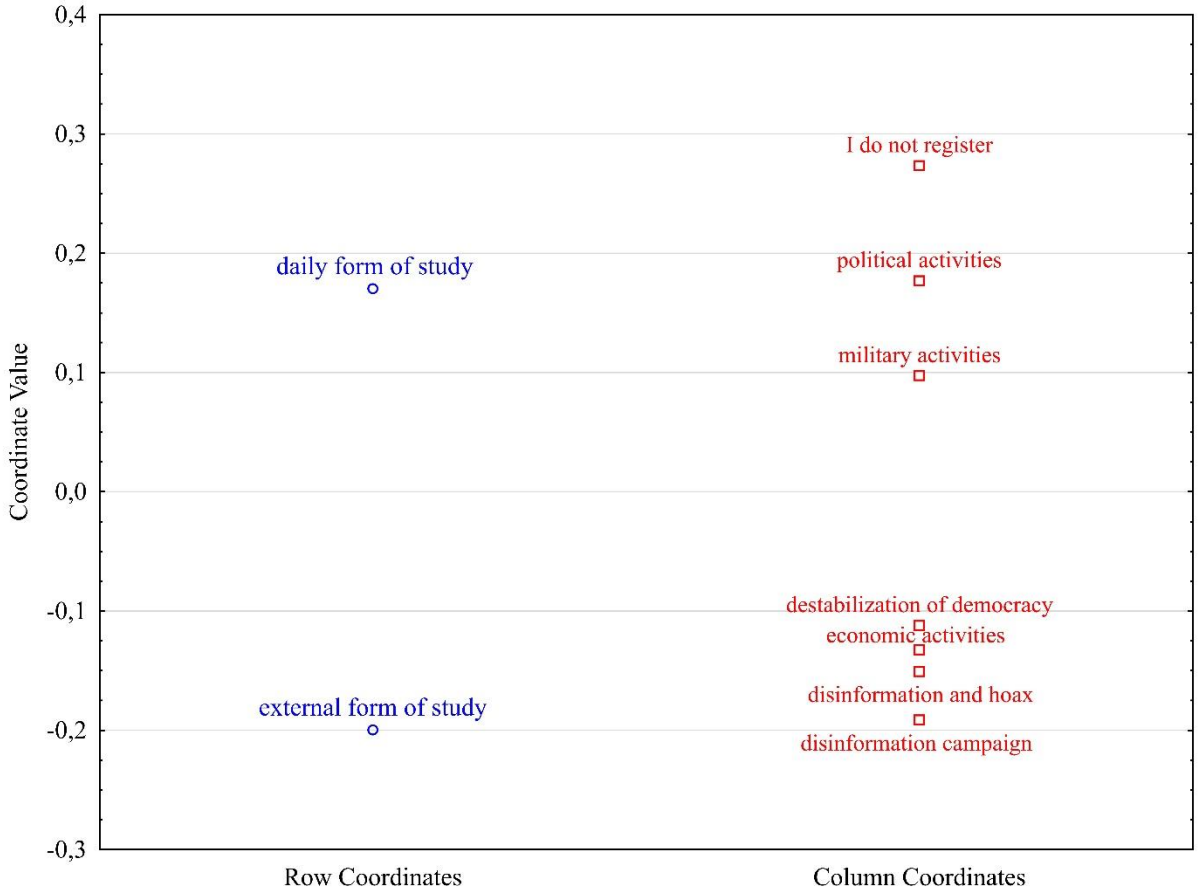
years) than the first group; at the same time we assume that within this group, the respondents are already working. 33.523% of full-time students and 45.333% of part-time students chose the most frequent option for defining a hybrid threat, namely different activities using disinformation and fake news to cause panic in another country. Another interesting difference is observed in the "I do not register" option, where 27.272% of full-time students and 15.333% of part-time students chose this option, and in the option "coordinated political virtual activity, the aim of which is to destabilize the political system in another country", which was selected by 15.341% of full-time students and 10.667% of part-time students. In the case of the other options, the differences in the number of answers are minimal, and both groups can be seen as homogeneous regarding these items. If we analyze the third research hypothesis, based on the achieved level of significance $p = 0.0011$ ($\chi 2 = 22.176$, $df = 6$), it is possible to accept the conclusion that the form of study of the respondent is related to the perception of hybrid threats at the chosen significance level of 5%. We present more detailed results in Picture 3.



Picture 3. Correspondence map of the analysis of the third research hypothesis.

Source: Own research

From Picture 3, it is evident that full-time students understand the concept of hybrid threats as a coordinated military activity whose aim is to disrupt the political system of another country, a coordinated political virtual activity aimed at destabilizing the political system in another country, or they do not register this term at all. On the other hand, part-time students perceive hybrid threats as a coordinated activity whose aim is to destabilize democracy in another country (10.667%), a coordinated economic activity whose objective is to destabilize the economic system of another country (6.667%), various activities using disinformation and fake news aimed at causing panic in another

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country (45.333%) and a coordinated disinformation campaign aimed at undermining trust in another country's political elites (6.667%).

All three research hypotheses were confirmed based on the use of correspondence analysis. The conclusion can thus be accepted that the perception of hybrid threats is significantly conditioned by the respondent's gender, degree and form of study. In the presented research, opinions on the understanding of the concept of hybrid threats among university students were analyzed, and the results entitle us to state that a comprehensive perception of this severe problem needs to be improved in all investigated groups.

Verifying the fifth hypothesis H5 was explicitly linked to identifying and characterizing an effective element that improves the building of Slovakia's resilience to hybrid threats. We identified this element based on knowledge from practice and detected contexts that condition the effective elimination of hybrid threats. Strategic communication, which primarily consists of tactical functions, was identified in the research as a prominent effective element. Strategic communication is one of the key instruments for building a secure country and a more resilient society ready to face modern challenges and crises through the systematic and coordinated cooperation of various authorities (Moss & Warnaby, 2010).

Even the professional literature needs to pay more attention to the discussion about the role of the communication function in the strategic decision-making process. Still, at the research level, we consider addressing it as justified. In the scope of conducting guided interviews with students, we identified that the nature and significance of strategic communication, in general, are less known to them, and its connection to eliminating the impact of hybrid threats on society is yet to be discovered. Therefore, for these reasons, we decided to interpret our findings to present the results of our research.

We believe that, even within the framework of a society-wide approach, it is crucial for authorized subjects in the field of strategic communication to cooperate with the academic sector so that strategic communication is as effective as possible. Strategic communication is marked by obvious elements that condition cooperation within the framework of international communication in solving transnational criminal activities; therefore, its use is extensive and almost inevitable. Illegal activities, including organized crime, stretching across state borders and affecting national security, must be solved based on a systematic approach and the application of elements of strategic communication (Vrtíková, 2023).

The advantages of strategic communication that we identified consist in the improved ability of a specific country to defend itself against disinformation campaigns and to more intensively cooperate and communicate with citizens as essential subjects of communication in building a safe society. Implementing the principles of strategic communication by state institutions is one of the critical prerequisites for an effective state response to hybrid activity. The need to elaborate a conceptual framework for strategic communication is based on fundamental documents of the Slovak Republic, which include strategic communication as an integral part of the defence and security of the Slovak Republic (Security Strategy of the Slovak Republic, 2021).

The aim of strategic communication is clearly, based on relevant knowledge, to set up and purposefully conduct a constructive dialogue between the state and citizens so that security threats to society can be prevented and, at the same time, eliminated to as great an extent as possible in the event of their intrusion, because the inconsistency, even chaos, that occurs in the presentation of important information in the country is unacceptable and requires an appropriate solution (Andersson, 2018).

In connection with the above, the future directions of developing strategic communication from the viewpoint of interdisciplinary science are also crucial because strategic communication is characterized by complexity and

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difficulty (Nothhaft et al., 2020). It is specifically insufficient and unsystematic communication of the state without a strategic framework that contributes to the establishment of entities in the information space that, as the Slovak Information Service points out, systematically spread harmful content, including disinformation and misleading, questionable and polarising narratives (Report on the Activities of the Slovak Information Service 2021). The strategic communication of states that devote adequate attention to this area, as also results from research findings, is characterized by:

- the existence of a central coordinating body,
- the adoption of a strategic document that arranges processes, principles and obligations,
- establishing crisis communication processes (Security Strategy of the Slovak Republic, 2021).

From the above, the fifth hypothesis has been confirmed because strategic communication is an effective element that, when consistently applied, can eliminate the hybrid effects and their danger to society.

4. Conclusions

The current stance of the academic and scientific community in acquiring new information in the scope of scientific research is a challenge in the processing and effectively making scientific information available. Social and security changes and their significant impact on the security environment are precisely the reason for the intensive perception of the exposed issue of hybrid threats by students from selected universities and building effective resistance to their effects. Modern research needs fast and efficient access to high-quality information to enrich theory and support empiricism. Knowledge and experience supporting creative scholarly activity represent significant strategic capital for developing a specific university field and social knowledge.

The presented scholarly study responds to the immediate need to specify the perception of hybrid threats by students at selected universities at all levels of accredited study, but also to an element through which we can effectively respond to the impact of hybrid threats on society. This need is conditioned by the current development and prediction of hybrid threats at the national and international levels. Only in the context of a purposeful approach to the given subject can we ensure, on the one hand, the effectiveness of education and, on the other hand, the intentional realization of the acquired facts in practice.

In connection with the perception of the issue of hybrid threats and based on the results of the research, we believe that it is expedient to improve and support, above all, the cognitive personality assumptions of students and, based on this, to clearly define specific contexts that support the perception of current security threats. We need to specify that thinking about the obtained information and evaluating and constructing its meaning is essential (Jakušová, 2016).

Based on the above, we also offer suggestions for the future, which follow from a constructive assessment of the research results; these are a detailed specification of the concept of hybrid threats among university students focused on the development and maintenance of security and a specification of evident shortcomings that occur in society in the perception of hybrid threats. Further, developing the essence of strategic communication is an effective element in building Slovakia's resilience to hybrid actions and the specification of information based on scholarly research, which is subsequently distributed to the general public. The above is because members of society today receive a large amount of information but cannot evaluate it, or they cannot analyze it because it needs a clear and verified origin.

We thus conclude that the primary goals specified in the introduction of the presented study – the detection and presentation of the perception of "hybrid threats" among university students as well as the presentation of elementary concepts associated with the issue of hybrid threats and a selected element supporting resistance to

hybrid threats at the national level, strategic communication – has been fulfilled. The content of the study responds to the specific definition of the investigated issue and presents the results of verifying the defined hypotheses. We can conclude that the research results herein acquired and presented are an added value in the specification of individual specializations of students subsequently working in building an effective security environment and enriching the scholarly level in investigating the suggestion of hybrid threats to society.

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PROPAGANDA AND DISINFORMATION IN THE SLOVAK AND CZECH REPUBLIC*

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Abstract. Propaganda and credibility of information are two concepts that are broadly intertwined, as both are closely linked to communication and dissemination of information. On the one hand is propaganda, which often uses manipulative and one-sided information to influence public opinion or convince people of a particular perspective. On the other side is the credibility of information, which refers to the truthfulness, accuracy and objectivity of the data transmitted. This article describes and evaluates the main disinformation actions in recent years in Slovak and the Czech Republic. Information manipulation campaigns are multifaceted, and many factors are at play simultaneously. As topical causes with a wide range of consequences, these campaigns are also political and highly politicized. The analytical part of the paper is based on the research that was conducted, which involved 964 respondents from the Slovak and Czech Republic, mainly university students. The research was conducted based on the authors' research instrument. Within the research itself, we surveyed the answers and opinions of respondents as a way of assessing the relevance of information separately for respondents from the Slovak Republic and individually from the Czech Republic according to the age of the respondent in terms of the respondent's assessment of the truthfulness of the information or the importance of the credibility of the information.

Keywords: propaganda; disinformation; Slovak Republic; Czech Republic; credibility of information; manipulative information

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Additional disciplines: law; political sciences; sociology; psychology.

1. Introduction and theoretical background

A long history of states and non-state actors taking disinformation actions against domestic groups exists. The Oxford Internet Institute has found that authoritarian regimes target their populations with social media campaigns. In contrast, in democratic states, information campaigns are used by non-state, e.g., partisan groups that target domestic populations (Bradshaw & Howard, 2017). A well-known example is China's "50 Cent Army", which has existed since at least 2010 and was recently revealed to post 448 million comments on social media annually (King, Pan & Roberts, 2017). This study found that, unlike previous reports, most posts do not aggressively push pro-government messages. Instead, they take over the conversation with positive posts about

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China. Another case worth mentioning is Turkey, where, following the Gezi Park protests in 2013, the ruling AKP party recruited 6,000 people to carry out a disinformation campaign against its population. "The 'AK trolls' are particularly active on Twitter, where they spread pro-government messages, drown out critical voices -often with the help of bots and abuse dissidents (Freedom on the net, 2017). The IRA also targets the domestic population, favouring the government line. In these authoritarian regimes, the government also tightly controls the mainstream media.

Politically motivated disinformation can be carried out by states and non-state groups or individuals. It should be noted that attribution in online disinformation campaigns is complicated, so it is only partially possible to define the source, the funding of the disinformation campaign, or whether it had a domestic or international effect. Disinformation affects almost all EU Member States and many countries around the world.

Content analyses have identified different categories of online fake news. It shows that the reconfiguration of accurate and false claims and their context prevailed over wholly fabricated claims about the COVID-19 pandemic (Brennen et al., 2020; Navickas et al., 2022).

Recognize similar trends in news about polarizing events, such as the 2016 EU migration crisis, and report other standard manipulative techniques besides fabrication, such as blaming, labelling, and appealing to fear in their study of Czech disinformation websites (Gregor & Mlejnková, 2021).

Alternative and mainstream media are also the subject of intense academic discourse. Data from 10 countries examined describe the dynamics in the relationship between misinformation and distrust of the news media (Hameleers et al., 2022). Several authors investigate how the alternative media stack up against the mainstream media, highlighting criticisms of content and objectivity in both directions. Horne points to the substantial homogeneity of a tightly formed community across social media and the sharing of content only with similar news sources. Meanwhile, alternative and mainstream news media often report on the same events but with competing and contradictory narratives (Mayerhöffer, 2021).

Regarding propaganda and disinformation campaigns, point to empirical evidence of a Russian government media apparatus with its political and military objectives integrated into the alternative media ecosystem (Starbird et al., 2017). The academic discussion also addresses ideological polarization and its relation to specific characteristics of online communication, such as the influence of filter bubbles on social media as crucial tools for amplifying fabricated news (Spohr, 2017; Soares, Gruzd & Mai, 2023).

A growing body of research has been devoted to so-called hybrid warfare. Clear evidence of 'master narratives' concerning the political and economic weaknesses of the European Union and Western liberal ideology can be identified in various forms and adapted to specific events and situations in individual countries (Levinger, 2018; Reddi, Kuo & Kreiss, 2023). Despite a growing body of literature on the topic, more research must be done on specific countries' peculiarities (Akram, Nasar, & Arshad-Ayaz, 2022). We address this gap partly by focusing on two countries.

1.1. Slovak Republic and Czech Republic

In the wake of the global pandemic COVID-19 and during the military conflict in Europe, the fight against disinformation appears to be an urgent matter at both the state and personal level. As the European Commission acknowledges, the public harm caused by deception includes "*threats to democratic processes as well as to public goods such as the health of Union citizens, the environment or security*" (European Commission 2018). Following the outbreak of the coronavirus epidemic, the dangers of mass dissemination of deceptive content became apparent (Radu 2020). This phenomenon, called 'infodemic', has shown its potential to 'hinder an effective public health response and create confusion and mistrust among people' (UN.ORG 2020).

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It is in the interest of the public authorities to prevent the dissemination of inaccurate information among citizens without hindering freedom of expression. The central role in disseminating fake news is played by social networking services and the public's expectation that measures will be taken in this regard, communicated internationally. However, the production of controversial content also occurs 'within a diverse, alternative" news ecosystem', which is increasingly dominated by hyper-partisan, anti-systemic and conspiratorial news websites". It is crucial to recognise the owners, contributors and business models of online media to recognise the right strategy to prevent the negative impacts of this information environment (Štětka, Hajek 2021).

Before the pandemic, personal experience with disinformation related to the Slovak region proved relatively weak. According to the 2020 Eurobarometer survey, Slovaks had less personal experience with fake news than the EU average (Eurobarometer 2020). But comparisons with previous periods showed a clear upward trend. The Slovak Republic recorded the second-highest increase in the proportion of citizens who frequently encounter fabricated news in the media. Subsequent public health concerns after the pandemic have changed the perspective on the state's role in preventing the spread of fake news. Police and state officials sought to challenge online content that promoted the denial of viruses and mass violations of social distancing or other health regulations. Intelligence services continued monitoring and reporting on the main disinformation channels that outwardly presented themselves as an alternative ecosystem (BIS.CZ 2021). Nevertheless, some parliamentarians have personally dealt with websites known for publishing manipulative articles (Krátka, Špalková, Činčerová 2021).

1.2. Online disinformation ecosystem in the Slovak Republic

The global financial crisis of 2008-2010 represented a pivotal moment for media systems in Central Europe after their post-communist transformation. As a result of the severe economic downturn, which affected the costs and advertising expenditure of most commercial media, most foreign investors sold their assets in key publishing houses to local entrepreneurs. It refers to this period as the third media ownership transformation, characterized by the deglobalization and oligarchization of the media sector (Štětka, 2015).

In the Slovak Republic, a model of "business parallelism" (Štětka, 2015). can be identified, characterised by local media tycoons operating in different business areas, where the presence of foreign investors has been practically reduced to Ringier Axel Springer, a Swiss-German publishing house (Dragomir, 2020). Media concentration and the long-standing lack of transparency in media ownership pose a high risk to regional market pluralism (Sampor, 2021).

The strong involvement of local oligarchs has been one of the factors behind the rise in public distrust of the country's older media brands. The 2021 Digital News Report confirmed a decline in trust scores for most of the brands surveyed in the Slovak Republic - with overall trust in news from domestic audiences at 30 per cent - compared to 36 per cent in the Czech Republic, for example, where the trend has improved slightly after several years of decline (Štětka & Hajek, 2021).

The problems of concentration and oligarch-dominated ownership of established media brands have also been fully exploited by the country's "alternative media". A network of print media and fringe websites has emerged primarily as a reaction to the pro-European and pro-NATO narratives adopted in the mainstream media following the expansion of the two international organisations into Central Europe. Combined with outlets related to public health issues, such as the fight against vaccination and the COVID-19 pandemic, these sites formed the core of the disinformation ecosystem in the region (Klingová, Hajdu & Sawiris, 2021). In addition to purely ideological and propaganda objectives, economic interests also played an important role. According to a conservative estimate, USD 76 million in advertising revenue flows annually to disinformation sites in Europe, with the most significant number of disinformation domains supported by Google, mainly through Google advertising (GDI, 2020).

1.3. Disinformation campaigns and their major actors

In the context of "master narratives" concerning the political and economic weaknesses of the European Union and Western liberal ideology, several alternative websites have emerged in the Slovak Republic that are now considered part of the disinformation media space, initially enjoying more comprehensive support from conservative groups and pro-life organisations. They were valued for their defence of traditional cultural values. These online platforms emphasised the same supportive stance towards Russian President Vladimir Putin and his criticism of modern liberal ideology.

The same "alternative news" ecosystem in the Slovak Republic produced misleading online content about the migration crisis and the influx of Muslims in 2016, which was reinforced through polarising discussions on social media (Šuplata, Nič 2016). Finally, during the COVID-19 crisis in 2021, new websites focused exclusively on public health issues emerged and contributed to the disinformation network with the same manipulation techniques, such as:

- Reconfiguration of texts produced by established media,
- translations of foreign videos,
- links to experts in unrelated fields of expertise.

The aim is to increase readers' trust and to interlink content addressed to pro-Russian and anti-vaccine COVID-19 vaccination doubters/questioners. State security authorities have confirmed the existing links between the actors behind the platforms with manipulative content and protest movements against social distancing and hygiene regulations.

As the mainstream media debunks fake news and exposes the actors behind alternative platforms, legacy brands have also become the target of verbal attacks by disinformation media and their discrediting campaigns in the country. Cross-border media reports, such as the Pandora Papers exposed by the International Consortium of Investigative Journalists, are also presented as orchestrated operations to undermine Slovak sovereignty by the EU, Washington, or George Soros and the Open Society Foundation (Pandora Papers 2022). On the other hand, politicians engage with websites from the alternative ecosystem in different ways. While the mainstream of the political spectrum in the country has warned citizens against propaganda and false news, especially on issues related to COVID-19, political parties and their members facing criticism from the mainstream media have resorted to alternative media to speak to their audiences. In several cases, politicians or officials in government positions refused to interact with older brands of newspapers or public media and instead responded to alternative media (Šnídl 2018).

The presidential election in the Slovak Republic took place in March 2019, and disinformation was used to undermine voter confidence in the integrity of the election (Sawiris, Klingová 2019).

1.4. Databases of disinformation websites

The increased volume of fabricated and manipulated content has sparked interest in fact-checking and investigating fake news sources. One of the first coordinated initiatives across the region was advertising, with a clear motivation to disrupt the business model of untrustworthy Internet portals. More importantly, the project aimed to protect companies from the potentially damaging association of their brands with controversial content on the Internet. In 2016, researchers, journalists and marketing experts created a database called "Konspiratori" (konspiratori.sk, 2022). The system initially listed 38 websites operating in Slovak and Czech Republic.

The public database is presented by its authors as a collection of platforms for unserious, deceptive, fraudulent, conspiratorial and propagandistic content". It is the largest database in the country.
The terminology applied to these sites varies from disinformation sites to "conspiracy and anti-system sites", with minor differences in the categorisation used by the various projects (Štětka, Hajek 2020). To achieve a higher reach and engagement of articles on social media, content producers on the websites above use some time-tested tactics such as (Hacek, 2020):

- Copying elements of established online media and news websites,
- mixing commentary with news from subscription services of news agencies,

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- providing a web design similar to established online news outlets,
- presenting their news as investigative journalism without crediting the actual authors,
- providing content created by translating articles from non-journalistic sources,
- sharing the same texts on the web,

In addition to promoting a political agenda, some websites mentioned above focus on health and healthy lifestyles, weapons and defence or religious issues.

In a separate analysis of the controversial websites with the most significant impact, proposed a four-tier classification based on the content prevalent in the topics and the motivations of the providers:

- Esotericists.
- Preachers. Ideologically oriented providers are most convinced of their truth.
- Healers. Websites focused on lifestyle and health issues.
- Entrepreneurs. Actual fake news is produced for profit (Syrovátka et al., 2020).

The domestic disinformation scene is mainly based on websites that often pretend to be serious media. Still, their activities mostly speak out against Slovakia's membership in the European Union and NATO and spread various "alternative" facts. A more detailed list of sites spreading disinformation and conspiracies can be found at konspiratori.sk, which has compiled it according to predefined criteria. In particular, Slobodný vysielač, Hlavné zprávy, Zem a Vek and Bádateľ are at the top of the list, as they have a high readership. Another strong actor is the personalities of the disinformation scene, mainly politicians, but non-political personalities have also found a place. Such independent personalities include the editor-in-chief of the conspiracy website and magazine Zem a Vek, Tibor Eliot Rostas, and Adriana Krajnikova, who owes her extreme increase in fans to her vigorous speaking out against government measures related to protection against the coronavirus (Šnídl, 2020).

Before the Czech presidential elections - in January 2018, 118 websites were identified as promoting questionable content - 71 Czech, 41 Slovak and six foreign websites. In the Czech presidential election, the pro-Russian incumbent President Miloš Zeman, the pro-European counter-candidate Jiří Drahoš, was reportedly the subject of extensive disinformation campaigns. Some 30 pro-Russian websites were found to have smeared Drahoš with claims that he had collaborated with the communist secret police, supported unrestricted immigration or was a homosexual paedophile. The study of six popular Czech disinformation websites also found that they paid little attention to the election, and even when they did, they relied on emotive language rather than false information per se.

In the Czech disinformation scene, it is possible to observe an overlap with the Slovak scene. Naturally, it is also thanks to the shared history and linguistic proximity. The similarities can be seen, especially in the type of disinformation spread and the platforms on which it occurs. AMO analyst points to the findings of the think-tank Security Centre of European Values, which states that the Czech disinformation scene consists of approximately forty websites that overwhelm the Czech audience with their unverified, manipulative content, which is often directly related to Russian disinformation narratives (Havlicek, 2020). They aim to question the country's foreign policy anchorage in the West and deepen social divisions and tensions, which can be described as a parallel to the modus operandi in Slovakia. Differences can be observed, for example, in China's greater interest in the Czech environment, Russia's interest in the Czech energy sector or the current government's greater susceptibility to these countries.

2. Analytical part: propaganda and disinformation in the Slovak and Czech Republic

Propaganda and credibility of information are two concepts that are broadly intertwined, as both are closely linked to communication and dissemination of information. On the one hand, we have propaganda, which often uses manipulative and one-sided information to influence public opinion or convince people of a particular perspective. On the other side is the credibility of information, which concerns the truthfulness, accuracy and objectivity of the data transmitted. Let's consider that propaganda is aimed at mass psychology to manipulate public opinion and influence social behaviour, which is done through selective presentation of facts, emotional appeal and often misleading. The credibility of information in scientific discourse is measured by criteria such

as objectivity, accuracy, verifiability and validity. These destabilizing moments can be used in all critical areas such as safety, corporate governance (Brečka, Korauš, 2016; Mihalčová et al., 2021) and many others. Based on an understanding of the nature of the meaning of the phenomena under study, the following influences and relationships between propaganda and information credibility can then be defined:

1. Public trust: propaganda can erode public confidence in information sources by casting doubt on their impartiality and objectivity. Conversely, credible information requires high transparency and verifiability, which can increase public trust.
2. Education and information: High-quality, credible information is vital to informing citizens and educating society, while propaganda often leads to misconceptions and distorted reality images.
3. Political and social influence: Propaganda can considerably impact political and social events by manipulating public opinion. At the same time, credible information is essential for democratic decision-making and an informed civil society.
4. Cognitive impact: Propaganda and misinformation can affect the cognitive processing of information, leading to the formation of prejudices, stereotypes, and false beliefs.

The analytical part of the paper is based on the research conducted with 964 respondents from Slovakia and the Czech Republic, mainly university students. The study was carried out based on the author's research instrument. In terms of structure, the research population consists of 521 - 54.046% males and 443 - 45.954% females from the two countries. The total number of respondents from the Slovak Republic was 580 - 60.166%, and from the Czech Republic, 384 - 39.834%. The mean age of the respondent was 26.03±0.51 years, with a standard deviation of 8.145 years. The minimum age of the respondent is 19 years, and the maximum is 63 years. The age of the respondent was also analysed as an ordinal variable, with respondents younger than 25 years 669 - 69.398% in total, respondents aged 26-35 were 156 - 16.183%, respondents aged 36-45 were 95 - 9.855%, respondents aged 46-55 were 41 - 4.253% and respondents aged 55 and over were three - 0.311%. Out of the total 964 respondents, 321 - 33.299% are studying at the bachelor's degree level, 591 - 61.307% are studying at the master's degree level, 52 - 5.394% are at the Doctoral degree level, and 592 - 61.411% respondents are studying full time, and 372 - 38.589% respondents are studying at the part-time level.

Within the research itself, we surveyed the answers and opinions of respondents on the way of assessing the relevance of information separately for respondents from the Slovak Republic and separately from the Czech Republic according to the age of the respondent in terms of the respondent's assessment of the truthfulness of the information or the importance of the credibility of the information. The primary area of assessing the relevance of information is the respondent's assessment of the information, with a subsequent subjective evaluation of whether the information is true. For this purpose, the research instrument item "I do not judge the credibility of the information, I read the report and judge for myself whether it is true" was used, which was rated on a 5-point Likert scale - strongly disagree - ...- strongly agree. The basic analysis shows that for respondents from Slovakia, there is a significant relationship, $p=0.0009$, between the respondent's age and the opinion that the respondent can subjectively judge the truthfulness of the information at the chosen significance level $\alpha=0.05$. A more detailed analysis of the respondents' answers shows that in the age category of respondents under 25 years of age, a total of 19.744% expressed complete disagreement with the question, which means that this group of respondents does not rely only on their judgment regarding the truthfulness of the information. Still, also the credibility of the information is essential to them.

This conclusion is also shared by 28.205% of respondents who disagree with the question. 25.128% of the respondents have an indifferent attitude to the issue of the credibility of information. On the other hand, 26.923% of the respondents, 17.949%, agree, and 8.874% strongly agree, rely only on their judgment to judge the veracity of the information, and do not address the credibility of the information. For the 26-35 age group, the overall percentage of respondents for whom the credibility of the information is important decreases slightly - 43.243%, while at the same time, the proportion of those expressing a neutral attitude towards the question asked increases - 36.937%. The proportion of respondents who rely solely on their assessment of the veracity of the information is 19.820% in this age group. For respondents aged 36 to 45, the proportion of respondents for whom the question of the credibility of the information is important is again decreasing - 37.097%, with a concomitant significant decrease in the proportion of respondents with a neutral attitude -14.516%.

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On the contrary, in this age group, we observe the most significant share of respondents for whom the credibility of information is unimportant, and they rely only on their own judgement to decide on its veracity - 48.387%. The last age group, namely 46–55-year-olds, has the lowest proportion of respondents for whom the credibility of information is important (11.765%), with the highest proportion of respondents with a neutral attitude - 29.412. The % of respondents in this age group who rely on their own judgement to define the veracity of information is 41.176%.

Based on the above results for Slovak respondents, it can be deduced that the Younger Generation, under 25, tends to disagree that they would somehow not address the credibility of information. This trend may result from the greater media education and information literacy they encounter in schools or on the Internet. The 26-35 age category shows strong neutrality, which could indicate non-commitment or uncertainty. Conversely, the 36-45 age group shows greater agreement with the statement, which may be related to greater confidence in evaluating information or a different approach to media. Neutral attitudes are also strongly present in the older age group, 46-55. We may also see a form of apathy, resignation, or a belief that their ability to judge information is sufficient or that this age group is less concerned about the potential impact of incorrect information or more confident in their ability to evaluate information.

Let's analyse the answers to the same question for the respondents from the Czech Republic as well as for the respondents from Slovakia. There is a significant relationship, $p<0.0000$, between the respondent's age and the opinion that the respondent can subjectively assess the truthfulness of the information at the chosen significance level $\alpha=0.05$. In the group of respondents under 25 years, 63.441% of those who chose the answers completely disagree - 29.032% and disagree (34.409%). Thus, the credibility of the information is important to them. A total of 17.024% have a neutral attitude towards dealing with the credibility of the information, and 19.335% rely on their judgment to decide on the veracity of the information. In the age group of 26-35 years, 53.333% of the respondents agree with the question, which leads us to conclude that for more than half of the research participants, the credibility of the information is very important. In this age category, only 6.667% of respondents take a neutral stance, and at the same time, 40.000% of respondents rely on their judgement to assess the veracity of the information. In the age group 36 to 45 years old, the credibility of the information is significant for 63.636% of respondents overall - strongly disagree 36.364%, disagree 27.273%. At the same time, 36.364% of respondents in this age category rely only on their assessment of the veracity of the information, and its credibility is not important to them. Not a single respondent of this age category indicates a neutral attitude towards the question asked. In the 46-55 age group, the credibility of the information is important to 50,000% of respondents overall. A neutral attitude is expressed by 12,500%, and 37,500% of research participants in this age group rely on their own judgement as to the veracity of the information. The last age group of respondents over 55 years, fully 100.000%, attaches importance to the credibility of information. The following conclusions can be drawn from the results of the respondents.

The younger generation - under 25, used to accessing information via the internet and social media, maybe more sceptical about the information they get their hands on. Most of them disagree with the claim, which could mean that they have adopted specific mechanisms to verify the veracity of the information. In the 26-35 age group, we see a large proportion of complete disagreement. People at this age may have already encountered more false information and prefer to verify information from multiple sources. The 36-45 age group has mixed views. Some of them still trust what they read, while others are sceptical. The absence of neutral responses suggests that people in this age group have strong opinions. The 46-55 age group is split between those who trust what they read and those who do not. This may mean that some are more conservative in their approach to information, while others are more open to new sources of information. Over 55: the absolute disagreement suggests that the older generation is very cautious in receiving information and has its methods of verifying its veracity. The results indicate that age may influence the way people access information. Younger generations may be more prone to scepticism and validation of information, while older generations may be either more conservative or more cautious in their approach to information.

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The graphical distribution of responses in relation to the age of the respondents is presented in the form of a correspondence map in Figure 1.

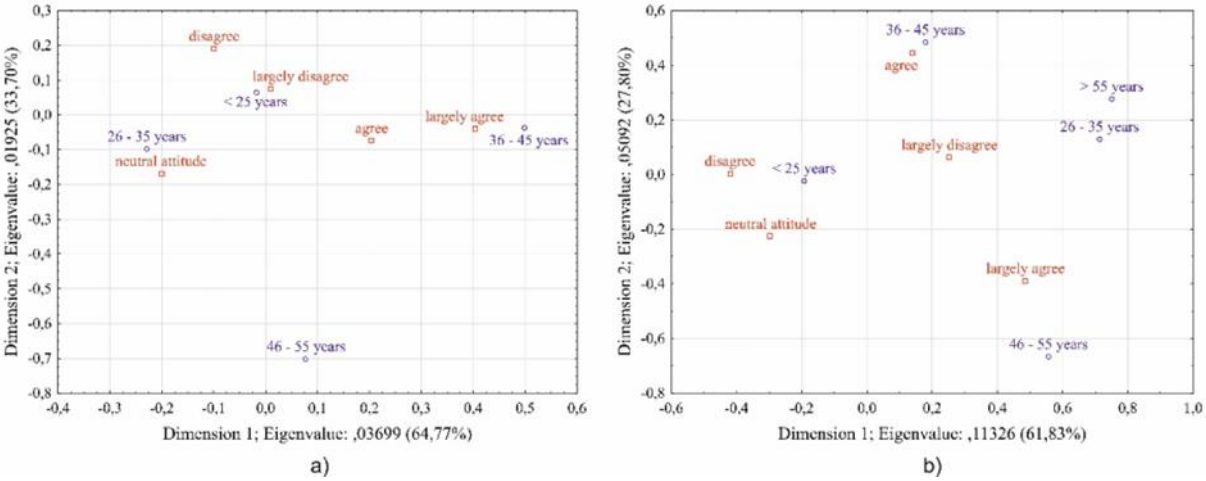

Figure 1. Correspondence map of the distribution of respondents' answers on the importance of the relevance of information according to their age (a) Slovak Republic, b) Czech Republic)

Source: own processing

Based on Figure 1 and the results of the correspondence analysis, it is possible to say that the respondents under 25 years of age from Slovakia preferentially lean towards the option of completely disagreeing and partially disagreeing, which implies that for this group of respondents, the credibility of the information itself is critical, while respondents from the Czech Republic in this age group lean more towards the option of disagree or express a neutral attitude to the question. Thus, the credibility of information is also crucial for the Czech respondents, but to a lesser extent than for the Slovak respondents. Respondents aged 26-35 from Slovakia tend to give a neutral answer, which may imply some middle ground between the importance of the credibility of the information and, at the same time, relying on their judgement in assessing its truthfulness. For respondents from the Czech Republic aged 25-36, we observe a looser relationship to the answer completely disagree, which leads us to conclude that the credibility of the information is essential for this group. Respondents aged 36-45 from both countries relied on their judgement to identify the truthfulness of information. Still, respondents from Slovakia preferentially chose the option completely agree and respondents from the Czech Republic the option agree.

Conclusions

The role of modern propaganda is, above all, to manipulate public opinion. Often, manipulation consists of deepening or sharpening opinions. Propaganda today is no longer just about spreading lies; it tends to be very creative. It works with the truth, but where it may add different accents or subtle lies, sometimes a different sound or subtext, often a slightly manipulated photo, and then the half-truth or lie cannot be detected so easily. Propaganda can take many forms from outright lying and manipulation of facts to selective presentation of information, to the use of speculative and conspiracy theories. Propaganda can also be a tool to support authoritarian and undemocratic regimes.

The research confirmed the previous findings (e.g., Šimberová et al., 2022) that propaganda is increasingly becoming predominantly digital and often used on the Internet, especially social networks. This channel allows misinformation and unverified information to be disseminated quickly and widely.

Disinformation operations are inherently covert; they are just the tip of the iceberg; they cannot be proven. Foreign countries accused of influence deny the accusations.

The findings are compatible with former ones, claiming that financial links are challenging to establish except in rare cases (Koraus, Stefko & Dobrovic, 2015; Dobrovič, Rajnoha & Korauš, 2018) when Facebook discloses relevant advertising information about purchases. Causal links to specific real-world events are also notoriously difficult to establish, making it complicated to assess the effects.

Various evasive manipulation methods aim to divide the group with distracting or divisive comments - making detection even more difficult. Identifying the target or targets may also be questionable in politically loaded cases.

Countering the spread of propaganda and disinformation is a complex problem that requires different approaches and measures. It is important to stress that countering propaganda and disinformation is a long-term process involving the cooperation of different actors and the synergy of society.

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REDUCTION OF CYBERSECURITY RISK VIA EVALUATING USERS' BEHAVIOUR*

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Abstract. Since the 1990s, process analysis has attained a fundamental position among business management approaches. With the gradual development and expansion of digitalization in businesses that have begun to use advanced information systems, a demand also arose to survey the processes within companies, including retrospectively from the digital records of information systems. This requirement laid the foundation for the emergence of the scientific discipline known today as Process Mining. In the presented article, we introduce its basic concepts and point out the possibility of using them in the field of security analysis of the log of a general system, which creates digital records of its operation (a so-called journal or log). The result of using Process Mining methods is identifying unrecorded processes running in a system and various deviations from the expected system operation, which may signal security threats to the system itself or its operator. In the battle against hybrid threats, many resources are explicitly devoted to protecting cyberspace. The approach proposed in this article allows a system to be analysed as a whole, identifying patterns of behaviour that would not otherwise arouse suspicion in individual steps but, as a sequence of separate steps (processes), do not fall into the expected pattern of system behaviour. This can be used as a long-term sustainable concept in the fight against hybrid threats. An analysis of a system's behavior can be built on continuous "learning" by labelling newly discovered processes as safe or unsafe, ensuring the long-term sustainability of this approach. The main advantage of the proposed analyses is that they run as an oversight of the system itself, analysing it only based on records from its event log. Therefore, no interventions are needed in the architecture and source code of the analysed system, and the analyses do not affect its operation or data.

Keywords: hybrid threats; process analysis; process mining, security; cyberspace; information systems; system behavior; cybersecurity; management

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JEL Classifications: E27, F50, G32

Additional disciplines: information technologies

1. Introduction

In an era characterized by rapid technological advancement and interconnectedness, global security dynamics have undergone a profound transformation. With the development of the digital environment, strategies

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employed by malicious actors seeking to exploit vulnerabilities are also evolving, expanding the surface area for potential attacks. Traditional notions of security, being static, need to be revised for the complexity and multifaceted nature of today's threats.

A category of security challenges that garnered particular attention in recent years is so-called "hybrid threats." These threats, marked by their hybrid nature, involve a fusion of conventional and unconventional tactics, blurring the lines between state and non-state actors. They present a significant challenge to the stability and security of nations and organizations globally. Hybrid threats manifest in various forms, from cyber espionage to disinformation campaigns, making them difficult to predict and defend against.

The traditional reliance on more than attic security measures and universal approaches is no longer sufficient for this requirement. A dynamic and adaptable strategy is required to respond not only to the current threat landscape but also anticipate and prepare for future challenges. Within this context, process analysis emerges as a fundamental and innovative concept in the realm of cybersecurity and defence.

This article explores the concept of process analysis as a long-term sustainable approach to combating hybrid threats. It scrutinizes how process analysis provides a meaningful perspective that prioritizes adaptability, continuous improvement, and resilience when integrated into security frameworks. By investigating the role of process analysis in understanding, mitigating, and responding to hybrid threats, we aim to elucidate its potential to shape the future of security practices.

The article delves into the intricacies of process analysis, elucidating its relevance, methodology, and real-world applications. It also examines the pivotal intersection between process analysis and human factors, acknowledging that security is not merely a technical endeavour but a holistic one encompassing individuals' and organisations' behaviours, perceptions, and decision-making processes. The dynamic evolution of hybrid threats, the transformative potential of process analysis, and the crucial role of adaptability and sustainability are emphasized in shaping the future landscape of security practices.

Security systems in organizations have undergone exciting development in recent years. Various types of security systems, such as cameras, attendance trackers, security guards, and others, can now be integrated into a unified system that facilitates communication with each of them. Several solutions of this kind are currently available in the market. Their primary objective is to collect data from individual systems, of ten from different manufacturers, aggregate this data in one centralized location, and monitor and control individual systems from a central console. The advantage of consolidating data from multiple systems is a more comprehensive view of the collected data and facilitating a more straightforward analysis.

The systems themselves have also evolved. Camera systems now commonly incorporate elements of artificial intelligence that can recognize people and objects in recorded images. Monitoring systems for communication networks continually "learn" from regular operations, enhancing their ability to identify non-standard behaviour on a network and detect potential threats more accurately. Nevertheless, it remains true that the overall analysis of all systems is conducted by an operator who assesses stimuli from individual systems within the broader context of the organization's operation.

A typical example of a threat that only an operator can evaluate within the context of reports from all security systems is a user's login using correct but stolen login data. Such an event may go unnoticed by network monitoring as it appears nonsuspicious. However, if the operator can identify that the user in question did not go through the attendance system and that the camera system in the parking lot did not record the arrival of a car with the corresponding number plate, the successful login with the data of a user who likely did not come to the workplace takes on a completely different dimension.

In this article, we will delve into available solutions that could assist in identifying security incidents based on system behaviour described using events from various sources. Events can originate, for instance, in a computer's operating system, an information system, or the monitoring of the communication network. Most companies utilize tools of this nature, allowing the monitoring of events in security systems, communication

networks, information systems, individual workstations and hardware devices. This abundance of information provides insights into the company's activities, and through the analysis of these events, we indirectly scrutinize the company's functioning. This article aims to highlight the potential of utilizing concepts from process analysis and process mining in the realm of security to identify non-standard behavior within a monitored system.

2. Literature overview

The rationale for selecting and analysing processes from the field of process mining lies in their applicability to a broad spectrum of systems. Managing businesses based on processes dates back to the 1990s (Hammer, 1994). It gradually gained popularity, and as companies underwent computerization, inquiries emerged regarding the automated identification of processes within a company. This was done to optimize costs, enhance output quality, or accelerate production. Once an organization's processes were delineated, a necessity arose to verify the actual execution of business operations against the formally described processes. Formal business process descriptions often involve using tools such as BPMN diagrams. These basic questions – identifying processes in the running system and verifying real processes in the system against the designed processes – laid the foundation for research in the field of Process mining (Van der Aalst, 2016). Process mining falls into the field of data sciences and connects the fields of process modelling and business intelligence. The basic concept used in process mining is an event. The process mining methods assume the availability of a record detailing the system's behavior in the form of events. An event is characterized by a few fundamental attributes: time, event type, and case. While the context remains focused on company processes, the abstraction provided by viewing them through events allows for the analysis of any system. This approach enables examining systems whose operation can be monitored as a sequence of events occurring within them. Therefore, in this article, we will also focus on process mining methods in the context of general systems. We focus mainly on cyberspace – computers, networks, information systems, and applications.

The frequency of cyberattacks has recently increased (Plėta et al., 2020). Information of dubious origin is spreading within the unregulated social media environment, contributing to societal polarisation. This phenomenon is not solely associated with the conflict in Ukraine. Cyberattacks and the spread of disinformation both fall under the umbrella term hybrid threats. The term hybrid threat refers to an activity carried out by state or nonstate entities aiming to harm the target by influencing its local, regional, state, or institutional decision-making (NBÚ, 2024; Kovács, 2022).

We aim to highlight the potential applications of process analysis of system behaviour and insights from process mining in combating hybrid threats. We place particular emphasis on the long-term sustainability of the proposed procedures. We assume that the investigated system generates structured information about the events that occur during its activities. The advantage of our proposed procedures is that they do not require interventions in the monitored system and do not affect its operation.

As business environments become increasingly dynamic and complex (Sliwa, Krzos & Piwoni-Krzeszowska, 2021). It becomes indispensable for organizations to objectively analyse business processes, monitor existing and potential operational frictions, and take proactive actions to mitigate risks and improve performance. Process mining provides techniques to extract insightful knowledge about business processes from event data collected during the execution of the processes. In addition, various approaches have been suggested to support the real-time (predictive) monitoring of process-related problems. However, the link between the insights from continuous monitoring and specific management actions for actual process improvement needs to be included. Action-oriented process mining aims to connect the knowledge extracted from event data to actions (Park & Van der Aalst, 2022).

Process mining is an approach which can discover and improve business processes by extracting knowledge from event logs created in an information system. Typically, process execution data in an event is supported by an information system and technology. Moreover, organizations perform various business processes to serve their clients. Process mining employs an event log to determine and control the flow and processing of

information and the performance of resources. Precise prediction helps a manager deal with undesired situations with more control; thus, future losses can be controlled (Neerumalla & Parvathy, 2022).

Historical data on the execution of processes stored in information systems provide a valuable source of knowledge for improving processes inside organizations. Running business processes consists of different events that shape the event data. Process mining is a set of data-driven techniques for unlocking the power of event data within organizations (Van der Aalst, 2016). It provides a variety of insights into processes, such as discovering process models, determining whether the discovered models and event data are aligned (Carmona et al. 2018), and revealing performance and bottleneck analysis (Van der Aalst, Adriansyah & van Dongen, 2012; van Dongen, 2018). These process reviews in different aspects should be put into action, i.e., the discovered status of a process and its problems should be addressed with regard to process improvement.

Process mining has demonstrated its ability to deliver backward-looking insights, but there is a growing demand for forward-looking insights that can be used to change processes. All techniques in process mining that intend to undertake future analysis are referred to as forward-looking techniques. We have divided them into two categories: simulation and prediction techniques. The mainstream forward-looking techniques in process mining are also at a detailed level, e.g., predicting the remaining time of a case using machine learning techniques (Tax et al., 2017) or simulating processes in detail (Rozinat et al., 2009). Simulation techniques are well-known forward-looking techniques introduced into the process mining field 15 years ago (Van Der Aalst, 2009). Discrete Event Simulation (DES) is a commonly used approach to play out process models at a detailed level (Rozinat et al., 2009). Simulation models and outcomes are improved using process mining approaches, such as in (Camargo, Dumas & González-Rojas, 2020). However, at detailed levels, some process aspects remain concealed and can only be captured at a higher level of aggregation. The impact of strategic and high-level decisions and external factors such as resource expertise are, for example, overlooked (Van Der Aalst, 2015).

In contrast to discrete event simulation or other detailed modelling techniques based on individual entities, system dynamics techniques are based on aggregation, e.g., the number of people or products per day (Brailsford, Churilov & Dangerfield, 2014). These techniques can cover various effects, including human factors, and model nonlinear relations at an aggregated level (Sterman, 2002). System dynamics tends to describe and capture a system using its variables and the underlying effects among them. Such approaches seek to provide a holistic system model that incorporates all possible effective variables in the system over time intervals (Pourbafrani & Van der Aalst, 2021; Berti & Herforth et al., 2023). However, most simulation-based approaches, including system dynamics, rely heavily on users and their understanding of the system.

Each level can be used for different simulation techniques, as proposed in where the results of coarse-grained simulations are used to update processes at detailed levels and later simulate the DES models at operational levels (Pourbafrani & Van der Aalst, 2022a).

Process mining techniques can describe and model real processes using historical event data from organisations' information systems. Later, these insights are used for process improvement. For instance, Discrete Event Simulation (DES) uses process models that can mimic real-world events. However, the aggregated performance status of processes over time reveals various hidden relationships between process variables. Coarse-grained process logs are sets of performance variables over intervals of time generated using event data from processes. The coarse-grained process logs describe processes at higher levels. System Dynamics completes process mining by capturing the relationships between various process variables at a higher level of abstraction. In their paper, the authors propose a new framework for capturing conceptual models of processes using transformed event data. The main idea is to discover the underlying relations as equations automatically. This allows system dynamics simulations of processes to be generated, and these employ various statistical and machine learning techniques to find the hidden relationships between process variables. The framework supports the simulation modelling task in the context of system dynamics simulations. Experiments using real event logs demonstrate that this approach can generate valid models and capture the underlying relationships (Pourbafrani &Van Der Aalst, 2022b; Berti & Jessen et al., 2023).

Process mining techniques help practitioners optimize the execution of P2P processes by analysing the execution data and providing valuable insights. However, existing techniques may result in misleading insights due to many-to-many relationships between business objects, e.g., between orders and invoices in the P2P process. Recently, object-centric process mining techniques have been proposed to avoid the limitations of traditional process mining techniques (Bouricha, Hsairi & Ghédira, 2023).

Process mining that focused only on activity-oriented processes and neglected users' behaviours behind the activities led to an overlooking of the reality they proposed to create. Recognizing the users' underlying intentions can improve guidance and offer better recommendations. As a result, an area of study known as Intention Mining has emerged. It aims to discover users' behaviours using an event log. Intention is frequently used in computer science research, including definition of requirements, business processes, and method engineering for context adaption. Authors have reviewed Intention Oriented Process Mining based on event logs in the information systems engineering field. The objective is to identify the different models, methodologies, and algorithms proposed, the tools used, and the various challenges in these fields based on four steps of review for the selection process, which start with identification, followed by screening, eligibility, and inclusion. For the first time, we are focused on process mining and intention mining based on log files and their relationship to get an idea about the area of intention mining (Qafari & Van Der Aalst, 2022).

Process mining techniques can help organizations improve their operational processes. Organizations can benefit from process mining techniques in finding and amending the root causes of performance or compliance problems. Considering the volume of the data and the number of features captured by the information systems of today's companies, discovering the features that should be regarded as in causal analysis can be quite involving (Elkoumy et al., 2022).

Privacy and confidentiality are crucial prerequisites for process mining to ensure compliance with regulations and safeguard company secrets. The authors in their article provide a foundation for future research on privacy-preserving and confidential process mining techniques. The main threats are identified and related to a motivation application scenario in a security context and the current body of work on privacy and confidentiality in process mining. A newly developed conceptual model structures the discussion that existing techniques leave room for improvement. This leads to several significant research challenges that need to be addressed in future process mining studies (Macak, Oslejsek & Buhnova, 2022).

Process mining techniques can help organizations improve their operational processes. Organizations can benefit from process mining by finding and amending the root causes of performance or compliance problems. Considering the volume of data and the number of features captured by the information system of today's companies, discovering the set of features that should be considered in causal analysis can be quite involving. In their paper, the authors propose a method for finding the set of (aggregated) features that could possibly have a causal effect on the problem. The causal analysis task is usually done by applying a machine learning technique to the data gathered from the information system supporting the processes. To prevent mixing up correlation and causation, which may happen because of interpreting the findings of machine learning techniques as causal, the authors propose a method for a structural equation model of the process that can be used for causal analysis (Keršanskas & Deterence, 2020).

The quality of hands-on cybersecurity training is crucial for effectively mitigating cyber threats and attacks. However, practical cybersecurity training is strongly process-oriented, making post-training analysis difficult. The authors present process mining methods applied to the learning analytics workflow in their paper. They introduce a unified approach to reconstructing behavioural graphs from sparse event logs of cyber ranges. Furthermore, they discuss significant data features that affect their practical usability for educational process mining. Based on that, methods of dealing with the complexity of process graphs are presented, taking advantage of the puzzle-based gamification of in-class training sessions (Macak et al., 2022).

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3. Hybrid threats

Hybrid threats, in general, represent a combination of threats in the real world and cyberspace. In recent years, the fight against hybrid threats has intensified (Korauš et al., 2023). The methods of combatting hybrid threats can be divided into preventive and responsive, with the preventive approach focusing on deterring attackers and increasing the costs of their attacks (Keršanskas & Deterence, 2020). Responsive approaches are oriented on reacting to an action already in progress, or based on an identified action; they try to prevent future actions.

The fight against threats in cyberspace, stemming from the dissemination of fake news and radicalizing posts, involves analysing the content of posts on websites and social networks to identify suspicious posts and their authors automatically. Sophisticated algorithms for lexical analysis using artificial intelligence, which can identify the post's sentiment (Wankhade et al., 2022) or categorize its content, are used for this purpose.

With information security protection, the foundation is the security of networks and all devices communicating within a given network against intrusions, misuse, and theft of sensitive data. A broad spectrum of resources can be used here, which can be divided into hardware and software. Hardware resources are devices used for scanning a system or monitoring network traffic; typical examples are hardware firewalls and proxy servers. Software tools ensure the monitoring of running applications, communication, and the availability of services. The following review highlights the most commonly used ones (Keary, 2023).

In this article, we propose using process analysis of the monitored system to identify non-standard behavior in a system. The proposed method of analysing a system is dynamic; it learns continuously by allowing discovered deviations from the system's expected behaviour to be classified as standard (the system changes over time and the newly discovered change is in line with its new processes) or as incidents. A standard behaviour model for the system in our proposal is stored as a continuously updated footprint matrix and/or as a list of permitted processes in the form of BPMN diagrams. The dynamic approach thus ensures the long-term sustainability of the proposed approach in detecting security incidents in the system, which in general may consist of several permitted steps but whose sequence as a process in the system is suspicious. The monitored system, in our case, is any system creating a log of its operation, so the proposed approach applies to a wide range of systems, particularly in cyberspace, and the proposed approaches can thus significantly help in the fight against hybrid threats (Korauš et al., 2024).

4. Basic concepts

In the following sections, we will introduce the basic concepts with which we will continue to work.

4.1 Processes

In general, a process is a naturally occurring or artificially created sequence of changes in the properties of an object or system. Suppose we focus on processes within an organization. In that case, we can define a business process as an objectively natural sequence of activities to achieve a given goal in objectively given conditions (Řepa 2012). In this article, we will deal with processes that can be identified in systems but which are not necessarily explicitly described. We are also interested in processes that are part of the system's normal functioning but may not be directly associated with fulfilling its goals, such as production or the provision of a service.

4.2 Events

As we mentioned in the introduction, we assume that the examined system keeps a record of the changes during its activity. In IT solutions, a system's operation records are recorded in a log. This common practice gives us information about what happened in a system, when, and who caused the event. It cannot be expected. However, system runtime logs will look the same in different systems and be available in the same form or structure. For a rigorous analysis of data from a system's operation, it is necessary, however, to create a basic definition that

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will determine what minimum information the system operation log must contain to be able to analyse it further. The basic concept we will continue to work with is the concept of an event.
Definition. *An event is a change of properties or attributes in a system, described by the time of its occurrence, case, and type.*

Under the term case, we understand, for example, the instance of the process in which the given event occurred, the instance of the process performed by a specific user, or for a particular customer. Along with the other listed necessary properties, an event may contain additional information that can be used for more accurate processing in a specific case. In general, however, we expect from an event that we will be able to talk about what kind of event it is when it occurred and the case of its occurrence.

A system log, in general, may also contain much other information that may relate to the system's state at a given moment. Therefore, it is very often necessary to process the log in some way so that the result of the processing is only a set of events relevant to the purposes of the selected analysis.

4.3 Log processing
The issue of collecting events from different sources and in various formats, unifying them and gathering them into one place is familiar in IT solutions. In the common practice of operating systems, it is very often necessary to have log entries available in a uniform format in one place for rapid and more accessible analyses of events in individual systems. For this purpose, tools convert log entries from different sources into a uniform format. Every technology currently used to develop IT systems includes support for creating logs. The conventions used in practice mean that the potential conversion to other formats is a simple task. Most of these conversions are secured by log processing tools, and if they do not support the given format, they provide the option of implementing one's converter. The purpose of this article is not to analyse these tools. Still, we can recommend to the reader, for example, an overview of freely available tools for log processing at the link (Ankush 10 Open Source Log Collectors for Centralized Logging, 2023).

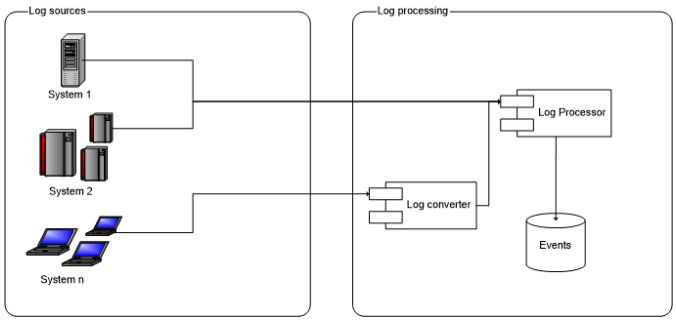

Figure 1. Processing of logs from different sources

Source: own processing

Figure 1 schematically depicts the processing of logs from different sources. Log processing tools support several log formats and sources which can automatically process, filter, and convert data into the desired output format. Suppose the system creates a log whose format is not supported by the log processing tool. In that case, it is necessary to write a custom converter that ensures the conversion of the log from its original format to a format understood by the log processing tool. After filtering out unnecessary entries from the log and converting the log data into the format according to the event definition, we get a unified structure of events stored in a database. This will further allow us to process events in time slices and contexts.

After unifying the event records, some applications may experience the problem of uniform user identification across several systems. In one source of events, a user can be identified, for example, by a username, but in another source, he may have a different username or only a personal number. When analysing events in a system, we usually need to trace one user's activity through multiple sources of events. Therefore, it is necessary when processing logs to think not only about the unification of formats but also the mapping of user identifiers when

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we replace various user identifiers in individual event sources with a single identifier so that we can identify events from different sources to a specific user.

4.4 BPMN diagrams

Business Process Model and Notation (BPMN) diagrams make it possible to represent processes in a standardized way graphically. Figure 2 shows a sample BPMN diagram that describes the process of gaining access to a customer's VPN network to perform an intervention by a vendor in a database with sensitive data.

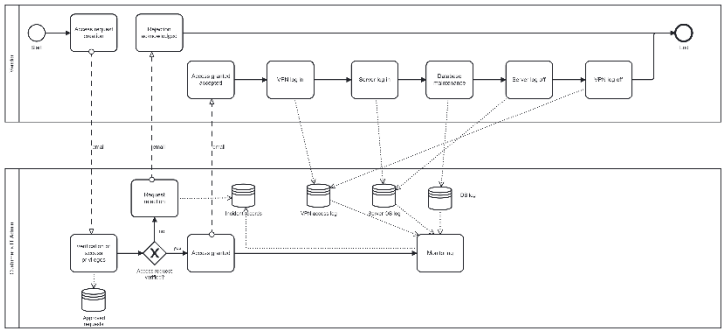

Figure 2. Example of BPMN diagram

Source: own processing

The process begins with the vendor's employee, labelled "Vendor", at the top of the diagram. The beginning of the process is marked as "Start". The vendor requests access by emailing the customer's IT administrator. The IT administrator who processes the request first verifies whether the vendor has approved access to the required resources in the "Approved Requests" database. If the vendor approves access needed, the IT administrator will grant access for a limited time. Suppose such access is not shown as approved for the vendor. In that case, the IT administrator will send an access denial email, will not allow access, and will also report an incident requesting unauthorized access to the internal system for recording incidents. In case of denial of access, the process ends on the vendor's side at the point "End" after receiving information about the denial of access. If the vendor's request for access is justified, the IT administrator allows access, and the process continues on the vendor's side by performing the intervention on the database itself. In practice, this may mean the sequential execution of steps on the vendor's side consisting of logging into the customer's VPN network, then logging into the server on which the intervention will be performed, performing the intervention itself in the database, and then logging out of the server and finally from the customer's VPN network, by which the process ends. We explicitly indicated in the process diagram that all process activities are written to the respective logs: "VPN Access Log", "Server OS Log" and "Database System Log". Thus, the IT administrator can monitor all vendor activities during the whole process. We point indirectly to the standard state of such solutions, in which each system element creates its log, and in the event of investigating an incident, it becomes necessary to search several logs in several formats and in several places. It is also necessary to obtain event records from individual logs in chronological order to create an overall picture of the sequence of activities performed in the system by one user.

The advantage of BPMN diagrams lies mainly in that they are clear and use a relatively small number of elements to represent processes that are easy to learn and understand. Therefore, both business representatives and technical staff understand them.

4.5 Petri nets

Petri nets are used for formally exact mathematical modelling of distributed and parallel systems.

Definition. *A Petri net comprises places, transitions, and the boundaries that connect them. The places may contain tokens that represent the state of the system. Transitions may create and consume tokens representing events or actions in the modelled system.*

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An example of a Petri net for the BPMN process from Figure 2 is in the following diagram (Figure 3).

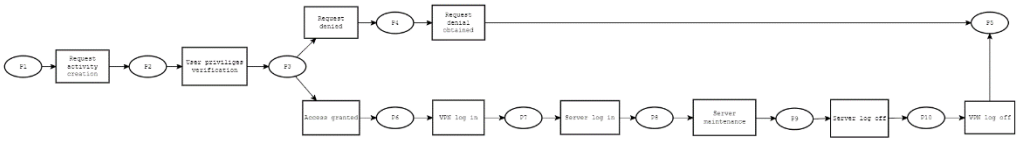

Figure 2. Example of a Petri net

Source: own processing

The places in the diagram marked as P1, P2, ... P10 represent places or positions at which tokens may occur at some point during the entire process. The individual activities of the process are represented as transitions in the Petri net. A transition (activity) can be realized only if all locations at its input places contain a token. A transition is carried out by consuming one token from one input place and creating one token at one of its output places. This process is repeated until all inputs have tokens. The transition stops now. There is one input place to a transition that no longer contains a token.

Petri nets are used in process mining algorithms. As we will show in the following sections, they are used as both inputs and outputs in the process mining methods that we will present.

5. System processes

Information systems and a high level of digitalization and automation are currently an integral part of business management. A typical business operates thanks to one or several information systems that ensure quick access to information where it is needed. Along with information systems, companies usually have various other systems that take care of security (cameras, a security system), control of employee attendance (time attendance system), and other potential systems. All such systems have one common basic concept: events occur in them, which these systems process in some way, and that is important for us to record.

For the analyses used in this article, data on the functioning of a business (and the system in general) are needed in a digitally processable and structured form. With this, we automatically orient ourselves on the records of events in information and other systems, through which we can monitor events, whether in the company that uses them or in some other system, such as a social network or a banking system. As we mentioned in the section on log processing, the problem of unifying log entries from different sources is technically solvable. Henceforth, we will assume that we have chronologically ordered logs collected from all sources of the investigated system. At the same time, the event log also identifies the source system in which it occurred.

As soon as we have an overview of the events in the system obtained from various sources and sorted chronologically, we have the basis for analyses of the events in the system. We can start searching for similar sequences of events, events that occur frequently or only exceptionally, and attempt to identify standard and non-standard behavior of the entire system. The answers to these and other questions are provided by process mining technologies, which we will describe in the next section.

6. Process mining

In practice, process mining is used primarily when the system's description of the processes is insufficient or cannot be obtained in any other way. In our concept of using process mining methods, we have several goals:

1. To obtain a description of the behavior of the monitored system.
2. To identify deviations from normal system behavior.
3. To verify whether the explicitly described processes run in the system according to their description.

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In the analysis of system behaviour using process mining methods, we will not focus on optimizing existing processes, which is the primary goal of process mining, but more on identifying relationships between events in the system, acquiring an overview of the functioning of the system, and detecting non-standard behaviour within the system. Process mining methods cover two main areas:

1. Searching for processes in the system (Process Discovery).
2. Verifying processes in the system against their formal designs (Conformity test).

Algorithm classes that deal with the discovery of processes in the system will help us fulfil the first goal of acquiring a description of the observed system. We will describe them in more detail in the next subsection. To demonstrate specific outputs, we will use the ProM application (Lohman, Verbeek, Dijkman 2009) to process and analyse the logs, which is a basic research tool for process mining, implementing several algorithms used in research in this area.

7. Process discovery

Searching for or discovering processes is the first step in process mining. Its main objective is to transform an event log into a process model. The basic algorithm for gaining insight into the causality of individual events in the log is the Alpha algorithm, which forms a Petri net from the events in the log representing the succession of individual events. It distinguishes the following relationships between events:

1. Direct succession, denoted as X>Y. It holds that X>Y if and only if the event Y follows X.
2. Causality, referred to as X -> Y. It is true that X -> Y, if and only if X>Y, but not Y>X. In other words, in the event log, event X results in event Y, but never vice versa.
3. Parallel events, referred to as X II Y. It is true that X II Y, if and only if X>Y and at the same time Y<X.
4. A choice, denoted as X # Y. It is true that X # Y if and only if (X>Y)' and (Y>X)', where the symbol ' indicates the negation of the statement.

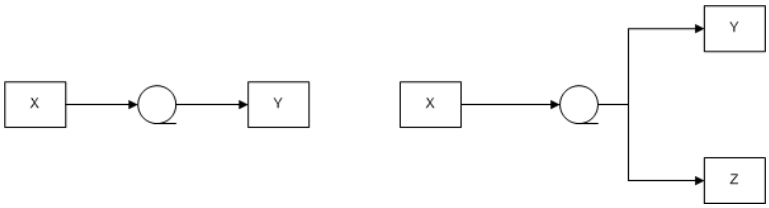

Figure 3. Patterns of event sequences: on the left, direct succession, on the right, exclusive selection

Source: own processing

Based on the given definitions, we can identify different patterns in the sequence of events in the logs. In Figure 4, the sequence of events X and Y is shown on the left, and on the right, the choice for which (X->Y and X->Z, and Y # Z) is valid is drawn.

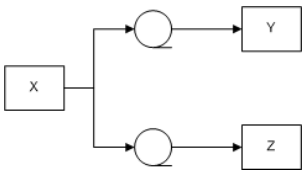

Figure 5. Patterns of event sequences, Y and Z parallel events

Source: own processing

Error! Reference source not found. shows a pattern with parallel events Y and Z when (X->Y and X->Z and Y II Z).

To illustrate this type of analysis, we used a sample of data from home sensors that indicate open and closed entrances to the house (Frank Front Door Motion & Brightness 2024). These are records of changes in the state

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of individual sensors. Upon a change of state, each sensor reported an event, event time and sensor status (input open/closed). The following table contains a sample of the data.

Table 1. Sample of testing data

id	timestamp	contact	isClosed	doy	dow	year	tod
0	1.5.2017 1:47	_Main_Door	FALSE	121	0	2017	1:47:00
1	1.5.2017 1:47	_Main_Door	TRUE	121	0	2017	1:47:00
4	1.5.2017 1:58	_Main_Door	FALSE	121	0	2017	1:58:00
8	1.5.2017 1:58	_Main_Door	TRUE	121	0	2017	1:58:00
11	1.5.2017 2:10	_SZ_Terasse	TRUE	121	0	2017	2:10:00
12	1.5.2017 2:10	_SZ_Terasse	FALSE	121	0	2017	2:10:00
42	1.5.2017 4:37	_Fiona_Terasse	FALSE	121	0	2017	4:37:00
103	1.5.2017 9:22	_Main_Door	FALSE	121	0	2017	9:22:00
107	1.5.2017 9:22	_Main_Door	TRUE	121	0	2017	9:22:00
109	1.5.2017 9:28	_Main_Door	FALSE	121	0	2017	9:28:00
110	1.5.2017 9:29	_Main_Door	TRUE	121	0	2017	9:29:00
112	1.5.2017 9:34	_Main_Door	FALSE	121	0	2017	9:34:00
113	1.5.2017 9:34	_Main_Door	TRUE	121	0	2017	9:34:00
119	1.5.2017 9:41	_Roof_Window	TRUE	121	0	2017	9:41:00

Source: own processing

The individual items mean (in the following order): record id, event occurrence time, sensor label, sensor status (true = closed), serial number of the day of the year (doy), serial number of the day of the week (dow), year, time of day (tod). The ProM tool uses as input for its algorithm's files in the. xes format, which is a format for describing events using the XML language. In most applications, the events file is in a different format; therefore, conversion to the. xes format is required. The ProM tool provided the conversions of some used formats to the. xes format directly.

For analysis in the ProM tool, when converting the source data in the .csv format to the. xes format, we chose a combination of the sensor name and its status as the activity identification. We obtained several sequences of events using the algorithm to identify local process models (mine local process models). The following Figure 6 shows a preview of one sequence obtained.

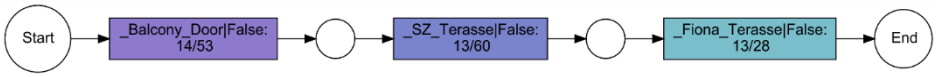

Figure 1. Example of a sequence of events found through the ProM tool

Source: own processing

The presented sequence means that the depicted events occurred in this order 13 times in the observed period. The order of events is:

- Opening of the balcony door.
- Opening of the entrance to the terrace.
- Opening of the outer door to the terrace (marked as Fiona).

The event of opening the balcony door occurred in this sequence 14 times out of a total of 53 events, opening the patio entrance 13 times out of 60 occurrences, and opening the exterior patio door 13 times out of a total of 28 events in the data sample. It is worth noting that the analysed data comes from a private house where several household members lived, including three cats. The algorithm found several sequences, most of which were difficult to interpret regarding the movement of a single inhabitant in the building. The sequence in Figure 1 was one of the few sequences in which a logical sequence of events could be interpreted – in this case, it was probably a person leaving the house through the balcony and terrace. Since the data also contained a number of events that were not related to each other because their temporal sequence was disrupted by the fact that they originated on different sensors from different residents of the house, we were able, thanks to the process mining method, to identify in the sequences found recurring habits the house's residents.

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With this kind of approach, we can map the behavior of a system, find repeating sequences that identify some common processes in the system, and subsequently monitor this system and evaluate at certain time intervals whether it is still behaving normally. With the example used, we tried to point out that not only can information systems be analysed using process mining methods, but they can also be used, for example, for events generated by an independent group of primitive sensors.

8. Conformance checking

In this section, we will verify the explicitly described processes in the system that we have available while adhering to the processes in the real operation of the system. The main motivation for this type of control is to verify whether actual processes carried out in the system comply with the rules stipulated by management, the government, or other interested entities. This is an audit of the system's functioning, and its result may be the uncovering of embezzlement, security incidents, or misuse of a system.

The analysis will once again be based on the availability of a log containing events from the actual operation of the system and BPMN models of the processes intended for examination in the real system operation. The outcome of such monitoring should indicate the current process's conformity with its design in the BPMN diagram. This encapsulates the fundamental concept of conformance checking, which will be employed in our analyses.

The BPMN diagram is used as an input because, in practice, it is the most used way of recording processes in both business and technical environments. Its basic problem is that it cannot be formalised, which is why Petri nets are used in the analyses, which have formal semantics, and the models they described can be formally verified. The conversion of a BPMN diagram to a Petri net can be done using various procedures (Frank Front Door Motion & Brightness 2024).
Among the basic methods for conformance checking are:

- Comparing the footprint matrix of the log and the model.
- The token-replay algorithm in the Petri net corresponding to the model.
- Alignments algorithm.

Our goal differs from the purpose of using a conformity test. Although it is interesting for us to know how exactly the agreed processes are followed in practice, we are mainly interested in situations when the real process in the system does not go according to design. All three algorithms, however, analyse the event logs using individual identified sequences, so it is not a problem to modify the algorithms so that the sequences of events from the log that do not correspond to the designed process are flagged in some suitable way.
We will discuss individual algorithms in more detail.

8.1 Comparing the footprint matrices

The algorithm's operation principle lies in the fact that it creates a footprint matrix for a given log, which represents the dependence of two events on each other. In the same way, it creates a footprint matrix for the process model against which the log will be compared. We use the definitions of relationships between events from the Process discovery section to create a footprint matrix. Let us assume we have identified the following sequence of events in the event log: {<A,B>, <A,C,D>}.
We create a footprint matrix from them:

Table 2. Sample footprint matrix for the log

	A	B	C	D
A	#	->	->	#
B	<-	#	#	#
C	<-	#	#	->
D	#	#	<-	#

Source: own processing

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The first row of the matrix was constructed by scanning the sequences of events from which we found that:

1. Event A never occurs after event A; therefore the character "#" appears at position [A,A].
2. Event B occurs after event A (see the first identified sequence); therefore [A,B] contains "->"
3. Event C occurs after the event A (see the second identified sequence); therefore [A,C] contains "->"
4. Event D never occurs after event A; therefore [A,D] contain "#".

Let us assume that the footprint matrix obtained from the model looks like this:

Table 3. Sample footprint matrix for the log

	A	B	C	D
A	#	->	->	->
B	<-	#	#	#
C	<-	#	#	->
D	<-	#	<-	#

Source: own processing

From the footprint matrix of the model, we see that the sequence of events (A, D) is also enabled in the model, but it does not appear in the log. This creates for us a difference between the matrices. The relation determines the similarity (fitness) of the matrices (Van der Aalst 2016).

$$1 - \frac{number \quad of \ differences}{number \quad of \ relations},$$

which in our case gives the value $1 - \frac{2}{16} = 0.875$.

To identify suspicious behaviour in the system, the similarity value is indeed interesting, but to determine whether this is some kind of incident in the system, we need to analyse the differences. However, we can get them very easily when we compare the matrices. Specifically, in this case, when examining the log, the absence of a sequence of events (A, D) that the model permits but which did not occur in real operation should be analysed. The sequences that occurred in the log are equally interesting, but the model does not allow for them.

Another option for using footprint matrices is to compare two logs obtained from different periods of system operation. The procedure could be such that we declare the log obtained for a specific period as the standard and, monitor the following periods and compare them with the standard. We then analyse the individual differences in the sequence of events in both compared logs in more detail – if it is an expected or "secure" sequence, we adjust the standard by supplementing this sequence of events. We will thereby gradually build a model of the system's standard behaviour as described by the footprint matrix, against which we can then continuously compare the real operation of the system and thus identify potential incidents.

8.2 Token-replay algorithm

The algorithm's main idea is to replay the running of one sequence of events on a model, represented by a Petri net. Replaying a sequence in a Petri net takes place according to the definition of a Petri net, with the difference that if an event from the sequence cannot be played because it does not have the necessary tokens at the input places, we create the missing tokens and count them in the missing tokens counter. Likewise, if any tokens in the Petri net remain unconsumed after the sequence is played, we count them in the remaining tokens counter. Overall, we define 4 counters that maintain counts for:

1. created tokens (p),
2. consumed tokens (c),

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3. missing tokens (m),
4. residual tokens (r).

$$\left(1-\frac{m}{c}\right)+\frac{1}{2}\left(1-\frac{r}{p}\right)$$

We demonstrate the execution of the algorithm using the process illustrated in Figure 2, depicting the procedure for making adjustments to sensitive data. In practice, however, we can acquire from the logs only events from the administrator's activity and, independently of them, events from the supplier's activity after gaining access to our system. Because we are working with a very general definition of an event, we cannot expect to be able to relate the granting of access by administrator A to user B and that the events raised on the system by user B are somehow related to events from A. In general, we can analyse the actions of an administrator and the actions of a user only independently of one another. So, let us see what a Petri net created from a system administrator process would look like:

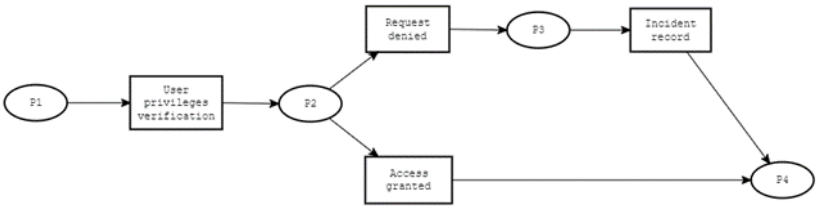

Figure 6. Petri net representing the process for the system administrator

Source: own processing

Let us assume we can find the corresponding events in the log for the individual displayed events. For example, we can verify the event of verification of the applicant's authorisations in the log by looking for a record of the administrator's access to the repository with approved requests (of course, whether he really opened the request and verified access, we don't see that in the log). Let us assume that we have from the log analysis the following event sequences: {<Verification of Requester Authorisation, Access Granted>, <Access Granted>}. We will now replay both sequences on the Petri net for the administrator's process. The first sequence contains events in this order: Verifying the Requester's authorisations, Access Granted. The procedure for playing this sequence on a Petri net looks like this:

1. From the surroundings, we insert a token at the input place in the Petri net (Figure 7):

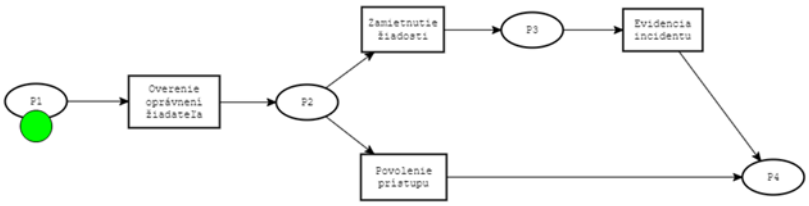

Figure 7. Petri net with a token in P1 place

Source: own processing

We will set counters for created (p), consumed (c), missing (m) and residual tokens (r) as follows: p=1, c=0, m=0, r=0.

2. The first step of the verified sequence is Verifying the Requester's authorisations. According to the definition of a Petri net, we can perform this step if all input places to the corresponding transition of the Petri net contain a token. In this case, this applies – the token is at P1, which is the only input place to the transition labelled as Verifying the Requester's Authorisations. The transition is done by

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consuming the tokens at the input places and creating tokens at all the output places from the transition (Figure 8):

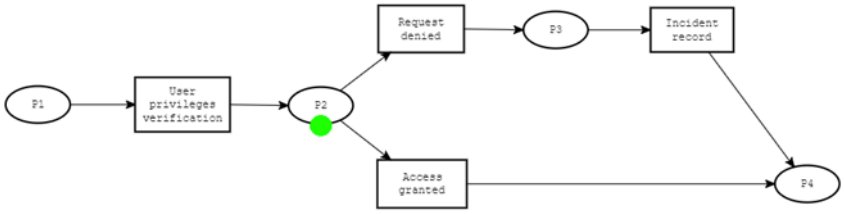

Figure 8. Petri net with a token in P2 place

Source: own processing

We increase the counters for produced and consumed tokens by 1: p = 2, c=1, m=0, r=0.

3. The next step in the verified sequence is Access Granted. In the current Petri net, we can perform this transition if all the input places to this transition contain a token, which is true in our case. So, we consume the token from location P2 and create tokens at all the output places of the Access Granted transition, which in our case is location P4 (Figure 9):

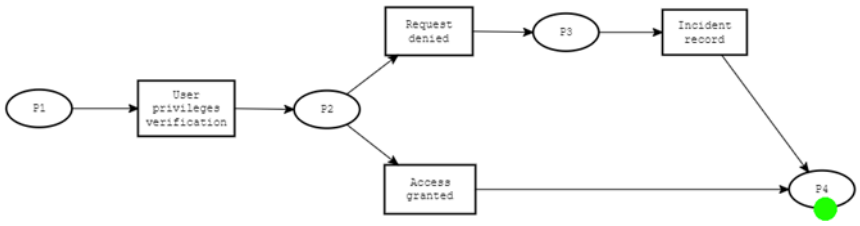

Figure 9. Petri net with a token in P4 place

Source: own processing

We increase the counters for created and consumed tokens by 1 again: p=3, c=2, m=0, r=0.

4. There is no longer any transition beyond the P4 location; therefore, the token on it will be consumed by the surrounding area. We increase the counter for consumed tokens by 1: p=3, c=3, m=0, r=0.
5. We calculate the similarity of the analysed sequence with the model according to the relationship.

$$\frac{1}{2}\left(1-\frac{m}{c}\right)+\frac{1}{2}\left(1-\frac{r}{p}\right)=\frac{1}{2}\left(1-\frac{0}{3}\right)+\frac{1}{2}\left(1-\frac{0}{3}\right)=1$$

The conformity of 1 means that the verified sequence of log steps fully matches the model and thus has run in accordance with it.

We will now look at the opposite case, a sequence in the event log that contains only one step: Access Granted.

1. We again start with a Petri net, in which the surroundings create a token for us at the input place (Figure 10):

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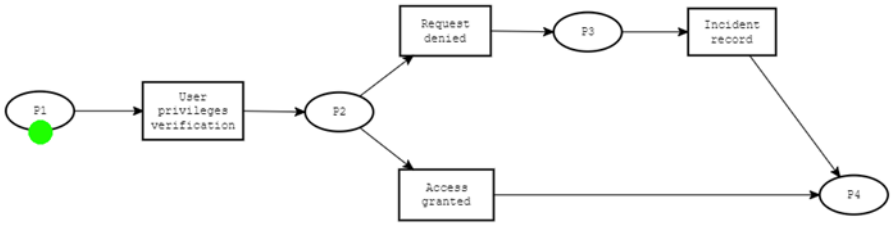

Figure 10. Petri net with a token in P1 place

Source: own processing

p=1, c=0, m=0, r=0.

2. The first step in the sequence is Access Granted. However, we cannot perform this step in the Petri net because there is no token at the input place to this transition (place P2). We produce a token on it and add 1 to the counter of missing tokens (Figure 11):

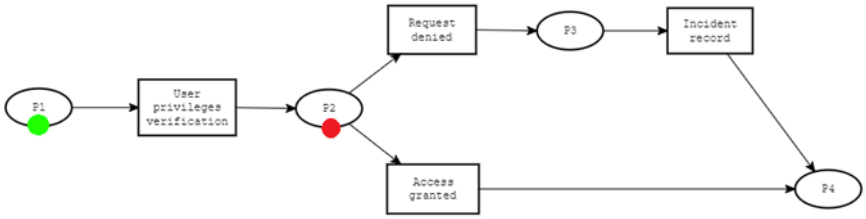

Figure 11. Petri net with a token in P1 place and a missing token in P2 place

Source: own processing

p=1, c=0, m=1, r=0.

3. In this Petri net configuration, we can now perform the transition. So, the Access Granted thus consumes a token at the input place and creates a token at the output place, which in this case is location P4 (Figure 12):

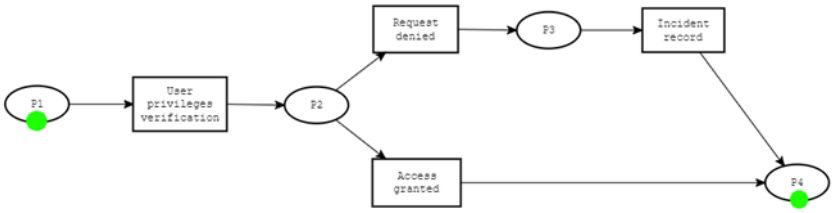

Figure 12. Petri net with tokens in places P1 and P4

Source: own processing

p=2, c=1, m=1, r=0.

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4. The token from location P4 is consumed by the surroundings because no further transitions follow it. The verified sequence has no further steps, so the final configuration of the Petri net will look like this (Figure 13):

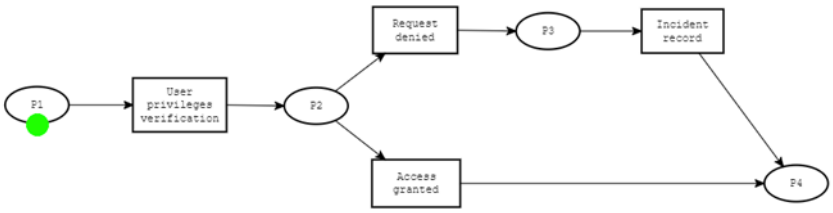

Figure 13. Petri net with remaining token in place P1

Source: own processing

We add the consumed token from P4 to the counter c, and we have an unconsumed token left at place P1, which we add to the counter of remaining tokens r. The final state of the counters is as follows:
p=2, c=2, m=1, r=1. The similarity of the verified sequence with the process model is then given.

$$\frac{1}{2}\left(1-\frac{m}{c}\right)+\frac{1}{2}\left(1-\frac{r}{p}\right)=\frac{1}{2}\left(1-\frac{1}{2}\right)+\frac{1}{2}\left(1-\frac{1}{2}\right)=0.5$$

Thus, the verified sequence only partially matches the model. As a secondary output of the Petri net marking process, we will use the residual tokens, which indicate which activities of the model did not run well in reality. We can, therefore, analyse them in more detail in terms of the severity of non-conformity with the prescribed process or from the point of view of the occurrence of a possible incident.

8.3 Alignment algorithm

The token-replay algorithm is efficient and easy to understand but has shortcomings. With a more complicated Petri net, it may not follow the most appropriate path given by events from the log. The alignment algorithm aims to systematically search the Petri net and find the most accurate matches between the verified sequences of events and the corresponding paths in the Petri net. However, this approach is computationally demanding (Frank Front Door Motion & Brightness 2023). It is unsuitable for analysing events in more complex systems, especially if we wish to analyse events in the system in (almost) real time.

Conclusions

In this article, we have taken a closer look at process mining and the possible use of its methods in the field of system monitoring to reveal non-standard behaviour in a system. In our analyses, the operation of a system was described only by a log of events that occurred in a system. The events were represented with only a few basic attributes, such as the time, originator, and event type. With a little work, creating such a log from ordinary log records of information systems and using the process mining method to analyse them is possible.

We demonstrated the process of analysis to detect processes in the system by simply logging events generated by the motion sensors of a private house. By doing this, we pointed out that even though we are dealing with systems, we can also apply the used methods to a group of primitive sensors, each of which independently generates events, and from an analysis of them, we are able to estimate the behaviour of the residents of the house. Suppose we have data obtained in this way. In that case, we can monitor the system in real-time or at time intervals and detect deviations in its behaviour that may represent a security risk.

The second main direction of research in process mining is testing the conformity of the actual operation of the system to the process model. We presented two methods: the comparison of footprint matrices and the token-replay algorithm on a Petri net constructed from a process model. In both cases, we proposed simple modifications of the algorithms, the purpose of which is to point out the differences in the system's behaviour compared to the model to identify potential incidents in the system's operation.

The application of the mentioned processes in combatting hybrid threats primarily covers cyberspace. Because we can assume the analysis of events, the system must somehow generate them – which automatically brings us into information technology. We can thus identify deviations in the behavior of the information systems of companies of interest and thus identify attempts at hacking, attacks in cyberspace, or industrial espionage. The use of methods from the field of process mining has the advantage that many companies (and thus also the information systems they use) have their internal processes described to a greater or lesser extent. To increase security and protection, other processes can be defined so that their subsequent monitoring is beneficial for the system's overall security.

In conclusion, this scientific exploration of process analysis as a long-term sustainable concept in combating hybrid threats underscores the importance of dynamic and adaptive strategies in our evolving security landscape. As we continue to witness the proliferation and sophistication of hybrid threats, it is clear that traditional, static security measures are insufficient.

Our findings emphasise that process analysis offers a valuable framework for organisations and governments alike to develop comprehensive and resilient approaches to threat mitigation. By continually assessing and improving their processes, entities can enhance their ability to detect, respond to, and recover from hybrid threats effectively.

Moreover, this research highlights the need for a holistic perspective on security, one that transcends traditional silos and embraces cross-functional collaboration. Stakeholders across sectors must collaborate, sharing insights, best practices, and threat intelligence to strengthen our defences collectively.

As demonstrated in this study, process analysis is not a one-size-fits-all solution. Instead, it is a dynamic and iterative approach that requires ongoing commitment and investment. However, its potential to enhance an organisation's resilience against hybrid threats cannot be overstated.

In an era where the threat landscape is constantly evolving, process analysis provides a forward-looking strategy that aligns with the principles of adaptability and continuous improvement. It empowers organisations to stay ahead of emerging threats and to develop sustainable, long-term security practices.

In conclusion, process analysis offers a promising path forward as hybrid threats continue to challenge our security paradigms. By integrating this approach into our security strategies and fostering collaboration across disciplines and sectors, we can collectively work toward a safer and more resilient future in the face of evolving threats.

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PERFORMANCE MEASURING OF WOOD-PROCESSING MICROENTERPRISES THROUGH DATA ENVELOPMENT ANALYSIS: A CASE STUDY OF SLOVAKIA, POLAND, AND BULGARIA

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Abstract. In the context of the role the wood-processing industry has in Slovakia, Poland, and Bulgaria, as an income provider in rural regions and contemporary challenges like inflation and intensive competition, there is a need to assess the performance of microenterprises using Data Envelopment Analysis (DEA), considering the crucial role these entities play in the regional economies. The aim is the creation of a more universally applicable DEA model for assessing the efficiency and performance of wood-processing microenterprises, taking into account the unique challenges and opportunities in Slovakia, Poland, and Bulgaria, defining the profile of optimal enterprise according to methodology in the current research, and indicating the leading problems in their performance. In their management, wood-processing enterprises respond to changes in the external environment, pursuing profit extraction in the competitive struggle. Comparisons with similar companies provide data on the economic efficiency of the sector and the gaps the enterprise needs to correct. Data from the Eurostat Structural Business Statistics were involved for 2011-2020. The current study used Data Envelopment Analysis (DEA), a nonparametric technique that allows enterprises to compare their efficiency frontiers and, from there, reveal their competitiveness. Thus, they can be arranged and measured, and the differences between the inputs and outputs of enterprises can be measured, as well as the efficiency. The results revealed that all the surveyed countries have a problem with the gross value added by a wood-processing micro-enterprise. Polish and Bulgarian enterprises have a problem with pure technical efficiency. Slovakian enterprises have excellent performance and can be used as a benchmark in optimizing the activities of Polish and Bulgarian enterprises.

Keywords: DEA; benchmarking; competitiveness; wood-processing industry; microenterprises

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1. Introduction

Micro and small enterprises are among the main driving forces of the economy. The close connection between the entrepreneur and the strategic and stable development of his business is particularly prevalent in micro and small enterprises due to the great connection between personal survival and the company's performance. The

forest industry uses resources from the forest regions of the countries. These regions are often not economically developed or rely mostly on forestry and related industries, mainly in wood-processing industry enterprises. Micro enterprises include employees of up to 9 persons. This creates the potential for using family business principles (Porfírio, 2020). This way, good performance in good economic efficiency provides welfare and better economic conditions to the local communities in the regions with developed wood-processing industries.

Micro enterprises function in an uncertain environment. The availability of sufficient information is vital to the performance level of the business activity (Kononiuk, 2022). It is challenging for micro and small enterprise entrepreneurs to get the necessary information to make the right decisions. Benchmarking, as an approach to compare different performance characteristics, can successfully support management decisions in many industrial enterprises (Zhang et al., 2017). It allows comparison with other enterprises and assessment of the state of a given enterprise relative to them. The wood processing industry includes the woodworking, furniture pulp, and paper industries, and the potential for comparison is interesting. The wood processing enterprises in the EU function in different environments, but they have many things in common. Comparison between different enterprises clarifies the possibility of using the best practices (Ruiz and Sirvent, 2016) for improvement. When comparing wood-processing enterprises between countries with Data Envelopment Analysis of the EU, it is possible to place an efficient frontier that can be used as a union target, regardless of the country specifics. DEA is a nonparametric mathematical methodology that includes many models in it. It was developed by Charnes et al. (1978) or the so-called CCR model, latterly complied by Banker et al. (1984) with their BCC model and developed in many directions by a lot of research until nowadays.

The current research is in line with studies like those of Guan et al. (2006), Baek and Lee (2009), Pastor and Aparicio (2010), Ruiz and Sirvent (2016), De et al. (2020), and others dedicated to benchmarking with DEA. This approach is quite suitable for performance measurement. Takouda et al. (2022) used DEA for performance analysis of financial inclusion in the West African Economic and Monetary Union's economies. Henriques et al. (2023) used Slack-based measurement of DEA to evaluate the performance of US and European exchange-traded funds. Ammirato et al. (2022) developed the performance measurement, further proposing innovative composite indicators to measure and control the performance of production processes. Tsolas (2020) measured performance differences between 62 precious metal mutual funds using weighted additive data envelopment analysis (DEA). Other authors like Dia et al. (2020), Neves et al. (2020), and Qayyum and Riaz (2018) used DEA for benchmarking and performance measurement in the banking sector in various ways, which proved the applicability of this approach. Horváthová et al. (2021) used DEA for benchmarking and performance measurement to provide necessary information for improving business performance. The current study provides an assessment through DEA efficiency scores of wood-processing micro-enterprises in Slovakia, Poland and Bulgaria and indicates the efficiency targets by comparing these three countries with the EU levels of efficiency as a benchmark. The study also evaluates the performance of wood-processing microenterprises in Slovakia, Poland, and Bulgaria across the research period. This article reveals the leading problems in their performance. The three countries were chosen to indicate the nature of the performance of two Central and one East European countries, which have had different genesiss in the last 10 years.

In this study, we gauge the enterprises' success in attaining managerial goals, utilizing their efficiency as a metric. The study's overarching question, formulated in alignment with its defined objectives, is: Can we discern the performance constraints of wood-processing enterprises in the examined Slovakia, Poland and Bulgaria through an assessment of efficiency?

2. Theoretical background

When comparing the wood-processing enterprises, the researchers used different methodologies and indicators as variables. Sedliačiková et al. (2016) analyzed the performance of wood-processing enterprises in financial controlling. For Performance Measurement Systems (PMS), the Key Performance Indicators (KPI) scale is very

important (Hyránek et al., 2021; Mihalčová et al., 2021; Du et al., 2022; Ferreira and Silva, 2022; Bumba et al., 2023). The variables are based on a particular survey, which is valuable when a problem is profoundly studied in industrial enterprises. Michal et al. (2021) analyzed the performance of woodworking enterprises in the Czech Republic. They conducted a statistical comparative analysis of the Czech Republic and several other countries. It appeared that Poland is among the most effective countries in the sample. The authors used variables such as wooden raw materials for production and the final products in processed wood. Stojčić et al. (2019) investigated the effect of clustering on the wood-processing company's performance. They compared the EU28 members to Slovenia and Croatia. The variables in their methodology, which is parametric (a regression model), are unit costs, subsidiaries, market concentration, turnover, the productivity of labour, etc. The authors comment on the efficiency of the labour. They found that labour productivity is higher in clusters than in individual enterprises. This is a typical example of a parametric measure of labour efficiency by implementing ratios. When using parametric approaches, the variables are usually grouped according to the purpose of the estimation. In DEA this is not necessary. When using DEA, the usual variables are considered inputs and outputs. There is a practice that follows the main production inputs (Woodwell, 1998) in economics. One of the problems using DEA (called "pitfalls" by Dyson et al., 2002) is the so-called "rule of thumb" (Khezrimotlagh et al., 2021) that requires the number of the DMUs to be at least three times more than the sum of inputs and outputs. The outputs in many DEA studies also have many in common. Chen (2004), Hua et al. (2007) and Ning et al. (2018) used the total revenues along with other specific outputs according to their studies. Tsolas (2011) used the production quantity in natural units, such as tones. Some authors (De et al., 2020) use lean practices and sustainability-oriented innovations as outputs, but this is a particular case of DEA problem formulation. Many others (Baek and Lee, 2009) use trivial outputs as revenues and production value. Sedivka (2009) analyzed the technical efficiency of 203 sawmills in the Czech Republic. He used a parametric approach with a stochastic frontier and double logarithmic regression model for the Cobb-Douglas production function. The variables in the model are many and include direct costs, labour costs, the value of timber, and times for production operations. Sedivka (2009) found that direct costs and the value of soft timber hurt the efficiency of the investigated sawmills. Trigkas et al. (2012) used DEA to analyze the efficiency of 17 furniture and wood-processing enterprises. They implemented the causally related inputs like innovation costs and revenues (sales) as outputs. The study's results revealed higher efficiency after introducing innovations in their products and processes. Salehirad and Sowlati (2005) investigated the performance of 82 sawmills in Canadian British Columbia. They used an output-oriented DEA CCR model (Charnes et al., 1978). For inputs, the authors implemented some employees into the model logs and, as outputs, lumber and chips. This is a way to utilize the DEA model without considering expenditures or prices. Results of the study showed that the mills perform well in scale efficiency but have shortages in pure technical efficiency. The authors point to the low labour productivity as the main reason for this. For this reason, using naturally measured inputs/outputs in DEA, like m3, tones, and kilograms, can be very beneficial when assessing labour productivity. This is not possible when wood-processing enterprises produce different products. Sari et al. (2018) calculated the DEA efficiency of 10 furniture enterprises in Indonesia. They used labour as input as well as electricity and other costs. The productivity of labour appeared to be vital for the total efficiency level. Kovalčík (2020) used DEA for performance analysis of Slovak forestry in some forest regions in the country. He discovered that the efficiency of forestry hardly depends on outsourcing the forest activities. This interesting result involves the costs for services and outlines their role in efficiency. The same authors (Kovalčík, 2020) and Gutiérrez and Lozano (2020) made cross-country efficiency comparisons of forestry through the DEA. The research of Gutiérrez and Lozano covered 29 countries, including Bulgaria and Slovakia. Kovalčík analyzed 22 countries and covered indicators for entire forest sectors in each studied country. Korkmaz (2011) and Šporčić et al. (2009, 2014) used a nonparametric approach with CCR and BCC DEA to calculate the efficiency of forestry units at the level of enterprises. They combined inputs and outputs measured in value and quantities. This very beneficial property of the models is not always applicable in parametric techniques. Kropivšek and Grošelj (2019) analyzed by DEA the financial performance of sectors C16 "Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials" and C31 "Manufacture of Furniture", through window analyses in which every sector is threatened as different DMU in each year. In the scientific literature, efficiency and competitiveness are considered common phenomena. Villaverde et al. (2020) directly associate efficiency with the competitiveness of wood enterprises and state entities. Lundmark (2021) used DEA and other approaches to estimate the competitiveness of Swedish forest regions. Charles and Zegarra (2014) and Martin et al. (2017) narrowly used DEA for competitiveness estimation.

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Summarizing some of the research based on the problem of forest-based industries and forestry as an actor in the wood supply chain in the current study provides a comparative table outlining some of the significant research gaps that can be addressed (Table 1).

Table 1. Comparative table of studies related to the problems of the present study

Study	Methodology	Observed indicator	Factors of influence	Application	Gaps
Stojčić et. al. (2019)	Regression-based	Labour productivity, Firm size, Sales revenues, Export propensity, Export performance, Wage premium, High growth firm	Unit labour costs (%), Unit material costs (%), Market concentration, Urbanization economies, Localization economies	Analysis of wood-processing clusters performance	There is no efficiency estimation and microenterprises analysis by different indicators
Michal et al. (2021)	"Black-calculation", various statistical indicators	Sales, value-added and income tax per one cubic metre, roundwood, chips and pulpwood	ROE, length of employment of the certification systems in the companies	Analysis of wood-processing enterprises in the whole NACE C16 sector	Lack of microenterprises distinguished analysis, efficiency is contextually measured
Kovalčík, M. (2018)	DEA CCR and BCC	Efficiency of forest enterprises	Inputs: Compensation of employees, fixed capital consumption, other taxes on production, interests, and rents paid Labour, material and overhead costs Outputs: Total output of the forestry, other subsidies on production and interest receivable	Efficiency of Slovak forestry in comparison to other European countries	There is not considered the specifics of the efficiency according to the enterprise size
Sari et al. (2018)	DEA CCR	Efficiency of small and medium-sized enterprises	Inputs: Labour, material and overhead cost Outputs: The amount of wood furniture produced in units, s	Assessing the efficiency of small and medium-sized wood-furniture enterprises: a case study	Lack of direction of enterprises to achieve improvements
Zhang et al. (2023)	DNSBM	Carbon emissions efficiency of China's provinces	Inputs: Labour, capital, energy per unit of output. Outputs: Wooden raw materials, wood-processing output, carbon emissions	Carbon Footprint Assessment and Efficiency Measurement of Wood Processing Industry Based on Life Cycle Assessment	Province level of analysis, no enterprise's recommendations

Source: own processing

Table 1 shows that the studies related to the issues of enterprises in the forest industry consider generalizing indicators for a sector or enterprises that do not lead to specific recommendations, with a high practical orientation. At the same time, micro-enterprises do not fall into the main focus of research, but they are leaders in the entrepreneurial ecosystem of the studied countries.

While existing literature employs various methodologies and indicators to assess the performance of wood-processing enterprises, there is a lack of standardization or consensus on the specific set of inputs and outputs

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considered in DEA analyses. Each study uses different combinations of inputs (such as labour and capital) and outputs (like total revenues and quantity of production) based on the context of their research. The research gap appears in establishing a standardized and comprehensive set of inputs and outputs tailored explicitly to the wood-processing microenterprises. The aim is to create a more universally applicable DEA model for assessing the efficiency and as a prerequisite for the performance of wood-processing microenterprises, considering the unique challenges and opportunities in Slovakia, Poland, and Bulgaria. By developing a standardized set of inputs and outputs, the research can contribute to the comparability and generalizability of DEA results across different enterprises.

3. Materials and methods

In the current research, the implemented methodology is based on the classical DEA models (CCR – Charnes, Cooper and Rhodes, and BCC – Banker, Charnes and Cooper) and some additional indicators that reveal different aspects of efficiency. In CCR models, the DMUs (Decision Making Units) are accepted without consideration of their scale, until in BCC models, the scale of each DMU is taken into account, and the model calculates the pure technical efficiency scores. The current study uses an in-put-oriented DEA model as it emphasizes improving efficiency by minimizing input usage while keeping outputs constant. This aligns with identifying areas like wages, personnel, or purchases of goods where microenterprises can enhance their performance by using resources more effectively.

Mathematical expressions of the DEA CCR input-oriented model are following (Charnes et al., 1978; Banker et al., 1984):

$$\min \theta$$
$$\sum_{j=1}^{n} \lambda_j x_{ij} \leq \theta x_{i0} \qquad (1)$$
$$\sum_{j=1}^{n} \lambda_j y_{rj} \geq y_{i0}$$

$$\lambda_j \geq 0, \forall j$$

where λj are the individual scalars of each DMUj j∈[1, 25], x_{ij} are the amounts of inputs of type i∈[1, 3] in DMU j, xi0 is the amount of i-th input of DMU_0 being under efficiency estimation. The yrj are the outputs of type r in DMU_j, and the consequent yr_0 for the DMU_0 is being assessed. If the sum of lambdas (λ) equals unity (Σλ=1), then the model becomes BCC with variable returns to scale. The BCC efficiency is the pure technical efficiency (PTE), also called BCC or VRS (θ_{BCC}).

Estimating improvements in the inputs are made through well-established and explained slack literature (Banker, 1989). The expressions for that are the following:

$$\sum_{j=1}^{n} \lambda_j x_{ij} + s_i^- = \theta x_{i0}$$
$$\sum_{j=1}^{n} \lambda_j y_{rj} - s_j^+ \geq y_{i0} \qquad (2)$$
$$s_i^-, s_j^+ \geq 0$$

where s_i^- denotes the input slacks, s_j^+ denotes output slacks. If the input slack is not zero for DMU_0 than it can be subtracted from the input i and if any output slack is not zero it can be added to DMU's j output.
The scale efficiency (SE) is a combines the CCR and BCC efficiencies. It is a proportion of CCR efficiency in the BCC efficiency. The expression of SE is as follows (Bielik and Rajčániová, 2004):

$$SE=\theta_{CCR}/\theta_{BCC} \qquad (3)$$

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where θ_{CCR} is the constant returns to scale DEA efficiency of model CCR and θ_{BCC} is the constant returns to scale DEA efficiency of model BCC. If SE<1, the DMU_0 is scale inefficient. The returns to scale assessment in the current study is provided by the sum of lambdas following the research of Banker et al. (2011).

The selection of Bulgaria, Poland, and Slovakia is based on the economic significance of the wood-processing industry in these countries, the regional impact of microenterprises, the contemporary challenges they face, and the aim to create a universally applicable DEA model that considers unique challenges and opportunities in each country. The comparative analysis enhances the understanding of efficiency and performance in the wood-processing sector across different national contexts. These countries travelled their way after the economic system change in 1989. The analysis in the current research shows how the wood processing enterprises dial with the efficiency under contemporary conditions. The analysis is made using two different research lines, according to the formulation of the DEA problem. The first direction or line of research is benchmarking the Polish, Slovakian and Bulgarian microenterprises with those in other EU countries. The DMUs include the EU countries with their data for microenterprises in economic sector C16 "Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials". In this way, the efficient EU microenterprises define the efficient frontier. The second direction is based on the efficient frontier defined by the years or windows (Jia and Yuan, 2017) of the best performance of microenterprises in each country. This analysis compares the microenterprises to their most efficient year during the research period.

Authors that investigate the efficiency of enterprises use different inputs and outputs. Kovalčík (2018) used compensation for employees' fixed capital consumption, other taxes on production, interests, and rents paid for the whole of Slovak forestry. Korkmaz implemented DEA with Capital, Production costs, Employee costs, Total amount of employees again for the entire set of enterprises. Sedivka (2009) used a set of variables close to those used in the current research but didn't use the DEA model. Some authors used labour and capital invested (Hua et al., 2007; Yang et al., 2016; Tsolas, 2011; Zhang and Xu, 2022; Ning et al., 2018). This practice follows the main production inputs (Woodwell, 1998) in economics. There are many approaches in inputs/outputs selection. Still, in the current research, the simplicity of interpretation and applicability in practice provoked the choice of variables used in the current study. The inputs for both lines of research are the following:

- Wages and Salaries per enterprise. When comparing microenterprises from different countries, excluding the national tax and social security features is valuable. That is why the Wages and Salaries data are more applicable than labour costs.
- Total Purchases of Goods and Services per enterprise. The value of these costs defines the risks for value added. Their reduction will ensure the capabilities of the microenterprises to be efficient.
- Number of persons employed per enterprise. This essential input reveals the productivity of labour in the post-estimation analysis.

For the output, Value Added at Factor Costs per enterprise is used. Whatever the microenterprises do, their ability to add value is the most important to them. That was the reason for choosing this indicator as the output. The final results of the comparison with DEA are the optimal values of the inputs and outputs. They are calculated by comparison with benchmarks. The benchmarks in the study are the following:

- The best performers of the EU countries (DMUs in this case). The efficient DMUs with $\theta=1$ and zero slacks are benchmarks for other DMUs with $\theta<1$. These benchmarks change every year according to the optimal lambdas.
- The average EU DMU. This benchmark, proposed in the current study, can compare the three countries with the average EU level. This is the standardized wood processing microenterprise involved in the study as a DMU.
- The best annual performance of the microenterprises separately in each country. Here, the DEA calculates an optimal solution of (1) and puts optimal lambdas to the years with the best performance. This benchmark compares the enterprises with themselves, not considering the performance of the European Union members. In this case the indexes are $j\epsilon[1, 10]$ and $i\epsilon[1, 3]$.

Data for the current study are delivered from the Eurostat database Structural Business Statistics, Industry by employment size class (EUSBS, 2023); Table 1 presents the wages and salaries per enterprise in the three studied countries and the average values for the other included as DMUs countries from the EU. They are 24

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(denoted as EU24), because Ireland, Luxembourg and Malta are excluded from the analysis. They have many zero values and this misleads the results.

Table 2. Data for the DEA analysis

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Wages and Salaries, thousands of EUR, per enterprise										
BG	3.19	3.59	3.85	4.39	4.95	5.42	5.57	6.29	6.65	6.89
PL	5.26	5.05	5.49	5.75	6.84	6.74	6.93	6.42	6.63	6.97
SK	1.60	1.34	1.42	2.01	2.12	2.16	1.94	2.58	2.98	2.73
EU24	19.83	19.77	18.74	18.57	19.42	19.58	19.42	19.13	20.61	21.68
Costs for goods and services, thousands of EUR, per enterprise										
BG	31.80	35.16	37.52	38.90	51.25	53.62	47.36	53.88	47.41	51.79
PL	64.96	72.75	77.25	57.66	61.18	57.11	55.97	85.67	87.86	78.20
SK	17.45	18.41	31.92	39.40	34.21	38.84	41.69	50.31	43.87	41.11
EU24	103.40	101.75	101.03	103.31	105.47	109.29	113.17	110.85	108.74	110.57
Persons employed, number per enterprise										
BG	3	3	3	3	3	3	3	3	3	3
PL	2	2	2	2	3	3	2	2	2	2
SK	1	1	1	1	1	1	1	1	1	1
EU24	2	2	2	2	2	2	2	2	2	2
Value added at factor cost, thousands of EUR, per enterprise										
BG	3.23	3.47	3.02	3.94	4.39	4.65	4.90	5.11	5.63	6.00
PL	6.08	6.94	6.30	7.45	5.69	5.74	3.36	9.11	10.63	9.05
SK	10.79	9.27	7.94	7.71	7.79	7.29	7.30	7.98	9.04	6.93
EU24	42.98	42.41	39.65	40.61	42.18	42.86	42.29	46.47	47.41	47.60

Source: EUSBS (2023)

The table illustrates an exceptionally high average level for the EU when compared to the surveyed countries. It is worth noting that Slovakia exhibits remarkably low wage costs, and in recent years, Bulgaria has been progressively approaching the levels observed in Poland. The overall trends are predominantly positive, except for the observed decline in recent years among Polish micro-enterprises.

The data in Table 1 indicate that costs for goods and services in Polish micro-enterprises closely align with the average EU24 level. Bulgarian enterprises, on the other hand, exhibit higher costs for goods and services compared to their Slovakian counterparts. Trends are notably positive for Bulgaria, Slovakia, and the EU24, while costs in Po-land demonstrate considerable instability. These fluctuations can potentially lead to a loss of efficiency for Bulgaria and Slovakia, though the impact on Polish enterprises remains unclear. As depicted in Table 2, Bulgaria leads in the number of persons employed among the studied countries. Bulgaria demonstrates a slight positive trend up to the EU24, while Poland experiences negative trends. Slovakia maintains a stable number of C16 microenterprises. Results further reveal that the output of the surveyed countries significantly lags behind the EU24 level, with Slovakia showing a negative trend. Bulgaria and the EU24 display positive and comparatively stable tendencies. Polish enterprises, although lacking a stable trend, exhibit a slightly positive trajectory. A comparison of input and output figures highlights the endangered efficiency in the surveyed countries, with a substantial difference from the EU24 level.

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The software for the DEA analysis used in the current research is Stata Version 14.0.

4. Results and discussion

The initial outcome involves a static analysis of the efficiencies in the three countries. The benchmarks are set by the most efficient countries within the EU, with the EU24 serving as the benchmark for the average EU efficiency level. The EU24 represents the average DMU for EU 27 countries, excluding Ireland, Luxembourg, and Malta, due to their lack of records in the database, potentially distorting the results. Throughout the period, the best performers varied each year. Notably, the efficient countries, specifically C16 microenterprises within each country, averaged over the period, include the Czech Republic, Netherlands, and Sweden for BCC efficiency, and only the Netherlands for CCR efficiency. The outcomes of benchmarking the investigated countries against the average EU level (EU24) are summarized in Table 3.

Table 3. Average efficiency scores and their standard deviation – σ

	CCR	σ	BCC	σ	SE	σ
SK	0.79	0.15	0.89	0.09	0.89	0.10
PL	0.52	0.10	0.55	0.10	0.93	0.10
BG	0.49	0.08	0.56	0.06	0.88	0.13
EU24	0.74	0.04	0.76	0.03	0.98	0.03

Source: own research

The findings presented in Table 3 indicate that Slovakia demonstrates the highest technical efficiency (θCCR=0.79) among micro-enterprises in the C16 sector, followed by Poland (θCCR=0.52), while Bulgaria exhibits the lowest performance (θCCR=0.49). Slovakian enterprises outperform the average EU microenterprise, attributed to their remarkably high pure technical efficiency θBCC=0.89, surpassing the EU24 score by 0.13 points (θBCC=0.76). This outcome underscores the adeptness of Slovak enterprises in effectively converting costs of wages and goods and services into gross added value. However, the scale poses a challenge for Slovakian enterprises, as their scale efficiency (SE=0.89) is lower than that of the EU24 (SE=98). This indicator suggests that within the EU24, microenterprises in the C16 sector exhibit superior scale efficiency. Slovakian enterprises also exhibit less stable efficiency than the EU24, with standard deviations of σ=0.15 for CCR, σ=0.09 for BCC, and σ=0.10 for SE. Polish enterprises face challenges with pure technical efficiency, scoring θBCC=0.55, significantly below the EU24 benchmark (θBCC=0.76). Polish enterprises exhibit evenly unstable efficiency across all types, with a standard deviation of σ=0.10. Bulgarian enterprises grapple with very low scale efficiency (SE=0.88). An intriguing phenomenon arises, indicating that stable low efficiency scores are more problematic than instability itself. Bulgarian enterprises record the lowest technical efficiency scores (θCCR=0.49) alongside high stability, with σ=0.08 for CCR and σ=0.06 for BCC, signifying sustained low efficiency in pure technical and technical efficiency. Scale efficiency exhibits high instability (σ=0.13) coupled with low efficiency scores (SE=0.88). For all the countries, the efficiency scores annually are presented in Table 4.

Table 4. Efficiency scores for each year of the research period

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Poland										
CCR	0.46	0.56	0.50	0.67	0.46	0.50	0.29	0.52	0.64	0.56
BCC	0.50	0.59	0.50	0.77	0.46	0.50	0.44	0.52	0.70	0.56
SE	0.93	0.96	0.99	0.87	1.00	1.00	0.66	0.99	0.92	0.99

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Slovakia										
CCR	1.00	1.00	1.00	0.86	0.75	0.68	0.72	0.62	0.67	0.61
BCC	1.00	1.00	1.00	0.88	0.83	0.82	0.88	0.76	0.76	0.92
SE	1.00	1.00	1.00	0.98	0.89	0.83	0.82	0.82	0.89	0.66
Bulgaria										
CCR	0.33	0.42	0.44	0.55	0.45	0.47	0.56	0.47	0.59	0.62
BCC	0.55	0.52	0.61	0.59	0.45	0.47	0.57	0.52	0.65	0.63
SE	0.60	0.81	0.72	0.94	0.98	1.00	0.98	0.92	0.91	0.99
BCC-EU24	0.74	0.70	0.79	0.78	0.80	0.76	0.73	0.75	0.75	0.80
SE-EU24	1.00	1.00	0.98	0.99	0.99	0.97	0.97	0.89	0.98	0.99

Source: own research

The presented results provide a broad view of which DMUs are efficient without differentiating them into "strongly" and "weakly" efficient (see Cooper et al., 2007). Table 4 illustrates that Slovakian enterprises exhibited scale efficiency with SE=1 and BCC=1 in 2011, 2012, and 2013. However, both efficiencies experienced a decline after that. Despite these negative changes post-2012, pure technical efficiency surpassed the average EU level (EU24) in 2017 and 2020. The SE levels post-2012 were lower than those of the EU24, with an additional drop in scale efficiency in 2020. Throughout the period, C16 microenterprises in Slovakia made decisions aligned with their performance to pure technical efficiency in the EU, but not in scale. Slovakian microenterprises are working under increasing returns to scale with $\Sigma\lambda=0.83$ (according to the interpretation of Banker et al., 2011), indicating a positive trend.

In contrast, Polish enterprises achieved scale efficiency (SE=1) in 2015 and 2016. Fluctuations in 2014 and 2019 led to instability ($\sigma=0.10$), as presented in Table 3. The results of the comparison of annual performance and efficiencies are presented in Table 5. This is the second line of research, as was described before. Following the formula of Yang and Chang (2009), the number of windows is 10 (10 years with 1 year width of the window).

Table 5. Results of DEA analysis using time windows as benchmarks for each country

	Slovakia			Poland			Bulgaria		
	CCR	BCC	SE	CCR	BCC	SE	CCR	BCC	SE
2011	1.00	1.00	1.00	0.76	1.00	0.76	1.00	1.00	1.00
2012	1.00	1.00	1.00	0.86	1.00	0.86	0.98	0.99	0.99
2013	0.81	0.97	0.84	0.72	0.98	0.73	0.81	0.99	0.82
2014	0.70	0.90	0.77	1.00	1.00	1.00	0.95	0.99	0.96
2015	0.70	0.90	0.78	0.72	0.96	0.76	0.96	0.98	0.98
2016	0.67	0.91	0.73	0.78	1.00	0.78	0.94	0.96	0.98
2017	0.68	0.93	0.73	0.47	1.00	0.47	0.97	0.97	1.00
2018	0.71	0.90	0.80	0.89	1.00	0.89	0.91	0.96	0.96
2019	0.80	0.89	0.91	1.00	1.00	1.00	1.00	1.00	1.00
2020	0.65	0.94	0.69	0.95	1.00	0.95	1.00	1.00	1.00
Average	0.77	0.93	0.82	0.81	0.99	0.82	0.95	0.99	0.97
σ	0.12	0.04	0.10	0.15	0.01	0.15	0.05	0.02	0.05

Source: own research

Slovakia demonstrated efficiency in the initial two years, with its enterprises exhibiting strong alignment with European trends. During this period, both technical and pure technical efficiency were achieved, showcasing effective scale and production methods. However, a subsequent decline in efficiency set in, with scale efficiency falling behind pure technical efficiency. Poland consistently maintained pure technical efficiency in almost every year. However, the enterprises did not adapt their BCC efficiency to align with European standards.

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Consequently, the management compared results to previous years rather than benchmarking against European enterprises in C16. Figure 6 illustrates the microenterprises' stability in technology and value-added maintenance when self-compared. Bulgarian enterprises adjusted their performance based on previous years, regaining efficiency in the last two years, mirroring their initial period's effectiveness. Like Poland, Bulgarian enterprises demonstrated independent management practices, deviating from European trends. As previously mentioned, the ultimate benefit of DEA benchmarking lies in optimizing input and output values. The research's recommendations are rooted in the methodological benchmarks, specifically the efficient countries and the average performer or microenterprise (EU24). The results, presented as input percentage changes, align with the input-oriented models. Table 6 delineates the necessary adjustments in input economies that the investigated countries should undertake to achieve benchmark performance.

Table 6. Improvements in inputs of each country's enterprises are necessary to achieve the optimal profile.

Benchmark	Efficiency type	Poland Wages and Salaries	Poland Goods and Services	Poland Number of Enterprises	Slovakia Wages and Salaries	Slovakia Goods and Services	Slovakia Number of Enterprises	Bulgaria Wages and Salaries	Bulgaria Goods and Services	Bulgaria Persons Employed
Efficient countries in the EU	CCR	-48%	-48%	-48%	-17%	-36%	-26%	-47%	-47%	-66%
	BCC	-46%	-46%	-51%	-6%	-28%	-17%	-61%	-43%	-60%
EU24 - average performer	CCR	-25%	-25%	-25%	-7%	-13%	-3%	-24%	-24%	-43%
	BCC	-24%	-24%	-28%	17%	-6%	6%	-39%	-20%	-37%

Source: own research

Table 6 shows the main areas in which enterprises in the studied countries should make improvements to improve their efficiency. Results for Polish enterprises are similar to Michal et al. (2021) for the Polish wood-processing industry. Pure technical efficiency consistently falls below the EU24 level, indicating cost challenges. According to the Central Economic Development Agency models, enterprises in Poland should reduce the costs of wages and goods and services by 48% to reach efficient levels and 46% to achieve pure technical efficiency. Bulgaria is very close to Poland in this respect. Bulgaria lags significantly in terms of the need for improvements. Bulgarian enterprises must optimize pure technical efficiency according to the higher improvement requirements suggested in Table 6. The primary attention there should be paid to the number of personnel, it is necessary to make a 66% improvement in the number of people employed and 47% in wages and salaries. The models imply that staff leads in improving performance. In combination with the need to reduce labour costs, the present study hypothesizes low labour productivity in enterprises in these countries. As revealed by Kropivšek and Grošelj (2019), Slovakian enterprises demonstrate high efficiency. Slovakian enterprises have modest requirements for economies, with a 28% reduction in costs for goods and services for pure technical efficiency. A 17% improvement in wages and salaries is necessary for CCR efficiency, 36% in costs for goods and services, and 26% in persons employed. Positive values in Table 6, when benchmarked against the EU24 average enterprise, indicate a better comparative position. Challenges arise concerning scale (see Table 3), but Slovakian enterprises are better than the Bulgarian ones. Slovakian wood-processing microenterprises can serve as benchmarks for the average EU enterprise in wages and salaries, which can be hypothesized to be a result of improved internal processes (see Malá et al., 2017) and despite the tax burden (see Gombár et al., 2022).

The results presented, addressed the research question, and identified directions for improvement of wood-processing micro-enterprises in Slovakia, Poland, and Bulgaria through DEA benchmarking. This validates the applicability of research methodologies such as those employed by Baek and Lee (2009), Pastor and Aparicio (2010), Ruiz and Sirvent (2016), and Zhang et al. (2017). The study also emphasizes the potential of enterprises based on past performance, emphasizing the difference between average efficiency levels and their best years. Optimizing implicit costs like taxes, as suggested by Dobrovič et al. (2016) and Korauš et al. (2021), would enhance competitiveness in international markets. These conclusions align with the findings of Trigkas et al. (2012), who analyze efficiency variation and identify development opportunities for both low-efficiency and efficient DMUs. In conclusion, the study reveals that Polish enterprises have significant potential for increasing labour productivity, while Bulgarian enterprises have a lower potential. During the research period, Bulgarian

enter-prises did not significantly change their capabilities. Implementing the economies outlined in Table 5 would help them achieve their best, although this achievement may not be substantially different from EU benchmarks. The introduction of digitalization (Šimberová et al., 2022) and risk assessment (Kollmann et al., 2023) in their activities provides tools for improving the efficiency, competitiveness, and sustainability, in line with studies dedicated to the wood-processing industry (Kovalčík, 2020; Gutiérrez and Lozano, 2020; Sari et al., 2018; Šporčić et al., 2014).

Conclusions

The empirical study and its findings underscore the suitability of DEA as a methodology for benchmarking and guiding strategies to enhance competitiveness. It furnishes insights into a company's positioning relative to competitors, similar organizations, or its historical performance. The examination of initiatives across the three countries yielded markedly disparate results. Regarding the defined research question, it can be affirmed that the initial suspicion of Slovakian enterprises operating similarly to those in Bulgaria or Poland was not substantiated. All surveyed countries face challenges related to the gross value added of micro-enterprises in sector C16. Polish and Bulgarian enterprises encounter issues with pure economic efficiency, as evident from the marginal disparities in the economies required for overall technical efficiency. A significant hurdle for Polish and Bulgarian companies lies in labour productivity, with a notable distinction – Polish enterprises exhibit substantial potential for improvement, unlike their Bulgarian counterparts. Regarding resource utilization, Slovak enterprises demonstrated exceptional performance, positioning them as potential benchmarks for the average C16 European micro-enterprise rather than the other way around. Unlike Slovakian counterparts, Polish and Bulgarian enterprises can select their benchmark, opting for either the top-performing or average EU enterprises.

The proposed and implemented here approach for defining the optimal future development in the current research is easy to understand and used like a landmark by entrepreneurs The limitations of the study include potential challenges in data availability and quality, the subjective nature of variable selection, difficulty in capturing the dynamic and diverse nature of wood-processing microenterprises, and the inability to fully account for external factors and macroeconomic trends in the proposed comprehensive DEA analysis. The current research is limited to DEA-based efficiency scores estimation of the wood-processing micro-enterprises in the investigated countries. The DEA approach in the current study is implemented in a deterministic way after the nature of the methodology. Further research is needed to identify the leading factors that influence economic efficiency in these countries and the problem with the uncertainty of the empirical data, which deserves particular attention. Thus, their differences will reveal how enterprises in each country focus on the critical factors to improve their performance.

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REVIEW OF CHALLENGES TO TRANSITION TOWARDS CIRCULAR ECONOMY

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Abstract. The growing volume of waste worldwide is driving us to search for solutions to recycle waste and reduce material consumption. It is necessary to create models that stop the deterioration of the environmental condition and offer a transition to a more efficient economic system where resources are less intensively used. The EU needs to ensure the transition to a sustainable circular economy (CE), which provides for waste recycling and preserves the value of natural resources, raw materials, and goods produced in the market for as long as possible. A more efficient economic system would contribute significantly to the United Nations (UN) Sustainable Development (SD) Agenda targeted until 2030. This topic has still to be addressed in the literature, so we aim to reduce the research gaps in the publications with this article. The authors selected and analysed the variables that mainly influenced waste recycling, which is part of CE processes. The paper assessed the relationship between resource productivity and waste recycling variables; a Vector Error Correction Model was used. The results allowed us to provide novel insights concerning CE challenges.

Keywords: circular economy; waste recycle; reduce; consuption; business process

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1. Introduction

Well-known environmental problems such as resource depletion and overexploitation, water, air, and soil pollution, and biodiversity loss are increasingly threatening the earth and call for an urgent shift towards more sustainable socio-technical systems (Adami & Schiavon, 2021; Yang et al., 2023). CE processes are being used to solve climate change and other global issues such as pollution, waste, biodiversity losses, and the decoupling of economic activity from using scarce natural resources. Global industrialisation and over-reliance on non-renewable sources of energy affected the increase of solid waste and climate changes, which is why the European Green Deal, the number of proposed means by the European Commission, aims to reshape the EU's climate, energy, transport, and taxation policies, and to pursue a CE in all sectors, to achieve a 55% decarbonisation of the EU's climate, energy, transport, and tax policy and to achieve a carbon neutral economy by 2050.

The terms "circular economy" and "sustainability" are broad, with no single definition in the literature, and which attracted the interest of scientists from different disciplines (environmentalists, economists, engineers, sociologists, and others), global organisations, businesses, policymakers, whole private sector, consumers and individuals (Nobre & Tavares, 2021; Geissdoerfer et al., 2017; Aithal & Aithal, 2023). This broadness creates

room for interpretation, misinterpretation, and misuse of the term greenwashing and the risk of damage to the landscape. Organisations are moving towards a sustainable and resilient economy by implementing circular principles, generating economic value, and reducing environmental impacts. However, it is common for organisations to adapt and shape CE definitions and paradigms according to established processes within the company rather than changing their practices (Kirchher et al., 2017).

The EU governments must coordinate the transformation of the CE and processes toward resource efficiency and greater material circularity. Although average resource productivity has increased by around 40% since 2000, more is needed to compensate for the increase in material use (OECD, 2019). The CE reveals design-based principles, eliminating the negative impact of economic activities that harm the health of the population and natural systems at the design stage, reducing the waste amount and pollution level, circulating products and raw materials, and creating maximum value. EU countries envision progressing towards sustainable CE and resource efficiency. Good practices should be identified to pursue better policies for implementing the CE.

2. Complex management of circular business processes

As the world moves faster and faster into the era of the CE, governments in the EU governments are playing essential roles in driving higher resource efficiency and material circularity. The EU countries must use resources efficiently. This requires complex management, understood as various forms and practice elements needed to implement business changes associated with increasing resource use efficiency successfully.

Recycling is gaining increasing attention in almost all areas of life. There is a clear need to develop models to halt environmental degradation and propose a shift towards a more efficient economic system with less intensive resource use. In the EU, it is essential to ensure the change to a sustainable CE, which would extend for the most significant possible reduction of waste volumes while at the same time preserving the value of natural resources, raw materials, and produced products in the market longer. Recyclable wastes can reduce the need for resource extraction as reusable material is collected seeking to reuse them applying the manufacturing activities. The need to extract primary resources decreases if the lower demand is for raw materials, resulting in less waste generation, correspondingly reducing harmful effects on the natural environment and promoting the conservation of nature.

Researchers and employees emphasised the application of new business models seeking to accelerate the transition from "linear" to "circular" solutions. International corporations promoting business models that follow circularity are cyclical and want the first to break up the unidirectional linear economic system (Schaltegger et al., 2016). One fundamental question still needs to be answered in the scientific literature: how could companies move toward circularity successfully? CE research has sought answers to such questions at the firm level. Such studies focus primarily on companies' motivations for adopting the creation of circular value approaches together with propositions dedicated to motivational aspects and possibilities, e.g., increasing competitiveness through increased efficiency of cost due to lower energy demand and inputs of natural resources, creating the environment to attract sustainable segments of the customer (Gusmerotti et al., 2023) and financial, organisational, market and institutional risks and barriers to integrating CE principles into everyday business practices. Second, existing research on the CE explored the contours of new models for business by describing their constituent elements. The prevailing view is that firms' chains construct stable social systems but incorporate dynamism.

3. Resource productivity in the circular economy

The CE is an economic system that seeks to use resources efficiently, avoiding waste and accumulation with environmental protection and sustainable development (Sverko Grdic el. al., 2020). It is often used in sustainable development (SD), seeking to reconcile economic growth while applying environmental protection (Belmonte-Ureña et al., 2021). Kirchher et al., 2017 examined 114 definitions of CE. They found that CE is generally portrayed as a combination of reduction, reuse, and recycling activities, but there is little clear linkage between CE and sustainable development. The CE goals are often associated with economic prosperity in line with the environment's quality, with little emphasis on its impact on socioeconomic justice for future

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generations. According to Mavi and Mavi (2019), by combining climate changes and global warming processes and protecting natural resources, the CE seeks sustainable development through renewable energy and waste management, defining the development of the economy and minimising the non-undesirable impacts on the environment. Moraga et al. (2022) observed that despite multiple and not always precise definitions, the CE does translate into concrete action plans based on specific indicators, and they proposed a classification system that categorises indicators into CE strategies and measurement scopes. The authors noted that the focus is on material conservation through recycling strategies. Cui and Zhang (2022) noted that the CE significantly impacts decarbonisation. The authors analysed the carbon impact of the CE on productivity by assessing the effect of the CE on decarbonisation through a framework of indicators along several dimensions, such as resource efficiency and economic benefits. The development of the CE has a positive impact on carbon productivity. Ding et al. (2020) described the environmental problems of China as a significant industrial-producing country consuming vast amounts of resources, emitting considerable amounts of pollutants, with correspondingly high and persistent land degradation, air pollution and quality of water degradation, and the loss of species, with the pressures of high resource consumption and high pollution emissions Malmquist productivity indexes needed to model dynamic performance changes. Moraga et al. (2022) argued that resource efficiency indicators can measure materials' life-cycle efficiency and are defined as benefits, not burdens. The authors found that the industrial CE maximises economic benefits by reducing negative environmental impact, redoing disposal, efficient waste management, and using renewable sources.

According to the European Commission, the CE monitoring system includes new indicators of material use estimates and resource efficiency, which measure the efficiency of using materials in the EU production and consumption system. There is also another group of indicators of waste prevention. These indicators are elements of a circular and zero economy that measure the contribution of the CE. The productivity resource of the CE is an essential indicator of how efficiently natural resources are used and how well waste is managed. Factors affecting the productivity indicator are distinguished and presented in Table 1.

Table 1. Factors affecting CE productivity

Factors	Description	References
Efficient use of resources	The CE seeks to make the most of resources, saving them and reducing losses. These include energy efficiency, water saving, material recycling, etc.	Moraga et. al., 2022; Lingaitienė & Burinskienė, 2021; Burinskienė et al. 2022; Yang et. Al, 2023; Figge & Thorpe, 2023; Lu et al., 2024; Xijie et al., 2023; Munaro & Tavares, 2023; Burke et al., 2023; Mostaghimi & Behnamian, 2023
Waste minimisation	The CE seeks to see it as a source of resources. This means that waste is minimised, and the recovered waste is recycled and converted into innovative forms of production.	Kirchherr et al., 2023; Lingaitienė et al. 2022; Burinskienė et al. 2022; Yang et. al, 2023; Figge & Thorpe, 2023; Lu et al., 2024; Xijie et al., 2023; Munaro & Tavares, 2023; Burke et al., 2023; Mostaghimi & Behnamian, 2023; Katakojwala et. al., 2023; Voukkali et al., 2023; Ruiz et al., 2020; Mintz et al. 2019
Cyclicality	The CE promotes the cyclicality of resources; that is, resources are used to be reused without significant losses. Such could be achieved by applying repair and recycling.	Moraga et. al., 2022; Xijie et al., 2023; Burke et al., 2023; Kirchherr et al., 2023; Voukkali et al., 2023; Den Hollander et al., 2017
Innovation and technology	The CE drives innovation and technologies that allow for the use of resources more efficiently and minimise the negative impacts on nature.	Sehnem et al., 2022; Yang et. al, 2023; Lu et al., 2024; Xijie et al., 2023; Munaro & Tavares, 2023; Burke et al., 2023; Mostaghimi & Behnamian, 2023; Kirchherr et al., 2023; Voukkali et al., 2023
Cooperation and partnership	In the context of a CE, cooperation between businesses, public authorities, non-governmental organisations, and society is essential.	Munaro & Tavares, 2023; Mostaghimi & Behnamian, 2023; Kirchherr et al., 2023; Voukkali et al., 2023
Socioeconomic responsibility	Companies and organisations must take responsibility for their activities and impacts on the environment and society. This may include commitments to sustainable production, responsible supply chains, and social support projects.	Lingaitienė et al., 2022; Burinskienė et al., 2022; Yang et. al, 2023; Lu et al., 2024; Xijie et al., 2023; Munaro & Tavares, 2023; Burke et al., 2023; Kirchherr et al., 2023; Voukkali et al., 2023

Resource efficiency and the CE are essential in environmental and economic protection. Resource efficiency reduces dependence on natural resources, playing a vital role in the economy and protecting the world, thus benefiting in the long term (Moraga et al., 2022; Burinskienė et al., 2022).

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Resource productivity in the CE is a complex and multidimensional indicator that values economic profit and social and environmental impacts. A successful CE seeks to reconcile these aspects for long-term sustainability and prosperity.

All waste poses indirect risks. Improper disposal of waste in landfills, if not properly equipped, can contaminate drinking, surface, and groundwater (Figge & Thorpe, 2023; Petrariu et al., 2022: Lingaitienė et al., 2022).

Climate change also risks landfills built close to water (Yang et al., 2023; Xijie et al., 2023; Lu et al., 2024). Waste incineration is practised worldwide following strict public health and environmental standards, but inadequate incineration or the burning of unsuitable materials results in the release of ash residues and other harmful substances and carcinogens into the air, with a wide range of adverse health effects (Kirchherr et al., 2023; Burke et al., 2023; Mostaghimi & Behnamian, 2023).

The authors describe CE's contribution to SD and promote responsible resource use. The literature often describes indicators regarding their life-cycle impact on environmental, social, or economic aspects (Moraga et al., 2022; Kirchherr et al., 2023; Xijie et al., 2023). Examining the basic principles of the CE, Skene (2018) argued that nature operates using short cycles rather than longer lifespans and that nature's economy works as an open system rather than a closed one.

Suchek et al. (2021) state that it is estimated that the world will have 2.59 bln. tonnes of waste annually around 2030; by 2050, the amount generated globally will grow to as much as 3.40 billion tonnes. Geissdoerfer et al., 2017 argue that CE is the solution which acts as a system, focusing on reducing inputs of natural resources and wastes, slowing down CO2 and demand for energy, and closing and straightening the material's chain. Suchek et al. (2021) and Prieto-Sandoval et al. (2019) emphasise the link between CE and environmental innovations in case society reuses. According to the authors, innovative business models have strong links with product innovation for circularity, with strategies based on new business models and product development, which are slowing down, aiming to close the circulation of materials.

The SD Goals follow innovative transformations that reduce environmental impacts in different areas, emphasising the importance of cooperation in all activities in the transition towards sustainable development (Munaro & Tavares, 2023; Mostaghimi & Behnamian, 2023; Kirchherr et al., 2023).

4. Practices for reducing different types of waste

Salmenperä et al. (2021) point out that the role of management in the CE is to promote the preservation of the value of natural resources in the cycles by recycling them, reducing wastes by strengthening the dialogue and cooperation of the key actors, ensuring the sharing of waste-related data and by reinforcing the economic benefits of the CE helping to reduce greenhouse gas (GHG) emission. 3R (reduce, reuse, and recycle) initiatives help reduce GHG emissions, implement sustainable resource applications, and promote resource efficiency (Sakai et al., 2017; Ruiz et al., 2020). Patwa et al. (2021) found that the 3R practice to extend the product's life and prevent resource wastage is in line with the objectives of the CE and contributes to the ecological balance. The manufacturing energy from wastes, the application of renewed energy, and the efficient usage of resources help to reduce waste and increase economic efficiency in the CE.

Di Foggia and Beccarello (2021) carried out an empirical analysis based on an econometric approach and proposed effective waste management at the national level. The authors pointed out that waste management technologies designed to reduce waste disposal in landfills are essential in achieving the goals of the CE. The authors also assessed the impact of such a system in line with the cost of waste management. They described how much the use of landfills would reduce the mechanical-biological treatment of waste by increasing the capacity for obtaining energy from waste, which could positively impact the environment and save waste management expenses at the treatment and other disposal stages. According to Sherwood (2020), the CE is an international collaboration between all stakeholders committed to eliminating waste without value. Reducing waste and limiting the use of scarce resources is part of sustainability and ensuring circularity. It is to be seen

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as a tool to promote positive action, building on the Renewable Energy Directive, the Waste Directive, and the CE Initiative, which defines waste limit values.

The practices of reducing different types of waste include various methods and strategies for reducing waste and saving the environment. Standard waste reduction practices are presented in Table 2.

Table 2. Reducing methods specific to types of waste

Type of waste-reducing	Reducing methods	Description	References
Waste prevention	Product design	Companies can develop products with long service lives, which are easily recycled and use less packaging.	Den Hollander et al., 2017; Sakai et al., 2017; Parajuly et al., 2020; Burke et al., 2023
Promotion of reuse	Deposit system	Stores can be equipped with deposit systems that allow customers to return and use the packages again.	Linderhof et al. 2019; Coelho et al. 2020; Cottafava et al., 2021; Balwada et al., 2021; Du Rietz, 2023
Other recovery	Incineration	Waste that cannot be recycled may be incinerated and incorporated into the production of energy, helping get electricity and heat, thereby preserving other natural resources to reduce waste.	Adami & Schiavon, 2021; Bisinella et al., 2021; Kirchherr et al., 2023; Yang et al., 2023; Munaro & Tavares, 2023; Lingaitienė et al., 2022; Istrate et al., 2023
Disposal	Landfill	Waste disposal in landfills is less desirable than waste prevention, reuse, and recycling. Still, sometimes squatters can be necessary when there are no other options or if a particular waste is hazardous and cannot be recycled.	Mukherjee et al., 2021; Siddiqua et. al., 2022
Waste recycling	Waste sort and separate	Businesses and households can use waste sorting systems to distinguish between recycling plastic, glass, metal, and carton materials.	Serranti & Bonifazi, 2019; Pluskal, et al., 2021; Feil & Pretz, 2020; Lange, 2021; da Silva & Wiebeck, 2020; Lim et. al., 2022
	Collaboration with recycling plants	Companies can work with local recycling plants to recycle useful materials and reduce waste.	Serranti & Bonifazi, 2019; Pluskal, et al., 2021
Stimulation of biodegradation	Using composting systems	Households and communities can use composting systems to biodegrade organic waste and produce natural fertiliser.	Castro-Aguirre et al., 2017; Ajmal et al., 2020; Kalita et al., 2020; Soto-Paz et al., 2021
	Reducing food waste	Restaurants and grocery stores could apply strategies to help reduce food waste by promoting food packaging and recycling.	Borrello et al., 2017; Talwar et al., 2023
Waste education	Educational campaigns	Governments and non-governmental organisations can conduct educational campaigns to inform the public about waste management techniques and promote environmentally friendly behaviour.	Abbasi et al., 2020; Soma et al., 2020; Szakos et al., 2021; Yusuf & Fajri, 2022
	Training and seminars	Companies can organise employee training and waste prevention, sorting, and recycling seminars.	Khandelwal et al., 2019; Magriotis et al., 2021

Preventing waste is the first and most effective way to reduce the amount of waste (Den Hollander et al., 2017). Concerning waste prevention, different authors highlight the role of product design, proposing to distinguish between eco-design and circular product design, redefining the product life cycle (Sakai et al., 2017; Parajuly et al., 2020; Burke et al., 2023). Many products, such as glass bottles, different paper, plastic packaging, shopping bags, or other waste, can be reused. Promoting reuse can reduce the need for single-use products (Balwada et al., 2021). The Circular Solution scheme, which promotes reuse, involves the involvement of circular denominators who take part in a deposit incentive scheme, paying a deposit when they buy beverages, which is then refunded to them if they recycle the beverage containers (Linderhof et al. 2019; Coelho et al., 2020; Cottafava et al., 2021; Du Rietz, 2023).

In the life cycle assessment of waste, scientists are looking for the optimal disposal or recycling solutions for each type of waste (Siddiqua et al., 2022). Waste recycling transforms old products or materials into new goods

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or raw materials. It involves processing plastic, glass, metal, and other materials to reduce the need to refine new raw materials (Kirchherr et al., 2023; Yang et al., 2023; Munaro & Tavares, 2023).

The rapidly increasing amount of waste is a global problem, of which organic waste accounts for a significant proportion (Kalita et al., 2020; Castro-Aguirre et al.). Composting is an efficient and effective way of converting organic waste into fertiliser, returning compost to agricultural land while reducing pollution (Borrello et al., 2017; Talwar et al., 2023). Stimulation of biodegradation is organic waste composting, such as food residues and vegetable waste, which can be useful as a fertiliser for natural plants or soil. This reduces the amount of organic waste in landfills and promotes the natural material cycle (Ajmal et al., 2020; Soto-Paz et al., 2021). Education and information on waste management techniques can help people understand the importance of the waste problem and raise their awareness so that they can act in a more environmentally friendly way (Soma et al., 2020; Abbasi et al., 2020; Szakos et al., 2021).

5. Recycling practices for different types of waste

Every year, the world generates an enormous amount of waste, which becomes one of the biggest environmental challenges. According to World Bank statistics, municipal waste could reach around 2.2 billion tonnes annually by 2025. Municipal, bio, and plastic waste are the three main categories of waste that are of great concern for their environmental impact (Pluskal et al., 2021). In this article, we will examine these three types of waste and the most important methods and options for recycling. Each person generates more than 1 ton of waste in a year alone. This huge part of the waste stream includes municipal waste, bio-waste, and plastic garbage. Such an intense pace of waste production poses a significant environmental challenge and requires effective recycling solutions (Kumari et al., 2019; Hasan et al., 2021). Recycling is becoming an increasingly important factor in the fight against the waste problem. The recycling of municipal, bio and plastic waste not only helps reduce landfill waste but also makes it possible to use waste as a resource for producing new products, thus contributing to developing a sustainable economy (Ajmal et al., 2020).

This article will examine the processes, principles, and options for recycling municipal, bio, and plastic waste. Understanding the importance of recycling this waste and effective recycling methods is essential to the environmental and sustainability challenge. In Table 3, we present the methods of recycling the selected types of waste.

Table 3. Recycling methods specific to types of waste

Type of waste	Recycling method	Description	References
Municipal waste	Burning and obtaining energy	Part of the municipal waste can be used as a source of oxygen for energy production. This is a normal process, especially when recycling particular waste is impossible or inefficient.	Mahari et al., 2021; Kumari et al., 2019; Hasan et al., 2021
	Composting	It can be recycled into compost to reduce the amount of organic waste that does not need to be incinerated or stored in landfills.	Ajmal et al., 2020; Oviedo-Soto-Paz et al., 2021
	Processing into secondary raw materials	Municipal waste, glass, plastic, metal, and paper can be recycled into secondary raw materials and used to produce new products.	Spooren et al., 2020; Pleissner & Peinemann, 2020; Vincevica-Gaile et al., 2021
Bio-waste	Composting	Biofluents such as food residues, green garden and garden waste, liquid and solid food waste in industrial production, sludge, animal manure, and slurry can be processed through composting. They are considered biodegradable and can be used as a fertiliser for growing plants.	Soto-Paz et al., 2021; Oviedo-Chia et al., 2020; Oviedo-Ocaña et al., 2023
	Anaerobic decomposition	This process breaks down biofacts containing organic matter without the presence of air. This can be beneficial for biofuel production or energy production.	Chavez-Rico et al., 2022; Hasan et al., 2023
Plastic	Mechanical processing	Plastic can be crushed into small pieces and used to manufacture various products. This process is often used for recycling plastic bottles or boxes.	Feil & Pretz, 2020; Vollmer et al., 2020; Thiounn & Smith, 2020; Schyns & Shaver, 2021

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	Chemical processing	Some plastics can be chemically processed into secondary raw materials or for energy production. Applicable when mechanical processing is impossible or inefficient.	Vollmer et al., 2020; Thiounn & Smith, 2020; Schyns & Shaver, 2021
	Restorative technologies	New technologies make it possible to restore plastic molecules to their original state, allowing plastic reuse without losing quality.	Kichu & Devi, 2021; Martin et al., 2022

Properly managing biodegradable waste makes it possible to avoid adverse environmental effects and has some benefits (Malav et al., 2020; Mahari et al., 2021). From this waste, you can get the electricity and biogas necessary for producing thermal energy and the excellent fertiliser of the earth – compost. These ways and principles may vary by region, technology, and laws. But, the general idea is to minimise the amount of waste, recycle it into new products, or use it as a resource for other areas of production or energy production. The most common practice in developing countries is the recovery of energy from municipal (solid) waste using thermal technologies such as gasification, pyrolysis, and incineration to convert the waste into energy (Kumari et al., 2019; Hasan et al., 2021) and biological technologies for composting (Ajmal et al., 2020; Soto-Paz et al., 2021). In Table 4, the authors presented the advantages and disadvantages of municipal waste, biowaste, and plastic recycling.

Table 4. Advantages and disadvantages of waste recycling

Type of waste	Waste recycling advantages	Description of advantages	Waste recycling disadvantages	Description of disadvantages
Municipal waste	Reduced landfill load	Recycling reduces the amount of waste that would finally be dumped in landfills, thus reducing the load on these sites over time and preserving natural resources.	Processing costs	Recycling can be expensive, especially if particular technologies or equipment are required, leading to additional costs.
	Energy production	Some municipal waste, such as biomass and waste fuel, can be used for energy production. Recycling processes, such as producing fuels from waste, can help reduce dependence on fossil fuels and greenhouse gas emissions.	Complexity	Sorting and recycling municipal waste can be difficult and require additional efforts and resources from the country's residents and authorities.
	Preservation of effluents/ Secondary raw materials	Recycling municipal waste makes it possible to obtain secondary raw materials that can be used to produce new products, thereby reducing the need to extract new natural resources.	Technological limitations	Some wastes may be difficult to recycle due to their composition or technological challenges, which can complicate the effectiveness of recycling.
	Environment protection	By reducing waste and recycling efficiently, emissions of pollutants and environmental impacts, such as pollution of precipitation waters and soil, are reduced.		
Bio-waste	Compost production	Bio-waste processing can benefit compost production, which can be used as a natural fertiliser for plants, promoting sustainable agriculture.	Costs	Bio-waste recycling technologies may require significant investments and actions to develop efficient recycling facilities.
	Biofuel production	The process of anaerobic decomposition can be used to produce biofuels, which can be helpful in energy production or as a heating source.	Hazardous emissions	Anaerobic degradation can lead to emissions of dangerous gases, such as methane, a potent greenhouse gas.
Plastic	Secondary raw materials	Recycling plastic waste allows you to get secondary raw materials that can be used to produce new plastic products.	Complexity	Plastic recycling can be complex and requires special equipment and technologies to obtain quality secondary products.
	Environment protection	Reducing plastic waste and recycling reduces plastic pollution in seas, rivers, and forests.	Limited recycling options	Some types of plastics may be difficult to recycle due to their composition or technological challenges, limiting the ability to recycle them efficiently.

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The advantages outlined in Table 4 show that recycling is a necessary measure from an environmental point of view regarding waste reduction and that it is, therefore, essential to find a way to ensure that the shortcomings listed can be addressed.

6. Research design and results

The authors applied the Vector Error Correction Model to analyse the relationship between two variables. The Vector Error Correction Model is a cointegrated VAR model—related to the Vector Error Correction Model (VECM). Panel VECM connection was determined between the indicator of resource productivity and domestic material consumption (measured in Euro per kilogram, chain-linked volumes) and the indicator of recycled waste biowaste:

1. Resource productivity and domestic material consumption Euro per kilogram, chain-linked volumes (RPDMCECHV)
2. REC_BIOW – Recycling of biowaste.

The Panel Vector Error Correction (VECM) model is a statistical method used to analyse the relationship between several variable time series, considering both short- and long-term equilibrium conditions. In this context, indicators of the productivity of resources and recycled waste, particularly bio-waste, are essential. The yearly data for the research was collected from the Eurostat (2024) database for 27 European countries on the indicators mentioned above.

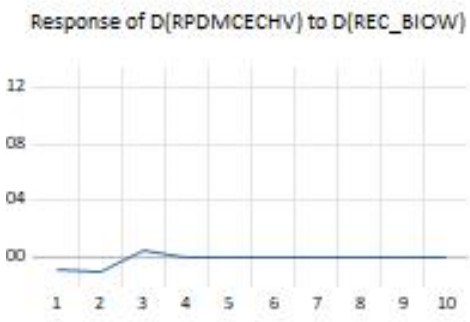

Figure 1. Relationship between indicators indicated after applying the VECM method

As we see from Figure 1, in the third period, the response was positive.

Table 5 below shows the relationship between the above-mentioned indicators in different periods.

Table 5. Response of D(RPDMCECHV)

Period	D(REC_BIOW)
1	-0.0088
2	-0.0101
3	0.0048
4	0.0005
5	-0.0002
6	0.0004
7	0.0004
8	0.0003
9	0.0004
10	0.0004

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The Resource Productivity Index, measured in euros per kilogram of material consumption in the household chain volume, shows how efficiently resources are used in the economy. A higher value means higher economic output per unit of material consumed, indicating higher resource productivity.

On the other hand, recycled waste, especially bio-waste, accounts for a high proportion of biodegradable waste that is recycled or reused rather than landfilled or incinerated. This indicator is essential when assessing environmental sustainability and waste management practices.

Conclusions

An analysis of the scientific literature has shown that there is a lack of research on the transition towards a sustainable circular economy, which aims to preserve the value of raw materials and manufactured products in the market for as long as possible by recycling waste and natural resources and by ensuring a more efficient economic system that contributes to the goals of the United Nations Sustainable Development Agenda. The paper's authors described recycling variables with the highest correlation to operational productivity that promotes interaction with the circular economy to fill an identified research gap. The novelty of this paper lies in the authors showing how a selection of significant recycling variables influences the transition to a circular economy, indicating the advantages and disadvantages of these processes.

The methodology developed is suitable for studying a wider range of overfilling variables for the comparative analysis of the transition to the circular economy.

Novelty of research. A sustainable transition to a circular economy has many interlinkages with achieving economic efficiency and managing different types of waste. The interactions are significant as they allow the possibility of promoting the diversion of various kinds of waste to protect the environment and preserve natural resources. The authors of this paper have carried out a study and identified the recycling variables that have the most significant impact on the transition to a circular economy.

Recycling significantly impacts the transition to a circular economy. The authors proposed a novel model analysing the time series relationship of several variables. Considering short-run and long-run equilibrium conditions, the importance of resource and productivity indicators for recycled waste, especially bio-waste, was determined.

The researchers looked at the variables necessary for recycling, excluding less important ones. They applied a Vector Error Correction Model to analyse the relationship between the two variables. They found a panel VECM relationship between resource productivity, the internal material consumption indicator, and the recycled biodegradable waste indicator.

This methodology could be helpful for those interested in the impact of recycling indicators on the transition to a circular economy. Recycled waste can reduce the need for resource extraction, as reusable materials are collected and reused in the production process. Primary resource extraction needs decrease due to lower demand for raw materials, resulting in lower waste generation and reduced environmental impact, contributing to nature conservation. Decreasing the use of materials will positively impact the environment. In the meantime, this requires assessments relating to the use of resources, the contribution of resources to economic development, and an assessment of the macroeconomic benefits associated with increasing resource efficiency. Policy evaluation should also be strengthened to identify good practices and pursue better CE implementation policies.

The study has some limitations. The authors analysed only bio-waste since variables responded to the changes in resource productivity indicators. It is possible to prepare forecasts considering other waste types in the future.

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