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# MORE SUSTAINABLE SPORTS ORGANIZATIONS' OPERATION AS A RESULT OF FAN INVOLVEMENT INTO THE PROCESSES OF DECISION-MAKING AND COMMUNITY BUILDING\*

# Michal Varmus<sup>1</sup>, Milan Kubina<sup>2</sup>, Martin Mičiak<sup>3</sup>, Pavol Boško<sup>4</sup>, Ivan Greguška<sup>5</sup>

<sup>1,2,3,4,5</sup> Department of Management Theories, Faculty of Management Science and Informatics, University of Žilina, Univerzitná 8215/1, 010 26 Žilina, Slovak Republic

*E-mails:* <sup>1</sup><u>michal.varmus@fri.uniza.sk;</u> <sup>2</sup><u>milan.kubina@fri.uniza.sk;</u> <sup>3</sup><u>martin.miciak@fri.uniza.sk;</u> <sup>4</sup><u>pavol.bosko@fri.uniza.sk</u> (Corresponding author); <sup>5</sup><u>ivan.greguska@gmail.com</u>

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Abstract. Sports clubs and other sports organizations are important to modern society because their activities provide important values linked to sports. This article focuses on the passive consumption of sports as a leisure activity that brings fans joy, a sense of belonging, and other values associated with their favourite sport and club. For sports club managers to achieve sustainable operation associated with sufficient funds obtained from fans, they can apply various ways of involving the fans themselves in creating a loyal community and in selected managerial issues. The article's aim is to describe the current level of knowledge in this area and follow it up with practical recommendations for the effective setting of the involvement of fans in selected processes. The applied methodology uses several methods, such as case studies, analysis of statistical data, storytelling, or the creation of flow charts describing the new setting of the processes in question. Data describing selected examples from practice and case studies were obtained from available Internet sources. However, the research results were supplemented by the analysis of data provided by the football association, which covers this sport at the national level within the Slevensk Republic. The main findings of the presented research include the fact that the involvement of fans in sports club management issues is often associated with concerns on the part of managers. Therefore, it is recommended to plan and implement the successive steps of this involvement, starting with involvement in the creation of a loyal fan community.

Keywords: sports; sports management; fans; fans involvement; sustainability

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#### **1. Introduction**

Sport serves as a tool for the development of social and economic factors. This is a fundamental reason why government bodies and other stakeholders invest in sports systems that deliver social and community values (Rowe et al., 2018). Sport can be perceived via two dimensions. These are represented by the dimension of active and passive consumption of sports. Active consumption of sports is defined as performing physical activity, or the situation when the consumer is directly involved in sports. Passive consumption, on the other hand, is characterized by watching sports on TV, via streaming platforms, watching news and searching for them on the Internet, or watching a sports event directly at the venue, or other similar ways of consuming sports. In this article the focus is on the passive consumption of sports, thus on the spectators of sports matches and competitions. A spectator who has developed an emotional bond with a club becomes a fan.

Sports fans show their devotion to their team by attending sporting events, watching competitions on television, buying products, and reading newspapers and magazines with the articles about their admired object. The investment of time and money is linked to their desire to belong to the fan community and to the object of their devotion – the selected sports club. Whether one's favourite team wins or loses also affects the feeling of the average fans' self-esteem (people's emotional perception of themselves) as well as their mood. (Levental et al., 2021; Mardosaite & Jasinskas, 2021)

Consequences of fan identification are fan loyalty, brand equity, game viewing and attendance, purchase of team merchandise, willingness to travel to the venues of the matches, satisfaction with team performance, satisfaction with participation in a sporting event, and future intentions to attend other matches and competitions. (Stevens and Rosenberger, 2012)

Devotion or loyalty is important to define. It is a deep-seated willingness to repurchase or re-patronize a preferred product/service in the future, resulting in repeated purchases of the same brand, despite situational influences and marketing efforts that have the potential to cause behavioural change (Stevens and Rosenberger, 2012).

The aim of this article was to provide an overview of the ways in which sports clubs can analyze the fans and their involvement, and the engagement in club issues. In the framework of fan involvement, there is a fundamental distinction between involvement in community building and the decision-making processes of the club itself within its management. The basic aim of the article and the related research is achieved by analyzing selected examples from practice and case studies meeting the set criteria for researching the chosen field of sports management. The article follows this up by analyzing data related to fan behaviour and loyalty. These data were obtained for the research from the Slovak Football Association – the national organization managing this sport in Slovakia. Additionally, foreign statistical data are used in the article in a secondary form, supplemented by the drawing of the original authors' conclusions and implications. However, the article does not end at the level of analysis. It continues with the design of processes related to the analysis of fans and their involvement in community building and in the management of sports clubs themselves. In this context, it also includes the application level of the research effort. Linking the necessarily performed analyses directly with their application to set corresponding processes represents a gap in the current state of knowledge approached in the article and forms a significant part of the overall novelty of the article and the whole research project conducted.

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# 2. Theoretical background

A part of the theoretical background analysis contains the necessary definitions and explanations of the involvement of fans of sports clubs and organizations in the issues of management of these entities as well as in building a loyal community of people for whom the given sport, and in a narrower sense the chosen club, is a significant value associated with how they are spending their free time. In connection with the fans themselves, possible ways of analyzing the demands of the fans, which the clubs must focus on in their activities, are also collected and systematized. Only this way it is possible to achieve long-term positive results associated with high attendance at the sports events organized. Building a loyal community of club fans (with the support of fan involvement in the events) is directly connected to an important (even fundamental) pillar of the overall sustainability of the given club's operation.

# 2.1. Definitions and contexts of fans' involvement in club management issues

Fan involvement is a concept defined by Stevens and Rosenberger (2012) as the degree to which consumers perceive the objects or activities as a central part of their lives and how they perceive their meaningfulness, appeal, and importance. Involvement refers to the level of interest or importance a fan attaches to a sport. It represents the level that the fan values or believes that the sport is relevant and important to his/her life and lifestyle.

However, the involvement of fans can also mean their involvement in the clubs' decision-making processes. For example, Hyatt et al. (2013) recommended increasing the frequency of participation in live matches to create platforms (for example, a website) where interested parties could pay for the right to vote on the club's managerial issues. However, fans at the stadiums also could vote, which should help increase the overall attendance. At the time, the authors recommended implementing additional devices in stadiums, but nowadays fans can simply vote using mobile phones. Wi-Fi connection security is a suitable addition in this case.

Su et al. (2021) examined the effects of sports brand involvement, crisis management performance, and perceived belonging on fans' sense of hope or emptiness during the COVID-19 pandemic. The results of the study indicate that fans' involvement with sports brands was positively associated with their psychological well-being. The involvement of fans in the sports brand alleviated the perceived emptiness. This relationship was partly mediated by the perceived co-existence, but not the performance of crisis management. In addition, sports brand crisis management performance and fans' perceived co-experience fully mediated the positive relationship between fans' sports brand involvement and hope.

Maxton (2019) investigated fans' motives for attending live rugby matches in South Africa. Based on the analysis of data obtained from an online questionnaire, the author concluded that fan satisfaction is an important factor influencing their loyalty and interest in a sports team. Fans who were satisfied with the stadium experience were more willing to stay loyal to the team and attended matches more frequently. The author advises teams to improve the fan experience in the stadium and increase interaction with fans to keep them loyal and attract new ones. The results of the study are useful for sports organizations striving for the improvement of the fan experience and the increase in their loyalty.

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#### 2.2. Approaches to the analysis of the sports clubs fans' demands

Fan requirements may vary depending on the socio-demographic, economic, cultural, and historical factors. They may differ in Europe and America, as the sports market is based on a different structure. In America, the dominant force is represented by the school or university leagues, in Europe the responsibility for the development of sports youth is often transferred to the sports clubs themselves. Thus, further research is appropriate to understand the requirements of these stakeholders.

Segmentation is the first step towards setting a unified direction of management activities so that they are aimed at achieving the main goal of the organization. The age factor also plays a role in determining segmentation. Several studies have shown a relationship between age and the willingness to spend money on sports events, even though different studies point to different age categories (Mortazavi, 2021). For example, as shown in the study by Reifurth et al. (2019), it does not make sense to target activities for children under seven years of age, as they are not able to form associations with the club's brand. Children under seven make associations mainly with sports, not with smaller subsets of the sports system. Therefore, they should not be the goal of activities to build a fan base or the club community.

According to the research conducted by Zhu et al., it is necessary for sports managers to focus, for example, on the development of the use of green funding tools, cultivation via various communication media to increase public awareness of the greening of sports management, and the development of green energy production for sports venues, such as stadiums, swimming pools, etc. (2023) These concepts are a part of the current trend. It is therefore possible to assume that the fans themselves can demand that their clubs address these concepts.

The physical participation of fans in the match is closely connected with the fan rituals. These can be divided into personal (praying for the team's victory) and social ones (singing the club's anthem). A ritual is a process that evokes emotions and is associated with symbolism. The authors recommend sports managers to find elements that could be transformed or incorporated into the service consumption process, which represents the experience of a physical visit of the stadium. (Fazal-E-Hasan et al., 2021)

Vassiliadis et al. (2021) investigated the requirements of visitors to sporting events. From the results of the questionnaire survey, they created regression models that were supposed to have the greatest impact on the dependent variable represented by the level of satisfaction. The model with the best results involved the event taking place on a summer evening with an entry price of  $\in 25$ . Additionally, trade exhibits should be present at the event and visitors should have access to Wi-Fi.

For a better understanding of the requirements of visitors on the day of the match, Škorić et al. (2021) analyzed the factors that the shaped satisfaction or the dissatisfaction. Most of the factors caused dissatisfaction (program and time of the event, price of the tickets, availability of the tickets, etc.) rather than satisfaction (security and promotion of the event), while one factor had the ability to cause satisfaction or dissatisfaction (preparation of the city for the event). An interesting insight is the need to choose a different approach to new visitors than to regular visitors since the factors have different weights for these groups. The authors recommend focusing on cooperation with city officials, or representatives of tourism and sports facilities. It is necessary to choose the ideal ticket price for all interested parties, which is suitable for the purchasing power of the visitors. Special attention should be paid to a less tangible factor of the atmosphere at the event.

The paragraphs below describe real examples of how sports clubs approach the analysis of their fans. The emphasis is mainly on the analysis of the examined indicators. The aim is to find out what specifically interests sports clubs about their fans. Examples are described in the following list:

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- Bayern Munich in 2017 created a questionnaire aimed at fans. The club tried to encourage respondents to fill in the questionnaire with the possibility of winning a signed jersey or a personalized link. The questions themselves could not be analyzed as the questionnaire was no longer available. (FACEBOOK.com, 2017)
- Manchester City based on the analysis of the available documents that describe activities aimed at the fan analysis, it can be concluded that Manchester City comprehensively analyzes the satisfaction of fans with visiting the stands during the match. They analyze, for example, the fans' attitude towards safety, the suitability of the premises for the family, and the access for women. The perceived value obtained from the ticket price is also analyzed. The club analyzes the average attendance, how many goals on average the visitor see per match, etc. According to the Manchester City's official documents, the main stadium, Etihad Stadium, has been one of the two best stadiums in the Premier League for several years in a row. (MANCITY.com, 2019)
- **English Football League (EFL)** in 2019, representatives of the second-highest football competition conducted an extensive survey of fan satisfaction with visiting the stands. The report on the survey states that this is the first such survey since 2010, although the process of communication with the fans served as a basis for improving the quality provided. Several statistics can be obtained from the report, which relates to the overall competition level, but the statistics also relate to individual clubs. These are referred to as case studies. The examined indicators are divided into seven units: the relationship between the club and the fans (reasons for club affiliation, age of first visit to the stands, motivation for visiting the stands), visit to the stands (factors related to activities carried out before visiting the stands -a match played at home or away, method of travelling, purchase of tickets – methods, sources of information about the tickets, factors influencing the purchase of the tickets), the experience of visiting the stands (factors related to the activities carried out during the visit to the stands – inclusivity and support of minorities, community activities, the role of technology in football, the roles of official staff and the perception of roles by the fans), content and communication (fan information channels, specific news media used, interest in the communication channels of individual clubs, information during the games, platforms used, information consumption times, access), information about broadcasts (where fans watch the matches, interviews, etc. - subscriptions to fan entertainment platforms such as Neflix, watching live matches, awareness of services), competitions (fans' perception of competitions and cup matches – e.g. interest in the Carabao Cup), EFL policies and their perception (sustainability, accessibility and inclusivity policy, importance of supporting domestic players, importance of success of the England National Team, betting). (EFL.com, 2019)
- ŠK Slovan Bratislava in 2013, they conducted a questionnaire survey that visitors to the match could fill in. Data collection was carried out using pencils and paper. The questions were divided into four topics, mainly related to the satisfaction with services, attendance, and fans' perceived space for improvement. (SKSLOVAN.com, 2013)
- HC Slovan Bratislava in 2018, this club teamed up with the research agency AKO and the ticketing partner Ticketportal and they conducted a questionnaire survey together. It contained 39 questions, six of which were of sociodemographic nature. The survey covered the frequency of attendance at the matches, sources of information about the club, popularity of the players, evaluation of accompanying and non-match activities, services at the stadium, spectator service, interest in the club souvenirs, and the like. The reasons for visiting home games were also examined, among which the team's support and the high level of hockey dominated (at that time the club was a part of the second largest hockey league in the world, the KHL, which meant better opponents for HC Slovan, compared to opponents from the highest Slovak league this raised the overall level of the game), followed by the atmosphere. Among the club souvenirs, the respondents identified textile products as the most popular ones, while smaller souvenirs included magnets

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and car accessories. The main source of information for fans was the club website and the club's profile on the Facebook social network. (HCSLOVAN.sk, 2018)

FC DAC 1904 Dunajská Streda – in 2018, the club conducted a survey focused on fan satisfaction via a questionnaire survey, which should have taken respondents about 4-5 minutes. The motivation for filling in was the opportunity to win tickets to a Europe League match. (Nagy, 2018)

The following table describes the key findings obtained from the examples included. The table captures the period in which the survey was conducted. If the way in which the survey was performed was found, it is described in the third column. The examined indicators are captured in the fourth column. They represent the most important part of the summary in terms of the article's aim.

Club/League name	Period of the survey conduction	Method of the survey conduction	Identified categories of the indicators examined
Bayern Munich	2017	Online questionnaire	Unknown
Manchester City	2018 - 2019	Unknown	Satisfaction with the price of tickets, perceived value obtained for tickets, feeling of safety in the stands, feeling of comfort of women in the stands
EFL	2019	Potential outsourcing by a research agency	The relationship between the club and the fans, fan activities before visiting the stands, satisfaction with visiting the stands, content and communication channels, broadcasting platforms, perceptions of specific competitions, perceptions of the EFL policy
ŠK Slovan Bratislava	2013	Pencil and paper for each respondent	Satisfaction with services, attendance and the space for improvement perceived by the fans
HC Slovan Bratislava	2018	Outsourcing by a research agency	Frequency of visits to the stands, sources of information about the club, popularity of players, evaluation of accompanying and non-match activities, services at the stadium, spectator service, interest in club souvenirs, reasons for visiting home matches
FC DAC 1904 Dunajská Streda	2018	Online questionnaire	Unknown

Table 1. Key takeaways from the analysis of sports clubs fans' analyses

Source: Authors' own elaboration based on the references listed in the text above

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From the analysis of the ways in which sports clubs analyze their fans, it follows that a key indicator for sports clubs is the perceived value received by fans for the price of the tickets. Indicators related to this are often repeated in club surveys. Indicators related to the experience of visiting the stands during matches are also often investigated. Surveys carried out more recently (closer to 2023) include indicators related to inclusivity, women's feeling of safety at the stadium, etc. Indicators related to sustainability should also be included in future surveys of sports clubs. It is increasingly important to examine these indicators from the perspective of sports clubs, as it is an increasingly frequent demand of fans that a sports club should fulfil. It is a highly modern concept.

# 2.3 Building a community and the fan base

Assuming that fans are key stakeholders whose involvement in management ensures the club's long-term sustainability, it is appropriate to focus on building the fan base. The sports club brand community brings the brand owner opportunities to implement sponsorship and branding strategies, and through the community, sports managers can create value, especially in the context of social networks (Popp and Woratschek, 2016). According to Yoshida et al. (2015), the community is built based on three elements. Two of them are formal, built by a sports club. This is the value of the brand of the sports club and the brandfest. Brandfest is defined as an event where brand users meet, and social interactions occur among them. The last, less formal element are the perceived rituals and traditions. Via these three elements, fans get involved in the community, improve products, and create a word-of-mouth effect.

Sports club communities are created either by the fans or by the sports clubs (Jang et al., 2008). Due to the growth of the sports market and globalization, more and more sports fans are connected to each other through social media, podcasts, online forums, and other communication tools that can be easily and cheaply accessed from all over the world. Therefore, according to Mastromartino and Zhang (2020), there is a need for sports managers to gain a deeper and better understanding of sports fan communities and how and why individuals identify as members of a sports fan community.

Since fans have created a certain emotional relationship with the sports club (Stevens and Rosenberger, 2012) sports managers should enable the satisfaction of their needs to promote and defend the brand community. Mills et al. (2022) suggest ways of involving fans in management, such as sending products for testing and review or even providing formal training on the product use. They also recommend taking advantage of social networking features, such as the ability for users to customize their profile picture by including a frame, which allowed individuals to show their group affiliation via a branded frame on their profile picture. This public display of affective commitment to the brand community will increase brand community identification and subsequently lead to further public displays of the brand loyalty.

# 3. Research aim and methodology

Practical and specific recommendations for the process of managing sports fans or building a fan (or brand) community are neglected in the professional literature. Therefore, the aim of this article is to create a set of concrete recommendations for building a fan community together with models of activities contained in the corresponding management processes.

These should help better understand the activities that the sports manager has to perform to achieve the set goal. The recommendations presented in the main aim of the article build on the provided overview of the ways in which sports clubs can analyze their fans and their involvement in community building and in selected management processes of sports clubs.

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The basic aim of the article and related research is realized by analyzing selected examples from practice and case studies meeting the established criteria for researching the chosen field of sports management. The article follows this up by analyzing data related to fan behaviour and loyalty.

The data were obtained from the Slovak Football Association – the national organization managing this sport in Slovakia. Foreign statistical data are used in the article in a secondary form for drawing the original authors' conclusions. The article does not stop at the level of analysis. It continues with the design of processes related to the analysis of fans and their involvement in the community building and in the management of sports clubs themselves. To obtain the relevant knowledge needed for the article, the data provided by the Slovak Football Association (SFA), which is the highest public body for football, futsal, and beach football in Slovakia, was analyzed. The data were provided to the authors for the purpose of data analysis. The data relates to players, leagues, matches, and other events. Even though the data covers different areas, for the purposes of this article, the data related to attendance at the stands of the matches were used. Other relevant statistics were obtained from the Statista portal.

With the selection of cases and examples, the aim was to exemplify common patterns in how sports clubs tend to engage with their fan base. Authors attempt to implement narrative-based research, which recognises that we live in a world of stories and often recount our experiences as stories and these can serve as the overall design, a means for collecting data, or a platform for disseminating the findings. In the article, the concept of ethnographies was applied as well, which in this context involves remote observation of culture within a particular context to understand how groups of people interact and behave. The inspiration for using these methods comes from Hoeber and Shaw (2017) who argue that alternative qualitative approaches, which may open research to new audiences and research participants, appear to be largely absent in the current research outputs.

Along with the above-mentioned methods, the analysis of best practices is mainly present in the results and the discussion section. Analysis of scientific publications is used in the theoretical background section. To get all the necessary information to construct this article, the authors used orientational analysis. Deduction and induction are largely present mainly in the results and discussion section to gather knowledge either about parts of the system or about the whole system.

The studied system is represented by the world's sports market. In the sports market, each individual sport competes for its market share. This is achieved via various stakeholders (governments, sponsors, fans, etc.) who can be characterised as the sports market's actors. These actors are mutually interconnected since they strive for achieving similar aims. This studied reality thus creates a complex system that needs to be approached in the research so that valid recommendations for the sports clubs' managers can be designed in the application part of the study.

For a clearer understanding, the entire methodological procedure is also captured in its graphic form in Fig. 1

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Figure 1. The structure of the publication

Source: Authors' own elaboration

The graphic description of the applied methodology contains an explanation of the vertical and horizontal structure of the overall scientific procedure. Within the vertical structure, it is a chronological succession of individual research phases performed. The horizontal structure of the description adds details of the individual parts contained in the obtained and interpreted results chapter. It is about linking individual selected data sources to create a categorized view of possible tasks and the importance of involving fans more deeply in the club's management processes to support its long-term sustainable operation.

#### 4. Results and discussion

The presented research results are divided into several parts related to the used data sources. The first part is a comparison and systematization of selected examples of involving fans in club events. These provide a basic insight and practical grasp of fan engagement options. This is followed by created case studies bringing a deeper understanding of the investigated phenomenon. These are directly linked with relevant statistics regarding the income streams of sports clubs. Complementing the investigated reality is then the analysis of the data provided by the SFA. These data refer to attendance at football matches in individual leagues. All these analyses subsequently lead to the design of practical recommendations in the form of a proposed process of analysis and involvement of fans in management issues of sports clubs.

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## 4.1. Examples describing the possibilities of involvement in selected issues of sports club management

The concept of involving fans in the management of a sports organization is not new. Even in the past, sports managers were aware of the benefits of this concept. Many examples can be given where clubs from different sports and backgrounds have tried to involve fans in their management at different times. In general, it is most often about the possibility of choosing the design of the jerseys, logo, colours, and team anthem, but systems for the regular involvement of fans in management are also created. This happens, for example, via regular all-star games, where fans vote for players who should be on the roster. Some clubs go a step further and create a separate fan body made up of fan representatives. These bodies then regularly communicate with the club's management.

For a better approximation of these methods, the following examples were selected:

- 1. **NHL Seattle Team Name Selection:** When the NHL announced it would expand to Seattle in 2021, the team held a public vote to determine the team's name. The choices were narrowed down to five and more than 100,000 fans participated in voting, resulting in the team being named the Seattle Krakens. (NHL.com, & Cotsonika, 2020)
- 2. **Pro Bowl Voting:** In the NFL, fans have a say in selecting players for the Pro Bowl, the league's annual all-star game. Fans vote for players online and through social media, and their votes count for one-third of the total vote, with players and coaches making up the other two-thirds. (NFL.com, n.d.)
- 3. **Manchester United (MU) Fan Forum:** The forum consists of 16 fan representatives from different parts of the stadium and with different opinions, who meet with club officials four times a year to discuss club matters. Other fans can ask to have their questions discussed at one of the Fan Forum meetings. Fan representatives can be contacted directly by other fans. Allegedly, every question submitted at least one month before the date of the forum should be discussed at the forum. (MANUTD.com, n.d.B)
- 4. NASCAR All-Star Race Format: NASCAR, the auto racing league in the United States, allows fans to vote on the so-called "fan-vote winner". This is a form of fan wild card. The All-Star Race competition is exclusive to the four winning clubs of the All-Star Open; this competition consists of three stages and the winner of each stage advances to the All-Star Race. The winner of the fan vote is then the last participant in the competition. If the winner of this vote advances from one of the stages, fourth place will be taken by the second winner of the All-Star Open vote in order. (NASCAR.com, 2022)
- 5. **NBA All-Star Game Starters:** The NBA allows fans to vote on which players will start in the annual All-Star Game. In 2023, the fan vote was assigned a weight representing 50%. The media, which was assigned a 25% weight, could also vote, but the players, whose weight represented other 25%, voted as well. The resulting numbers were therefore recalculated based on the assigned weights. (PR.NBA.com, 2023)
- 6. **MLB All-Star Finals Voting:** Major League Baseball allows fans to vote on which players will appear in the opening lineup of the All-Star Game. (MLB.com, n.d.)
- 7. **NFL Pro Bowl Rosters:** The NFL allows fans to vote on which players make the Pro Bowl roster. (OPERATIONS.NFL.com, 2022)
- 8. **F1 Fan Voice Formula 1 Driver of the Day:** Formula 1, the international motor racing league, allows fans to vote for a "Driver of the Day" after each race. (FORMULA1.com, n.d.)
- 9. World Cup Mascots: The FIFA World Cup, a major international football tournament, allows fans to vote for the official mascot of the tournament. An example is the vote for the mascot of the 2018 World Cup held in Russia. (ESPN.com, 2016)

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The categorization of ways of involving fans in the management, which is created based on the analysis of numerous practical examples and case studies, includes the following points:

- Club membership: In some European football clubs, fans can become club members and have a say in the club's decisions. For example, in FC Barcelona, members can vote for the president and board of directors of the club. Fans who meet the criteria set by the club can vote, such as: age of majority, duration of active membership for at least one year, without suspension of membership, and being included in the electoral census. To obtain the membership, it is necessary to agree on a meeting with club representatives and to identify oneself with an ID card. The membership fee was €195 per year (valid until 31/12/2022) (Jenson, 2022; FCBARCELONA.com, n.d.; FCBARCELONA.com, 2021)
- Fan council: In various sports and leagues, sports clubs create separate bodies to participate in the management of the club. For example, in 2023, the leadership of the NFL club Houston Texans (HT) decided to create a fifty-member board of fans. (Criswell and Chron, 2023)
- **Team name and logo:** Fans sometimes get a chance to have a say in a new team's name and logo. An example can be the aforementioned Seattle Krakens.
- Choosing a mascot: Some sports teams allow fans to vote on choosing a new mascot. For example, the management of the Washington Commanders (WC) team invited fans to choose a theme for a new mascot (dog, historical figure, pig, superhero). Subsequently, proposals were designed and, during the match, fans (online and in the stadium) could vote for the best proposal. (Byrum, 2022)

# 4.2 Case studies aimed at involving fans in the selected issues

Following the selected practical examples analyzed and compared above, this part brings a deeper insight into the involvement of sports club fans in the processes of creating loyal communities and in selected issues of the management of these clubs. Individual case studies are created by linking available information describing ways of involving fans in club management issues and relevant statistics capturing the sources of revenue of the investigated sports clubs. It is therefore the application of a qualitative approach to research with the creation of stories, enabling a higher level of understanding of the analyzed phenomenon and drawing connections between the elements revealed.

# Arsenal London (AL) – Case Study

A football club from the English Premier League gives fans the opportunity to get closer to the club through membership programs. They are divided into three categories: Red, Platinum, and Junior Gunners. (ARSENAL.com, n.d. D)

Red membership is the basic program priced at £34 per season. Here, the fan mainly gets priority access to match tickets, the possibility to sell tickets due to the impossibility to attend the match, and a 10% discount for the fan online store. Another system in which the fan participates by purchasing a membership is the My Arsenal Rewards. The fan earns points for interactions with the club (ticket purchase, physical presence at the match, etc.). (ARSENAL.com, n.d. A)

Points can be used to purchase tangible rewards (match tickets, players' jerseys worn at matches or training, signed merchandise, etc.), or intangible rewards (a tour at the training facilities or the stadium, participation in a press conference after the match, etc.). (ARSENAL.com, n.d. B)

Platinum membership is a product that is meant to make the fan feel like a valued business client. In addition to the basic benefits, the Platinum member has access to "hospitality" from AL. This includes a free official program

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on the day of the match or half-time drinks. The members can use the services of a team of account managers, and access to club restaurants, bars, and other areas. Some services are available for additional fees. Memberships range from £779-£1,540 for the 2023/2024 season. (HOSPITALITY.ARSENAL.com, n.d.)

However, it is not always clear which services are covered by the membership and which are those with the additional fee. Another official source puts the price at  $\pounds 2,865$ , with the price subject to change depending on who the club faces during the season. (HOSPITALITY.ARSENAL.com, 2022)

Different packages can be purchased separately, with a total of seven packages, each priced differently. For example, "The Heritage" package includes pre-match access to the restaurant including a five-course meal, with a welcome drink and half-time and post-match drinks. The price depends on the locations made available and is between  $\pounds720$  and  $\pounds1,800$  per person.

These packages are meant to enhance the match experience for a premium, which is in line with the scientific recommendations. Mostly this includes the additional access to restaurants and bars (in some cases a person can watch the match live and with a view of the field) or other VIP areas. (HOSPITALITY.ARSENAL.com, 2022)

The Junior Gunners program is further divided into age groups (0-3, 4-11, 12-16, 17-18) and the membership fee ranges from £15-£30 per season. Benefits include those of the Red membership, plus experiences (for example, behind-the-scenes at the London Colney training ground), the opportunity to become a member of the team of ball feeders during the match, or a subscription to the Junior Gunners Newsletter. (ARSENAL.com, n.d. C)



For the analysis of the success of the strategy, or system of creating a matchday experience for fans, the structures of sales over time were analyzed. Figure 2 shows the data of the sales structure of AL during the studied period.

Figure 2. Revenue streams of Arsenal FC from 2008/09 to 2021/22 (in million euros)

Source: (STATISTA.com, 2023 A)

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It is estimated that nearly a third of AL's revenue regularly comes from the Matchday category, which means that it is a significant source of revenue for AL. During the COVID-19 pandemic, AL compensated for the impossibility of obtaining revenue from this source through the Broadcasting category. The club's efforts were therefore apparently focused on the management of the broadcasting rights.

For perspective, Chelsea FC is mentioned as having a similar model of creating a match-day experience to AL – match-day hospitality packages can be purchased which include comparable benefits. With Chelsea, prices range from lower values than with AL (which does not necessarily mean that they are cheaper). (CHELSEAFC.com, n.d.) Chelsea is mentioned since the total sales can be considered similar, it is also one of the biggest clubs from the same league. Figure 3 shows Chelsea's sales over time by category.



Figure 3. Revenue streams of Chelsea FC from 2008/09 to 2021/22 (in million euros)

Source: (STATISTA.com, 2023 B)

# Manchester City (MC) – Case Study

MC has a membership model built differently than AL, with different benefits. MC offers three types of membership: Cityzens Membership (£25 per year), Matchday Membership (£35 per year), and Junior Membership (£20 per year). An interesting benefit of Matchday Membership is, for example, the possibility to take an additional person to one women's club match for free, which helps to attract more attention to women's football. (MANCITY.com, n.d.)

In the case of MC, the membership is paid annually, in the case of AL, for the season. AL also provides benefits to the sector with an above-average income at a high price. MC focuses on simpler provider services. An article by Forbes (2018) shows an effort to incorporate technology to increase interaction with fans who cannot attend matches or are not close to the MC's hometown. As part of the plan, they already incorporated AR and VR concepts in 2018, creating an app that allowed fans to watch the winning celebration in 360°. The next application should have been aimed at children between the ages of 7 and 11. (Tobin, 2018)

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Thus, an alignment with the aforementioned study can be found, when children under 7 years of age were not observed to have the ability to create a link between sport and the brand. Therefore, it makes sense to target the application to children from the age of 7, since at this age the abilities to connect a sport with a specific club are expected to be developed. As in the case of AL with the additional example of Chelsea, the revenue sources of MC were also investigated in this case. The MC's performance by category over time is shown in Fig. 4.





#### Source: (STATISTA.com, 2023 C)

Compared to AL and Chelsea, in the case of MC, match-day experience revenue is a relatively small part of the total revenue. It can be concluded that MC does not put sufficient emphasis on this area. On the other hand, despite this fact, the overall level of sales is higher compared to AL and Chelsea. This means that MC has different strategic goals, or the basic business purpose (profitability) is fulfilled in a different way (since these are private clubs, basic economic principles can be applied here).

# The Basketball League (TBL) - Case Study

The TBL is a relatively new American professional basketball league that emphasizes the experience for fans, local communities, and business partners. They achieve this through visits to schools and clinics (players read to children, and lecture about the negative effects of drugs), cooperation with non-profit organizations, and youth camps, or they try to create an environment suitable for family entertainment. So, the philosophy is to provide the youth with "role models". (THEBASKETBALLLEAGUE.com, n.d.)

Based on the analysis of available official materials, it follows that the opportunity to own the club is offered to the private sector. TBL proclaims low risk with a certain return on investment. It also follows that the method of building a sponsorship network is up to the owner, as well as securing revenues from the club's activities. Local businesses in each local market are supposed to create a source of income to cover the costs of the match. TBL describes the market situation as favourable for entry (the barrier is low). The primary value is to be generated

through communities. However, this is a description of the situation in 2019. (THEBASKETBALL LEAGUE.com, 2019)

# MK Dons (MKD) – Case Study

The football club from the second highest English league realizes that it receives essential information directly from the fans, which it tries to involve in management via fan representatives. The ticket pricing strategy and promotional activities are then determined through meetings between fans and club executives. The club's ticket sales strategy is based on the highest possible price availability of tickets. It is also important to focus on families, as this way the club will get more visitors at once. Children under the age of 12 have free entry, which is communicated mainly in primary schools and junior football clubs. (EFL.com, 2019)

For the 2023/2024 season, the club has changed the ticket price strategy for younger age groups. The prices applied for the (previously) under 12 age categories are now applied for the under 14 category and the under 12 has changed to under 21. With this, the club wants to attract a larger number of young spectators to the stands. (MKDONS.com, n.d.)

# **Fan Controlled Football – Case Study**

Fan Controlled Football (FCF) is a professional indoor American football league that is built on the decisions of the fans. They make decisions via the application. The votes are tallied and relayed to the coaches on the sideline, who then direct the game accordingly. Games are streamed live on platforms such as Twitch and YouTube, which are especially popular among the virtual gaming community. It is mainly about the younger generation. This helped differentiate the FCF from traditional sports leagues and helped attract a new generation of fans.

The rules of the game have been modified to make it more dynamic (fewer players in the field, smaller fields, etc.). The fan voting system is based on the so-called FanIQ. This is a score that serves to increase the level of the fan. The higher the level, the stronger the voting right. FanIQ is increased through fan interactions with the application. (FCF.io, n.d.A)

For example, fans can decide on the following:

- Drafting players into teams: Fans can vote on players on the roster. The league has a draft where fans can vote on players in real-time. The draft takes place in the weeks leading up to the start of the FCF season.
- Real-time game tactics: Fans vote on the type of play they want to see, and the team coach must choose the play with the most votes.
- Team and jersey branding decisions: Fans can vote on various aspects of each team's branding, such as the team's name, logo, and the jersey design.
- Choosing team names and mascots: Fans can vote on each team's name and choose a team mascot.
- Selection of players to participate in the games: Fans can vote on which players they want to see in the game. Players with the most votes are more likely to be in the field.
- Game rules voting: Fans can vote on league rules and policies, such as what types of games are allowed, what the rules should be for the league over time, and how teams should be penalized for rule violations.

FCF, through its partnership with IBM, provides fans with various data and statistics about the game and players in real-time. The concepts of AI and machine learning are also involved here. Fans can view these statistics in the app during the match, where they also vote on their team's tactics. (Nehme and Adler, 2021)

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According to official sources, the first season started in 2021. FCF, through the partnership with Twitch, achieved 10 million live-streaming views and over two million fan interactions (voting on game tactics, draft picks, and other voting) during this season. Four teams were present in the first season. In the second season, FCF collected USD40 million and used this money to create four more teams. (FCF.io, n.d.B)

FCF's debut games on the Twitch platform reached more than 700 thousand live viewers. Ranked as the mostwatched sporting event on Twitch during its opening weekend. FCF also achieved high levels of viewer engagement, with viewers spending an average of 30 minutes watching the games and engaging with the interactive elements of the FCF format. (SportsPro, 2021) While there are many indications of the success of the league, no profit has been generated so far, but the plan is to break even by the end of 2023. (Casey, 2022)

# **4.3.** Summarizing the findings from the analyzed case studies and examples from the practice of the selected clubs and leagues

Table 2 lists all the mentioned examples and case studies under the relevant categories. The purpose of the table is to communicate the key findings from the analysis of examples and case studies more effectively. Individual cases were categorized based on similarity of targeting, characteristics, way of involving fans in management or community building and purpose of involvement.

Category	Clubs/leagues	Segment – target audience	Characteristics – basic description of the case/example	Way of involving fans in club management/community building	Purpose of involvement
A new league based primarily on the involvement of fans in management	FCF	Generation Z, American football fans	Incorporating modern technologies to differentiate from traditional forms of fan interaction	Voting in real time through the application	Maximizing fan interaction
Social policy and approaching local communities	TBL	American teenagers, families with children	Focus on community, building local networks, delivering value	A higher level of interaction between club members and fans	Creation of local networks at the lowest levels of the system – use of the word-of-mouth effect

Table 2. Summary of the key takeaways (pieces of knowledge) from practical case studies and examples

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A separate fan body – fan representatives	MU, HT, MKD	Segment of proactive fans	The possibility of personal contact with the club's management, encouraging all fans to express their opinions and questions	Indirect communication between management and fans at regular meetings	Creating a formal communication channel between the management and the fans – increasing communication
Focusing on the experience of visiting the stands – strengthening the feeling of belonging to the club (exclusive concepts for fans)	AL, MC, FC	Long-time fans, junior fans, fans with above- average incomes	Classification of fans according to socio- demographic factors; each fan should find a program for themselves; however, the middle segment may not be sufficiently fragmented in terms of age and income	Creating more touch points while consuming services	Maximization of revenues resulting from the holding of matches
The right to vote via membership	FCB	Long-time fans	The possibility for fans to directly vote for issues related to the club (e.g., the election of the president), if the fans meet certain criteria and show their ID when joining the membership	Fans can vote in different ways, electronically or by mail; this creates a form of independent isolated democracy	Using the high awareness of fans for the benefit of the club, satisfying the need of an interested party for a fee
Voting on player rosters or the presence of athletes on the All- star games format and choosing the best player	Pro Bowl (NFL), All- Star Race NASCAR, All-Star NBA, All-Star MLB, F1 Pilot of the day	Fans with favorite players, or fans following the performance of the players during the season	The possibility for fans to use their knowledge about the league, clubs and players in an isolated environment, or without affecting the course of the season	Roster voting, where fans choose the best players of the season	Involvement of fans without direct influence on the management of clubs – satisfying the need of fans to show their knowledge

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One-time vote on the choice of logo, name, mascot of the club	SK, WC, FIFA	Fans of the league where the club in question is a participant; local residents if it is a new club of a particular place	The possibility for fans to participate in building the brand through voting on some elements of the brand	Brand building should be based on the knowledge of the segment to create associations close to it; through segment voting on the selection of brand elements, the club can get closer to the desired segment perception of a potential brand	Involvement of fans, direct influence on the brand – it can be a form of satisfying the demands of the segment
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Source: Authors' own elaboration based on the references listed in the text above

The findings summarized above clearly show that clubs can use various modern ICTs to implement fan voting on selected issues. Various options for involving fans in creating a loyal community are also described. For sports club managers, these summarized findings provide a source of inspiration and a wide range of ideas. From these various tools, the manager of a specific club or other organization can choose a combination that respects the conditions and restrictions of the given club.

# 4.4. Analysis of data provided by the SFA – visitors of football matches

The following section describes the results of the data analysis of SFA data for the purpose of obtaining knowledge about the attendance of football matches in Slovakia. Figure 5 below shows the average number of spectators in the stands at all levels from the 2016/2017 season to the 2020/2021 season. From the time series, an increasing trend can be observed from the first season to the third (2018/2019), and from the following season, there was a decrease due to the COVID-19 pandemic.





#### Source: SFA data

However, the SFA data also provides insight into the attendance at the stands of individual leagues. The Fortuna league can be called the most visited on average (for all observed periods), as can be seen in Figure 6. It is also the highest football league in Slovakia. The second most visited league on average is the II. League. The third position in the order occupied by the  $1^{st}$  SK futsal league is interesting. The next place was taken by the qualification for the youth competition under the age of 19 with the designation Qvalif. for I. LSD – U19. The Slovnaft cup took fifth place in average attendance throughout all seasons. This is the renamed Slovak Cup, the winner of which represents Slovakia in the UEFA European League.

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Figure 6. Visualization of the mean number of match visitors by leagues

#### Source: SFA data

However, it is also possible to analyze the time series of attendance at the stands of selected leagues over time. For the purposes of this study, the first two most attended leagues were selected. The following leagues in order are similar in progress and proceed similarly to the attendance of the second league. For visualization, they were therefore not included in the graph in Figure 7. An interesting phenomenon occurred in the 2018/2019 season for the Fortuna League. After an increase in the two previous seasons, there was a sharp decrease. The decline in the following seasons can be justified by the start of the COVID-19 pandemic. However, the decline in the mentioned season is not clear.



Figure 7. Visualization of the mean number of match visitors by selected leagues in time

#### Source: SFA data

This situation was addressed in an article from the sports section of the Pravda Daily (2019). The lack of interest was commented on by Milan Lešický, who claims that it is a general lack of interest of Slovaks in national sports competitions. In football, one of the factors is the decline in club affiliation of fans, which was maintained at a level especially in the club Dunajská Streda (visitors here increased in the 2018/2019 season compared to the previous season) and in Trnava. Another reason is the absence of football derbies, which created tension. The movement of players between clubs also did not contribute to this situation, since, according to the analyst, the fans did not have time to form a relationship with the players. Additionally, the contrast of the level of playing with the increasingly broadcast European leagues can also be considered an influential factor. (Zeman, 2019)

It can be concluded that this is a managerial failure, as the demands of the fans were not considered sufficiently. Fans seem to be under-involved in governance and community. It would be appropriate to investigate the

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experience of the fans on the day of the match. According to the analyzes described in this article, this is an important factor. Underestimating it can have serious consequences. An example can also be the recent event F1 Grand Prix Miami. Here, fans criticized the too-high price of tickets, which did not correspond with the value obtained. The prices of food products and drinks were perceived negatively as well. Fans also complained about the lack of view of the track, with their seat constantly in direct sunlight. The statement of one of the fans who claimed that he did not feel "among his own" is critical. The organizers did not satisfy the demands of the fans, and because of this, the event was perceived very negatively. (Pavlík, 2023)

# **4.5.** Recommendations in the form of the proposed process of analysis and involvement of fans in the management of sports clubs

Since the aim of the study was to focus on managerial recommendations, a process model for involving fans in club management was proposed (Fig. 8). The idea is to involve the fans in management so that the club's strategic goals are achieved. A frequently expressed concern is the extent to which fans should be involved in governance. That is so that the fans do not get out of control. Therefore, the basic forms of involvement of fans in management are distinguished in the model. This is about ways that do not have a direct impact on the management of the club. It can be the choice of an anthem, a logo, a mascot, or a slogan. It can also be about fan events, where fans can decide on the time of the event, refreshments, etc. For example, the club can organize a fan meeting on the club's premises.

At the beginning of the process, it is necessary to analyze the fans or viewers. The club must know its segments and find out their requirements. Based on the analyses, it is necessary to establish meaningful strategic goals with an orientation towards the fans. The next step depends on whether the club has an official or unofficial fan base. If the fans have established their fan club, it is recommended to support this club through official channels. This leads directly to involvement in management (such as the fan events).

If a club has an established official fan base, it should create (if it does not exist) or modify a community-building plan to align with strategic objectives. Subsequently, in accordance with the plan, it is necessary to start building communication channels (social networks and the web) and be active on them, trying to increase the activity of fans (increasing the number of interactions with fans).

If the community is built (indicators: number, interactions between club and fans, interactions between fans, the positivity of fan comments, etc.), it is possible to start involving fans in the management. Each involvement of fans in the management should be measured by predetermined indicators of success (number of positive feedbacks from fans, the mood of fans during the involvement process, number of involved fans, etc.). Each indicator must have its own threshold, the crossing of which indicates success. Subsequently, it is possible to measure success. If the basic management involvement is successful, it is possible to proceed to advanced types of fan involvement in management (creating a fan body, electing fan representatives, etc.).

After such involvement, it is recommended to get feedback, based on which the processes should be modified. This is followed by a verification of whether the created system fulfils the strategic goals. If so, it is good to collect the lessons learnt that can be used in the future. If not, the strategic goals should be adjusted, as they may not have been set realistically enough. The process continues again. Also, if the indicators have not been fulfilled, it is necessary to return to additional community building, as perhaps the fans have not yet developed an emotional relationship with the club and the community.

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Figure 8. Proposal of the process of fans involvement into the sports club's management

#### Source: authors' own elaboration

For a better approximation of the audience/fan analysis process, a process diagram was created, which is shown below (Fig. 9). In the first step, it is necessary to evaluate the free resources of the club that can be used for the given process. Subsequently, with the help of brainstorming, it is recommended to establish possible variants of ways of performing the analysis of fans or viewers. Variants are evaluated using the critical success factor method. This method directs the management to choose the most suitable variant considering the club's resources. The continuation of the process depends on whether the club has decided to carry out the analysis in-house or whether it has decided to outsource the process. In their own direction, the usual managerial steps follow – planning, implementation, and evaluation of the survey. When outsourcing, the selection of a suitable company

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must be performed. The sports club then plans a survey with the selected company, and then regular communication takes place. The selected company will evaluate the survey. Subsequently, managerial implications will be determined, which will serve for setting the strategic goals.



Figure 9. Proposal of the process of fans analysis from the perspective of sports club's management

Source: authors' own elaboration

#### **Discussion and conclusions**

The aim of the article was to provide an overview of current knowledge in the field of analysis and involvement of fans of sports clubs in community-building processes and in selected managerial issues for achieving the long-term sustainability of these sports organizations. This goal was fulfilled through the achieved and interpreted research results. The results led to the formulation of the following points:

- Fans are key stakeholders of a sports club as they have developed an emotional bond with the club which leads to their loyalty even when the club is not doing well (tolerance depends on the level of commitment).

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- To satisfy the needs or demands of the fans towards the club, it is necessary to carry out analyses. Accurately defining the fans' needs is a prerequisite for fans involvement in management. Theoretical knowledge indicates that sports fans demand their involvement in the club management. However, the sports club should know exactly how the fan imagines being involved in the management of the club.
- Analyzes of practical examples of fan analysis by various sports clubs were carried out. Indicators of fan
  satisfaction with ticket prices and indicators of fan satisfaction with the experience of the match day are
  most often investigated. For future analyzes of fans, the authors of this article recommend including
  satisfaction indicators with indicators related to inclusivity or sustainability concepts.
- Fears often prevail that involving fans in management leads to anarchy. Therefore, the authors of this article propose a gradual and careful involvement of fans in management. In addition to building the community, it is possible to use simpler forms of involvement of fans in management (decision on the club's anthem, the decision on some elements of upcoming club events what kind of refreshments the fans prefer, etc.), or such forms that will indirectly affect the operation of the club. Only when these simple forms of fan involvement in governance are successful can the club proceed to advanced forms of fan involvement in governance (e.g., by creating a fan body with voting rights).
- Analyzes of practical examples and case studies related to fan involvement in management, but also to ways of bringing fans closer to the club (e.g., how AL and Chelsea provide hospitality options to fans to create a sense that the club values the fans) were performed. A distinctive way of involving fans in the management of the sports club for the American sports markets is the opportunity to vote on the players who will participate in the All-star games. For England within football, the creation of fan bodies that have voting rights is common. In this case, systems of indirect democracy are created, where members of fan bodies are representatives of all fans. A similar element was observed in the case of the Spanish club FC Barcelona, where, however, a separate system of direct democracy is being created within the club, since every fan meeting the specified criteria can directly vote, for example, on the selection of the club's president.
- Enhancing the experience of a fan's physical participation in a match is essential for all sports clubs. This is evidenced by theory as well as examples from practice. The aforementioned AL and Chelsea place a high emphasis on this area, as a result of which their sales increase in parallel. In the article, examples were also given when incorrect or insufficient addressing of this area caused a decline in attendance (for example, Fortuna league the decline was also demonstrated through the analysis of the SFA data), or fans publicly communicated dissatisfaction (for example, Formula 1 and the event in Miami), which can jeopardize the future level of attendance, or it may affect the brand of the event, but also the brand of the league (since they are mutually linked).

Pandita and Vapiwala (2023) also address fan involvement and engagement in global research. These authors analyze the use of digital strategies and the role of social networks within the research area and selected phenomena associated with sports club fans. These authors also used a qualitative approach to research in their study, as it is also applied in our article. An important result of the given study, which is in line with our findings, is the fact that to achieve the active involvement of fans, active presence on social networks is necessary on the part of sports clubs. Behrens and Ulrich (2022) address this in their research project as well. They draw attention to the importance of showing fans directly in stadiums when creating visual content for the media. Such content then influences the cognitive and affective components of fans 'behaviour. This only confirms the value and need to focus on the creation of loyal communities of fans through their involvement in selected activities and management processes of clubs.

Zelenkov and Solntsev (2023) in the context of sports management research draw attention to the dynamics of the development of this entire research area. As part of such oriented research, researchers deal with the business and

social aspects of sports. Our article links both aspects in its content. However, according to the conclusions of the research of these authors, the interest in fan loyalty within the framework of other research projects is rapidly decreasing. Therefore, our study can also be considered as filling this identified knowledge gap in the current period.

To assess the complex results and impacts of changes in the management and (market) performance of sports clubs after the implementation of the proposed processes and steps, it is advisable to choose several relevant criteria and then evaluate them using a multicriteria evaluation (as applied by e.g., Vrabková et al., 2021; Malichová et al., 2016; Ďurišová et al., 2020). Searching for ways to achieve sustainability by looking at its diverse aspects and manifestations in the operation of various types of organizations, including sports clubs, is one of the most frequent topics in current research. This is also confirmed by the studies of the authors Tumová (2019), Soviar et al. (2018), Kucharčíková et al. (2023), Gergel et al. (2019), or Boršoš and Koman (2022).

The limitations of the presented research include those that directly result from the applied methods. The deliberate selection of concrete examples from practice and case studies is always linked to the determination of the final number of such cases and studies that can be included in one research project. At the same time, there are many other cases that could not be included. The future direction of the presented research also includes an orientation towards obtaining primary data in the form of a large new questionnaire survey carried out in Slovakia and in neighbouring countries. This way, it will be possible to supplement the qualitative findings and conclusions with a quantitative component and statistical evaluation of the obtained primary data.

This research paper interconnects theoretical findings with practical examples and multiple use cases. This approach yielded practical pieces of knowledge for sports managers, applicable in their everyday tasks in the management of various sports organizations. The scientific novelty of the article is included in the findings that sports managers are increasingly implementing means and measures to enhance the sports fans' experience. This is being done via involvement in the processes of decision-making and community-building. Application of these concepts in sports management leads to increased fan engagement and stronger relationships between sports clubs and their fans. Finally, this results in a more stable market position. Neglecting fans might negatively impact sports clubs, as it happened in the case of the Slovak football sports market, or the recent example related to the F1 Grand Prix Miami.

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Assoc. prof. Michal VARMUS, PhD is a lecturer of marketing communication and inovation management. He focuses on the topics of sports management, sports marketing, and sustainability of sports organizations. ORCID ID: https://orcid.org/0000-0002-9001-286X

**Prof. Milan KUBINA, PhD** is a lecturer of business information systems and information management. He focuses on the topics of ICT support of management and decision-making and sustainability of organizations via data analysis. **ORCID ID:** <u>https://orcid.org/0000-0002-0214-3836</u>

Martin MIČIAK, PhD is a lecturer of managerial theories and project management. He focuses on the topics of human capital, sustainability, sports management. ORCID ID: <u>https://orcid.org/0000-0002-8636-3560</u>

**Pavol BOŠKO** is a PhD student of economy and management. He focuses on the topics of sports management and relevant stakeholders. **ORCID ID:** <u>https://orcid.org/0000-0002-5420-6480</u>

Ivan GREGUŠKA is a PhD student of economy and management and a sports management practitioner. He focuses on the topics of sports management and sustainability. ORCID ID: https://orcid.org/0009-0006-3510-0492

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Clarivate

# FACTORS IMPACTING HEALTH PERSONNEL MIGRATION IN SLOVAKIA: ROLE OF REMUNERATION \*

# Tatiana Masárová<sup>1</sup>, Marcel Kordoš<sup>2</sup>

<sup>1,2</sup> Alexander Dubček University in Trenčín, Študentská 2, Trenčín, 911 50, Slovak Republic

E-mails: <sup>1</sup>tatiana.masarova@tnuni.sk; <sup>2</sup>marcel.kordos@tnuni.sk

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**Abstract.** Migration is influenced by many macro (environmental, social, economic, political) and micro (personal characteristics) factors that lead to cross-border movements. Currently, we consider the topic of personnel management in hospitals in Slovakia to be extremely crucial, as it is related to the announced reform efforts that may affect the emigration sentiment of health care workers. The main goal of the paper is to compare the attitudes of doctors and nurses on remuneration before and after the Covid -19 pandemic outbreak in Slovak hospitals and to identify emigration sentiments. As principal methods the base index, chain index and rate of increment have been used to calculate the wages. Next, we used basic statistical methods (sum - "n", proportion - "%") in the study. Student's t - test was also used in the study. Work remuneration was one of the worst rated conditions. The results of the analyses have shown that work remuneration got worse from the point of view of medical staff - the difference before and during the pandemic was 0.2. The pay-for-work scores showed higher average score within the health personnel group with less than 5 years of experience. A Student's t-test was conducted and has confirmed a statistically significant difference in the assessment of conditions as reasons for going abroad. The outflow of healthcare professionals from Slovakia is due to more favorable working conditions and organization of work in other countries.

Keywords: emigration sentiment; doctor; salary; work remuneration; nurse

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JEL Classifications : F66, J16, J21, O11, Q55

#### **1. Introduction**

The significance of personnel management in health care sector lies in the provision of quality and efficient health care, provided that human resources are well managed and of high quality. Different countries have their own specific problems, one of the main problems of Slovak health care system is its insufficient funding, causing an

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outflow of labor force. Migration of doctors leads to a loss of investment in human capital (Castro-Palaganas et al. 2018). In terms of the situation in Slovak Republic, characterized as dissatisfaction of medical staff with their salaries, a reform has been approved to increase salaries in 2023. The minimum salary coefficient for a doctor from 01.01.2023 for certified doctors is 2.5 times of the average salary, for non-certified doctors 1.5 times. In addition, the doctor's salary will be increased according to the number of years of experience - for non-certified doctors by 0.015 times of the average salary, for certified doctors by 0.025 times for 30 years. From 01.01.2025, the seniority coefficient for certified doctors is to be increased to 0.03 times of the average salary for 30 years. The Ministry of Health of Slovak Republic declares that the increase in doctors' salaries is to ensure the withdrawal of mass resignations of doctors, to prevent a decline regarding the interest to study in the field of health care, to prevent the outflow of healthcare professionals from the system or their transfer to other countries (Ministry of Health of Slovak Republic, 2022).

Year	Basic salary (€)	Increase (€)	Base index	Chain index	Rate of increment (%)
2017	1103,75	+ 31,25	Basic Year		
2018	1140,00	+ 36,25	103	103	3,28
2019	1192,50	+ 52,50	108	105	4,61
2020	1266,25	+ 73,75	115	106	6,18
2021	1365,00	+98,75	124	108	7,80
2022	1416,25	+ 51,25	128	104	3,75
2023	1695,40	+ 279,15	154	120	19,71
		(proposal)			

Table 1. Salaries of doctors without specialization and experience - without salary supplement (2017 - 2023)

Source: authors - own processing and calculations based on MF SR

Year	Basic salary (€)	Increase (€)	Base index	Chain index	Rate of increment (%)
2017	2030,90	+ 57,50	Basic Year		
2018	2097,60	+ 66,70	103	103	3,28
2019	2194,20	+ 96,60	108	105	4,61
2020	2329,90	+ 135,70	115	106	6,18
2021	2511,60	+181,70	124	108	7,80
2022	2605,90	+ 94,30	128	104	3,75
2023	3027,50	+ 421,60 (proposal)	149	116	16,18

Table 2. Salaries of doctors with specialization and 20 years' experience - without salary supplement (2017 - 2023)

Source: authors - own processing and calculations based on MF SR

The Table 1 and Table 2 show the salaries of doctors from 2017 to 2023. The highest increase rate is observed in 2023 compared to 2022 - 19.71% for doctors with no specialization and experience and 16.18% for doctors with specialization and 20 years of experience.

In 2023, the Slovak Ministry of Finance (MF SR) plans to increase the salary of other healthcare personnel nurses and midwives from  $\notin$ 200 to  $\notin$ 450, physiotherapists, medical and pharmaceutical laboratory technicians, dental and radiology technicians, public health workers from  $\notin$ 90 to  $\notin$ 340, laboratory diagnosticians and pharmacists from  $\notin$ 120 to  $\notin$ 360, dental hygienists from  $\notin$ 90 to  $\notin$ 330, paramedics from  $\notin$ 120 to  $\notin$ 375, and

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ambulance workers from  $\notin 100$  to  $\notin 340$ . Salaries depend on the evaluation, length of experience, expertise, and specialization (MZ SR, 2023).

### 2. Literature Review

It is obvious from the literature that the decision of doctors and other health professionals to migrate is multifactorial (Milner, Nielsen, and Norris 2021). Migration is influenced by many macro (environmental, social, economic, political) and micro (personal characteristics) factors that lead to cross-border movements (Pinto da Costa, Moreira, Castro-de-Araujo, da Silva, dos Santos 2021). The decision to migrate is made by an individual at a personal level; however, how, why, where, and when to migrate appears to be determined by a complex interplay of professional, local, national, and international factors (Davda, Gallagher, Radford 2018; Snieska et al., 2020). In particular, researchers argue that satisfaction with the working conditions factor plays a key role as a push factor regarding the emigration of hospital doctors and nurses (Schneider et al., 2023). Ndikumana (2018) argues that factors such as financial remuneration, the career of health professionals, their qualification training and development, motivation, working relationships, or working conditions are factors influencing the decision to migrate. The results of Onah et al. (2022) indicated that the most common reasons for emigration (the main push factor) are poor remuneration. The migration flows determinants within the European Union by means of networking approach were investigated by Windzio et al. (2021). The publication of Dohlman et al. (2019) assesses the motivational factors leading to physician migration in terms of Maslow's hierarchy of needs. The authors suggested that financial security needs were the main drivers of physician emigration. A study by Botezato and Ramos (2020) evaluates how doctors choose their destination countries for emigration. The authors found out that good remuneration of doctors was among the main drivers of doctors' brain drain. It is significant to bear in mind that the migration of medical professionals may not only take place from low- and middle-income countries to high-income countries, but also from high-income countries (Saluja et al., 2020). Tankwanchi, Hagopian, and Vermund (2019) have pointed out to the understanding of health professionals' mobility in lowincome countries, whereby policy makers will be able to develop more informed policies to address the shortage of skilled health professionals. Chojnicki and Moullan (2018) focused their study on doctors' shortage issue to see if policies are taking an effective approach to addressing the shortage of doctors.

The HR manager in healthcare institutions performs all activities and tasks in terms of recruitment, training, motivation, remuneration, etc. Personnel management in healthcare sector is regulated by Act No 576/2004 Coll. on health care, services related to the health care provision and on amendment and supplementation of certain acts as well as Act No 578/2004 Coll. on health care providers, health care workers, professional organizations in health care sector and on amendment and supplementation of certain acts. How to remunerate healthcare workers to be motivated to treat patients effectively has no clear answer even on the threshold of the Healthcare 4.0 era. Salary costs constitute the highest item within the healthcare organizations budgets, (most often between 65% and 80% of the total budget), which only increases the need for discussion and search for solutions. In developed countries, the treatment outcomes payments (pay for performance) in combination with treatment procedures standardization and efficiency indicators adherence are becoming more and more widespread (Stachová, Blštáková, Stacho, 2021). Performance management systems (rewarding the good and punishing the bad) are implemented in healthcare organizations. They are often ineffective because the health personnel shortage leads health managers not to risk demotivation and leaving. Healthcare organizations are most often a highly hierarchical processes, as long as a line manager proposes a reward or punishment, it usually has to go through an approval system, which limits the final activity outcome (Raijani et al, 2018). Schumann, Maaz, and Peters (2019) argue that migration of doctors has become a global phenomenon with significant implications for health care delivery systems worldwide, the motivations and factors leading to physician migration are complex and constantly evolving. Meanwhile, Thompson and Kapila (2018) emphasize that the shortage of human resources in health care leads to serious and lasting damage to health care systems, according to Yakubu et al. (2022a), also to the threat of inadequate health care delivery. Yakubu et al. (2022b) conclude that countries could follow common

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public value propositions for source and destination countries. It has been mostly spoken about emigration sentiment, but the opposite can also be stated, that the migration crisis due to the Pandemic seems not to have affected the patterns of migration to Slovakia (Přívara, Rievajová, 2021).

#### **3. Research objective and methodology**

Remuneration is one of the HR activities that can influence the migration of health personnel. The research part is based on quantitative research methodology and the goal of the study is to compare the attitudes of doctors and nurses towards remuneration before and after the Covid -19 pandemic outbreak in Slovak hospitals and to identify emigration sentiments. Based on the research objective, the research question has been formulated: Which personnel activities influence the propensity of doctors and nurses to emigrate abroad for work? In formulating the research question, we drew on the findings of Slovak Medical Chamber (2020), according to which the propensity of doctors and nurses to migrate abroad for work is mainly influenced by remuneration and working conditions. Similarly, Jankelová (2021) reports that healthcare personnel migrate in search of better remuneration and working conditions.

According to Jašková (2021), the empirical data is collected from the respondents at the stage of obtaining empirical material. The distribution of the questionnaire was done online through Google Forms. The Research set consisted of 119 healthcare workers, including 88 nurses and health assistants, 31 doctors. In the items related to working conditions, the respondents answered by means of a Likert scale where 1 - very satisfied, 2 - rather satisfied, 3 - neither satisfied nor dissatisfied, 4 - rather dissatisfied, 5 - very dissatisfied. We used the point method, assigning 1 point to a very satisfied response, 2 points to a rather satisfied response, 3 points to a neither satisfied nor dissatisfied response, 4 points to a rather dissatisfied response, and 5 points to a very dissatisfied response. In the study we used basic methods of statistics (sum - "n", proportion - "%") and Student's t - test was used as well. We used the arithmetic mean and assigned scores 1 - 5 to each answer. The higher the average score, the higher the dissatisfaction, the lower the average score, the higher the satisfaction.

Working conditions before Covid-19	Average score	Working conditions during Covid-19	Average score	Difference	Student t-test
Work remuneration	4,0	Work remuneration	4,2	+0,2	0,011

*Source:* own processing (questionnaire survey 11/2022 - 12/2022)

Table 3 shows that work remuneration was among the worst rated conditions. Apart from the work remuneration issue, the research also has been focused on work organization, workload, training, and other working conditions, and we based our item formulation on the findings of Beutner et al. (2022); according to these researchers, the working conditions of doctors and nurses deteriorated significantly as a result of the pandemic. We note that work remuneration got worse from the perspective of health personnel - the difference before and during the pandemic was 0.2. The performed t-test did not confirm a statistically significant difference in satisfaction ratings before and during the pandemic for the item work remuneration.

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Working conditions during Covid-19/ Practice	Average score up to 5 years	Average score 6 – 15 years	Average score 1 5 years +	Sum
Work remuneration	4,6	4,2	3,8	4,2

*Source:* own processing (questionnaire survey 11/2022 - 12/2022)

Table 4 shows that the assessment of work remuneration shows a higher mean score in the group of health professionals with less than 5 years of experience. We interpret the results as suggesting that better remuneration when working abroad is a reason to go abroad, especially for young doctors and nurses. This may have an adverse impact on the population for whom health care will be unavailable due to the lack of personnel.

Table 5.	Working	conditions	as a reason	for	going a	abroad
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Working conditions during Covid-19 with up to 5 years' experience and more than 5 years	Student t-test
Work remuneration	0,001

Source: own processing (questionnaire survey 11/2022 – 12/2022)

Table 4 shows that the conducted Student's t-test confirmed a statistically significant difference in the ratings of conditions as reasons for going abroad. Work remuneration for is a reason for going abroad, especially for personnel with up to 5 years of experience, i.e., young doctors and nurses.

The questionnaire also contained open questions. In one of them we investigated what suggestions doctors and nurses have to influence (prevent) the tendency to emigration, the departure of healthcare workers abroad. The most frequent item in the measures was the following: remuneration system - salaries, personal evaluation and benefits.

Based on the research objective, we formulated the research question: Which personnel activities influence the propensity of doctors and nurses to emigrate abroad for work? We found out that among the working conditions, it is the remuneration for work that most affects the emigration sentiment of healthcare professionals (mean score 4.2). The problem area of work remuneration was also reflected in the respondents' views as a possible measure to address emigration propensity. Our findings are in line with those of the Slovak Medical Chamber (2020) and Jankelova (2021).

### 4. Discussion

The authors of the study (Gkioka, et al. 2018) who explored the motivation factors of doctors and nurses working in Greek public hospital came to the following results. Data were collected between September 2016 and January 2017 from 366 healthcare employees (149 doctors and 217 nurses) by administering the Paleologou questionnaire, which explores four motivation factors (job attributes, remuneration, co-workers, and job performance). On a questionnaire 5-point scale, lower values reflect bigger levels of motivation. The alpha index of the questionnaire ranges from 0.914 to 0.851 (job attributes index: 0.914, compensation index: 0.903, co-workers index: 0.853, job performance: 0.851). By measuring the motivational factors significance, the following values were found out for doctors: job performance 2.03, co-workers 2.65, job attributes 2.91, and remuneration 3.15. For nurses, job performance 1.88, co-workers 2.6, job attributes 2.64, and remuneration 2.89. The most important motivation factors for both doctors and nurses are recognition of their job performance and their co-workers, while the less important factors are remuneration and their job attributes.

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Our findings are not consistent with the results of the Gkioka, et al. study, which we attribute mainly to the different period of empirical data collection. Regarding the limitations, the results of our research cannot be generalized to all healthcare workers because the respondents have been selected randomly. For example, a study (Lambrou, Kontodimopoulos, & Niakas, 2010) in which the medical and nursing staff in the Nicosia General Hospital was explored to see how they are affected by specific motivation factors along with their link between job satisfaction and motivation. The authors used a validated instrument focused on four job-related motivators (job attributes, remuneration, co-workers, and job performance). Two categories of healthcare workers, doctors and dentists (N = 67) and nurses (N = 219), participated in the survey, and motivation and job satisfaction were compared within the sociodemographic and job-related variables. The survey showed that job performance ranked first among the top four motivators, followed by remuneration, coworkers, and only in last place were job attributes.

Our findings are more in line with the study results of Lambrou, Kontodimopoulos, and Niakas, 2010. The remuneration factor revealed statistically significant differences by gender and hospital sector. Medical staff showed statistically significantly lower job satisfaction compared to nursing staff. The results are consistent with the literature that focuses on management approaches using both monetary and non-monetary incentives to motivate healthcare workers. Healthcare workers tend to be more motivated by intrinsic factors, hence this should be the goal to motivate employees effectively.

### Conclusions

Apart from wage incentives, countries usually use other strategies related to personnel activities to recruit and retain health professionals, as many healthcare workers are underpaid, poorly motivated and show high levels of job dissatisfaction. In the quantitative research, we found out that work remuneration got worse from the perspective of healthcare personnel (comparing the period before and during the pandemic). The category of healthcare personnel with up to five years of experience is more likely to consider working abroad. Emigration sentiment of doctors and nurses to work abroad is most influenced by work remuneration.

We believe that the main reason for young medical professionals to migrate abroad for work may not necessarily be higher salaries, but may be optimal work commitment, feeling of support in practice and quality training. The most important aspect of personnel management in healthcare sector is primarily to ensure the sufficient quality of human resources, and secondarily to ensure that healthcare personnel have adequate working conditions (including work remuneration). Changes in the remuneration system will be useless without modernizing hospitals, improving equipment and facilities, and empowering staff.

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**Tatiana MASÁROVÁ, Ing., PhD.** is PhD. in Economic Theory at the Department of Personnel Management and Human Resources management, Faculty of Social and Economic Relations at Alexander Dubcek University of Trencin, Slovakia; the author of more than 100 scientific papers and publications published domestically and abroad. Fields of scientific interests: human resource management, corporate culture. **ORCID ID:** 0000-0003-4753-3309 **Researcher ID:** AFI-0299-2022

Marcel KORDOŠ, Ing., PhD. is the Assistant professor at the Department of Public Administration and Regional Economy, Faculty of Social and Economic Relations at Alexander Dubcek University of Trencin, Slovakia; the author of more than 100 scientific papers and publications published domestically and abroad. Fields of scientific interest: international economics, economic diplomacy, integration processes in EU. ORCID ID: 0000-0002-1833-7096 Researcher ID: P-4568-2018

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# INFORMATION AND COMMUNICATION TECHNOLOGY: ELECTRONIC HEALTH RECORD AS SUSTAINABLE CHOICE IN SOUTHERN EUROPE IN THE EUROPEAN CONTEXT\*

# Alfonso Marino<sup>1</sup>, Paolo Pariso<sup>2</sup>, Michele Picariello<sup>3</sup>

<sup>1,2</sup> Università degli Studi della Campania "Luigi Vanvitelli" – Dipartimento di Ingegneria, Aversa, Italy <sup>3</sup>Università degli Studi di Napoli Federico II, Dipartimento di Ingegneria, Napoli, Italy

*E-mails*: <sup>1</sup> <u>alfonso.marino@unicampania.it;</u> <sup>2</sup> <u>paolo.pariso@unicampania.it;</u> <sup>3</sup> <u>michele.picariello@unina.it</u>

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**Abstract.** Following the European outlook, in the reform context, as declared by the European Government Law related to National Health Service, the countries are implementing Information and Communication Technology (ICT) and Electronic Health Records (EHR). The present research assesses the degree of ICT and EHR and its sustainability in diffusion and adoption across southern Europe cities' hospitals. It outlines the framework of European ICT to evaluate the different degrees of EHR present in southern Europe. The evaluation of the degree of diffusion and adoption of EHR is based on the Southern Europe Inpatient Dataset. It shows how the EHR is in close correlation with ICT policies and how it can also affect such policies.

Keywords: Europe; Sustainability; Cross Hospital Comparative Study; Cities; HER, ICTs diffusion and adoption

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JEL Classifications: I11; I18, O33, O38.

Additional disciplines: Healthcare, Government Policy, Technological Change, Public Health.

### 1. Introduction

Information and Communication Technology (ICT) provides both opportunities and challenges for redesigning economic and service structures in terms of production and information worldwide. Therefore, it is unsurprising that many European countries are implementing ICT processes. These processes are strictly linked to ICTs (Marino et al., 2022), and one of the main goals is to ensure the creation of continuous value in health (Squitieri et al., 2017; Zhao et al., 2019; Caratas et al., 2021). Following this research stream is strategic to ensure and activate ICT tools because it could allow for keeping and add to the creation of value in health as in the case of public

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services (i.e. health, education, national and local services). The research in this study is focused on ICT tools with particular reference to ICTs diffusion and how these two factors affect European Health to create value in the public health sector (Capone et al., 2020). These actions are strictly linked to how the European government operates at the micro and macro levels using ICT (Bloom et al., 2019). The complexity of service delivery has increased over the years as the expectation for transparency of the citizen part, especially in a sector with high technological innovation level (Hwang & Christensen, 2008; Ash, 1997; Gardner et al. 2007; Marino, 2001, Marino & & Tamburis 2005; Lehoux et al. 2019; Piccinetti et al., 2023). Recent studies highlighted the original character of the ICT and how a government should realize the value of health (van Gemert-Pijnen et al., 2011; Oh et al., 2005; Eysenbach, & Jadad, 2001; Marino et al., 2020; Benjamin, et al. 2019). Interestingly, these studies align with other conceptual research in which it emerged that the creation of PVs requires work in alignment, coordination, and co-creation. Creating PVs means changing the programs of public departments. These changes have been implemented in many countries and have produced interesting value in health (Kelly et al., 2019; Norman & Skinner, 2006; Casado-Vara & Corchado, 2019). Such changes are related to departments' communication, coordination and integration regarding the new services delivered. These actions and decisions highlight the necessity to negotiate procedures and reorganize the budget and department employees. A recent study argues that these processes are functional in generating positive value in health (Iqbal et al., 2019; Porter & Kramer, 2019; Urena et al., 2019; Finkelstein et al., 2019). The governments are operating in a continuously changing context. According to literature (Chohan, 2019; Williams & Shearer, 2011; O'Flynn, 2007) conceptualizations of public value, the government can improve the collective and individual service delivery (Besley & Ghatak, 2007; Romzek et al., 2014; Mamokhere, 2023). In this sense, the output of a government is aimed at improving public value as a collective goal. Public value means that public interest and the common good should be the main concern of the public sector. Interestingly, this approach considers the citizens as effective stakeholders in public value in health creation (Cluley & Radnor 2020; Mintrom & Luetjens, 2017; Bryson et al., 2014). The citizens can determine a higher level of democracy and legitimate the government within two processes of democracy: bottom-up and top-down. Furthermore, the ICTs are strategic drivers for enhancing public value in health. They may be fundamental tools in optimising processes to increase the stakeholders' engagement by including the employees in a network governance logic. The governments might have to manage and deliver information and services and gain legitimization in an interactional logic with stakeholders. In this context, ICTs can propose new service delivery ideas and models. Interesting contributions consider ICTs as enabling factors to create public value in health. (Martins et al., 2019; Ferlie et al., 2019; Cronemberger & Gil-Garcia, 2019: Twizeyimana & Andersson, 2019). For example, ICT can contribute by improving efficiency and introducing innovation in the delivery of services, by enriching hospital-patient relationships with employees, and by strengthening trust in and support for and legitimacy of health organizations (Miller et al., 1997; Palanisamy & Thirunavukarasu, 2019). Following this research stream, ICT is an enabling factor to empower hospitals, patients, and health services and support inclusive practices, especially for the different processes at the national and local levels (Cooper et al., 2019; Krebs & Duncan, 2015). Furthermore, recent studies highlight the potential of ICTs in creating value in health by enhancing ICTs-relations to assess intra-hospital services, which produce added value in health. It is interesting to note the different approaches to value in health, Porter (2010, p.2) argues that: "Outputs, not inputs, measure value. Hence the value of health care depends on the actual patient health outcomes, not the volume of services delivered. More care is not always better, and shifting focus from volume to value is a central challenge. Nor is the value measured by the process of care utilized; process measurement and improvements are important tactics but no substitutes for measuring outcomes and costs". Following this definition, Mosadeghrad (2013, p.1) proposes a different definition: based on "consistently delighting the patient by providing efficacious, effective and efficient healthcare services according to the latest clinical guidelines and standards, which meet the patient's needs and satisfies providers". The evolution of these studies related to the value of ICT is in Capone et al. (2020), with special reference to Electronic Health Records (EHR) and one of the results shows that EHR systems can improve the value of health. Following this research stream, value in health and EHR, Leventer-Roberts et al. (2020, p.216), in the conclusion of the paper, argues that "linking individuals' health records with their data-derived family history has untapped potential for supporting diagnostic and

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clinical decision-making." The studies based on EHR point out that each public hospital should promote more interactive and active contributions to decision-making through the timely sharing of information and communication. The result of this process is that ICT would contribute to creating value in health by improving hospitals' actions regarding value and transparency of public services. All these positive elements present a weakness linked to the decision-making process between professional instances (medical, nursing, technological) and choices of the public health service. (Adler-et al. 2015; Desautels et al., 2016; Tavares & Oliveira, 2016). On the one hand, assessing the value of health provision delivery has become strategic over the last few years. On the other hand, governments need to guarantee transparency and encourage stakeholder collaborative participation. Following this research stream, specific applications to create value in health have been applied (Graber et al., 2019; Kruse et al., 2016). In the recent period, February 2020, ICT and EHR have been considered a strategic asset also in response to the health emergency of Covid-19. In this context, European countries are turning to massive use of ICT to create an effective balance between the value of health services and lockdowns. The level of ICT diffusion also represents the extent to which each country is operating in the development, effectiveness, and efficiency of both human and economic advancement (Marino et al., 2021). This development process involves the creation of culture and investments in network building by including in the public and private fields several sectors (i.e., education, health, economies) at different levels (i.e., service delivery, production process). In this context, it is fundamental for European countries to be able to implement the processes of diffusing and integrating ICT within their societies to translate the benefits into economic development (European Policy E-Health, 2020). The divergence in ICT accessibility and disparity of digital opportunities within the European country, with a different distribution among its hospitals, may create bottlenecks in developing value in health. Although this phenomenon has tended to contract, it is still a critical issue for many European countries (Tuikka et al., 2016; Grossman et al., 2016). The ICT is in close correlation with EHR implementation, and use the chance to access this tool efficiently represents, on the one hand, the countries' ability to provide innovative digital services through adequate infrastructures and, on the other, to guarantee all patients, full access to the opportunities offered by ICT tools. Europe shows a different degree of ICT and EHR implementation and use within its territory, with great differences between the regions. This issue represents an important bottleneck to developing ICT

### **1.1. European Context**

ICT and EHR in the European context have the potential to significantly contribute to improving healthcare quality, efficiency, and patient outcomes. However, sustainability issues need to be addressed to ensure the longterm viability and effectiveness of EHR systems. Interoperability and Data Exchange: One key sustainability issue is interoperability among EHR systems. In Europe, a fragmented landscape with multiple EHR platforms and standards hinders the seamless exchange of patient information across healthcare providers and regions. Achieving interoperability is crucial to ensure the continuity of care, reduce duplication of tests and procedures, and improve overall healthcare efficiency. Privacy and Data Security: Protecting patient privacy and ensuring the security of EHR data are significant sustainability concerns. Strict privacy regulations, such as the General Data Protection Regulation (GDPR) in the European Union, necessitate robust security measures and consent management systems. Adhering to these regulations while maintaining the accessibility and usability of EHR systems is a delicate balance that needs ongoing attention. Long-term Maintenance and Upgrades: EHR systems require continuous maintenance, upgrades, and infrastructure support to remain functional and up to date. Ensuring adequate funding and resources for these activities is crucial to prevent system obsolescence and maintain the usability and effectiveness of EHR systems over time. User Adoption and Training: User acceptance and engagement are critical factors for the sustainability of EHR systems. Adequate training and support for healthcare professionals are necessary to encourage adoption and ensure efficient utilization of EHR functionalities. User-friendly interfaces, transparent workflows, and ongoing user feedback mechanisms can help address usability challenges and promote sustained adoption. EHR Impact: The sustainability of EHR systems also extends to their environmental impact. Energy consumption, e-waste generation, and carbon emissions associated with data centres and hardware infrastructure must be minimized. Adopting energy-efficient technologies, optimizing data storage and retrieval processes, and promoting responsible e-waste management practices are essential for reducing the environmental footprint of EHR systems.

Furthermore, a recent study commissioned by the European Union, "Interoperability of Electronic Health Records in the EU" (EU, 2022), highlights that the implementation of the EHR has had a limited impact in some Member States of the European Union. In this context, south Europe highlights a series of bottlenecks related to implementing this technology in the public health sector. The data in the report show the general trend for the individual Member States with a comparison between them, without highlighting any imbalances present within the individual EU countries to their division by geographical area: in the case of southern Europe. Electronic health records in southern Europe have yet to become a reality. In this context, it is useful to understand the main dynamics blocking the development of EHR in southern Europe. This study assesses EHR diffusion and adoption across southern Europe cities and elaborates on the framework of ICT to evaluate the different degrees of digital health present in European southern cities and can help to understand how this issue may develop European health service. The present analysis will interest researchers, policymakers and government planners, who can acquire information for developing national ICT strategies. The paper is organized as follows: section two outlines a conceptual background on ICT and EHR. Section 3 shows the methodology, section 4 displays the results, and section 5 discusses the European experience. Finally, section 6 shows the conclusions of the paper.

### 2. Conceptual Background

The studies on the EHR, starting from a technological point of view, highlight the strategic role of ICT and the extent of the missed opportunities when they are not exploited. Moreover, the EHR is linked to a gap identified as a social issue between European countries. (Katehakis et al., 2011; McGinn et al., 2011; Emmanouilidou, & Burke, 2013). In line with this point of view, EHR was first linked to ICT access and only later to the development of the information society. (Al Aswad et al., 2013; Nguyen et al., 2014; Coorevits et al., 2013). These papers represented a critical literature review of some studies on the means of electronic health records. These studies analyzed the advantages and disadvantages of EHR from different perspectives and viewpoints. The main perspectives of these studies are related to adopting electronic health records in different European countries to trace the current status of adopting this technology. These studies highlight the importance of adopting electronic health records and the differences among European countries. The relevant outcomes are linked to the critical points related to the no adoption of EHR. These critical points are related to the organizational, technological and managerial gaps. These critical points concern national and local health services and the absence of one European Health Service. However, these papers will follow a critical review method of the adoption of EHR, starting with its implementation in European countries, highlighting that at an organizational level, the critical points are linked to the need that while organizations implement ICT to effect change, current culture and procedures are pay insufficient attention to the change goals. Following this research stream, hospitals, service delivery, and the medical culture are developed and studied (Strong et al., 2014; Kazley & Ozcan, 2007). The ICT impact is multilevel in the organizational change process. At the ICT level, it is interesting to note that future hospital success depends on managing, accessing, using, and reusing information. (Miriovsky et al., 2012; Buntin et al., 2011). Managerial ones should support the organizational and technological levels. At the managerial level, the studies cited above suggest that management provides medical ICT training and pays attention to it as a strategic outcome. If this training is done ineffectively can increase managerial risks (Terry et al., 2008). These variables, linked to organizational, technological and managerial tools, are important to support the hospital information systems. These three approaches determine an important step forward in assessing the EHR because it is associated with efficient usage and information access. These studies were always limited and not strongly linked to both pathology and cities context in which strategic hospitals deliver health services. Only in recent years, the literature developing studies in this research line and Europe, less than at the worldwide level. (Martel et al., 2018; Aldosari, 2017; Saleem & Herout, 2018; Fukami & Masuda, 2019; Joukes et al., 2019). In

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line with this assumption, it is important for the future of the European health service. It will be studied with the adoption of EHR because recent reforms assign a central role to the strategic hospitals of the city to implement public health policies. The reform proposed by the central government must be implemented at the local level. In this framework, the Public Administration is the main actor in implementing EHR activity (Fernández-Cardeñosa et al. 2012). In this context, the reform is more complex than the ICT as a technological, organizational and managerial issue, evolving into the information society concept. In line with this assumption, the EHR is studied as a European global issue, a strategic decision in all cities with strategic hospitals from northern to southern Europe. In line with this assumption, it is important to study the future of European health service, particularly the adoption of EHR, and recent reforms, to assign a central role to the strategic hospitals of the city to implement public health policies. The reform proposed by the central government will be implemented at the local level. The pillars related to EHR adoption are care, research and governance. Firstly, the care related to prevention, diagnosis, treatment and rehabilitation. This pillar aims to sustain the Institutions of the National Health Service, the Local-Health Service that takes care of the patient. Secondly, the research related to the medical, biomedical and epidemiological sectors. This pillar aims to deliver, by National Health, economic resources within their respective responsibilities assigned by law. Thirdly, governance is linked to the quality of care and evaluation of health care to assess organizational, technological and managerial issues. The aims are to coordinate, integrate and control Local Health Services within their respective responsibilities assigned by law. The debate, linked to EHR in cities with strategic hospitals, highlights the different roles of innovation: organizational, financial, operative (process and service delivery), management, managerial and technological. These are useful for the decisionmaking process of each city government to establish the course of action to improve the public value of Local Health Services. Currently, the Covid-19 emergency forces many countries to strengthen ICT adoption and invest in this way in ICT. For instance, a large part of Europe, particularly the Southern European experience (Marino et al., 2022) and other European Countries are characterized by very few opportunities for innovative action related to ICT adoption. It is interesting to note that the European government underlines the importance of better performance related to the National Health Service through the capacity to utilize the opportunities created by ICT to disseminate information and knowledge to improve individual and collective choices. At the European local level, regions and cities, local governments recently and later point out that disparities between cities' ICT widely mirror disparities in income and other socio-economic factors. In many European cities, large portions of the population are out of the information society network and risk becoming outcasts. Governments should aim at removing disparities linked to existing access inequalities. Governments must overcome the function of those who provide services; they should focus on reforming the public national health service in which the ICT and EHR are strategic bottlenecks that hinder communication between patients and health. In this logic, if governments want to implement EHR, they must shed the role of service provider supervision, create favourable conditions, and ensure equal opportunities for all. This is the design of inclusion. A new frame of mind focused on inclusion is required, particularly in the European southern cities. Particularly, as Research Question (RQ) in southern Europe, and its cities, there is still much to do to bridge the ICT and EHR. Will it be possible? The next section, methodology, deals with the approach adopted to answer the question.

## 3. Methodology

### 3.1. Data Source

Starting from data 2022 of the Eurostat Inpatient Database (EID), the following variables are considered: Healthcare Cost (HC) as Bed Utilization Rate (HCBUR), Reservation Unique Center and Quality (RUCQ), to assess the following cities' hospitals:

- Athens, Sparta, Corinth, (Greece GR).
- Madrid, Barcelona, San Sebastian, (Spain-SP).
- Naples, Bari, Palermo, (Italy IT).

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### • Lisbon, Porto, Coimbra, (Portugal - PO).

This shows the implementation status of EHRs; in these 12 cities are all provincial capitals or metropolitan cities. The EID collects data from the hospitals. The hospitals are public because EID does not collect data from private health. In the selected cities, there are the most significant number of hospitals in the region and are strategic about the guidelines of the reform law. These hospitals collect large numbers of patients as residents and people of the region. The hospitals considered have adopted all the EHR during the year 2019. The EID is a European database containing information on patient characteristics, diagnoses, and procedures. The EID database contains information on Electronic Health Record (EHR) utilization in different hospitals, along with other important hospital characteristics. Both surgical and medical patients from several diagnostic categories were included in the study. These categories were chosen based on the RUCQ dataset and classified as an acute diagnosis - ICD9 CM (2020). The most acute diagnoses are concentrated in a range between 5 and 20 days with relative occupancy of the Bed Utilizational Indicator (HOI). Each HOI includes a unique denominator, numerator, and set of risk adjustors.

# 3.2. Statistical Analysis

Correlation analysis, also known as bivariate, is primarily concerned with determining whether a relationship exists between variables and then determining the magnitude and action of that relationship. The HOI is based on European codes and Medicare severity diagnosis-related groups (DRGs), with criteria determined by the RUCQ. Using Statistical Package for Social Science software (version 26) has been possible to identify adverse events in our dataset. Univariate regression analysis has been developed to obtain descriptive statistics. A hierarchical regression relating to the level of EHR utilization and quality of care was developed. The independent variables are:

- no EHR; (level of EHR utilization)
- partial EHR; (level of EHR utilization)
- full EHR; (level of EHR utilization)
- patient demographics;
- pathology;
- medical group;
- surgical group.

The dependent variables are:

- mortality;
- readmissions.

measured by HOIs.

Relative-risk difference (RrD) used by RUCQ, has been considered to implement an EHR system that may improve quality care. All considered, hospitals have implemented EHR since 2012. This comparison is important to eliminate some types of potential confounding. The use of EHR was split into 3 groups: those that gained full EHRs by 2022 (treatment 1), those that gained only partial EHRs by 2019 (treatment 2), and those that still had no EHRs in 2022. Directly comparing these groups to obtain a logic sequence about EHR use, the rates in 2019 are compared with the same hospital's in 2022. The changes (rates) are used to compare the treatment, i.e., EHR adoption level with no EHR adoption. All statistical analyses were performed using SPSS version 26.0.

### 4. Result

To answer the RQ and create an accumulation of knowledge linked to RQ highlighted in the conceptual background, tables 1 and 2 display patient characteristics as explained in the methodology.

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	Ν	No EHR	Partial EHR	Full EHR
	Total	159859	2.70	57.84
Procedure	NSTEMI	44.693	3.70	52.00
	STEMI	7793	3.22	56.68
	ANG	9890	2.70	58.63
	PUE	14.748	1.49	51.53
	CATAM	74.613	2.85	55.76
	VEFI	8122	3.00	58.44
Cities	Naples (IT)	42.292	13.05	56.72
	Madrid (SP)	31.232	7.62	54.32
	Barcelona (SP)	33.324	5.54	57.83
	Lisboa (PO)	9232	6.32	53.64
	Athens (GR)	25.346	5.63	54.68
	Coimbra (PO)	18.433	4.32	58.63
	18 to 39	2945	2.48	56.78
Age range	40 to 64	62.634	3.02	57.66
Age Funge	65 to 74	39.824	2.33	58.75
	>75	54.456	2.78	56.76
Day ticket	exemption	36.686	2.82	56.42
r ay ticket	partial	104.384	2.32	57.34
	full	18789	2.12	55.43

#### Table 1. Surgical Patient by EHR Status - 2022

Source: Our Elaboration on Eurostat 2019 - 2022-

Legenda: Heart Attack NSTEMI Code ICD: 41071; Acute myocardial infarction STEMI Code ICD: 41091; Angina ANG Code ICD: 4111; Pulmonary embolism PUEM Code ICD: 41519; Cardiac tamponade CATAM Code ICD: 4239; Ventricular fibrillation VEFI Code ICD: 42741

	Ν	No EHR	Partial EHR	Full EHR
	Total	332362	2,38	59,72
Condition	Emergency	144.693	3,70	62,00
Condition	Planned	87794	3,11	68,08
	Day Hospital	99875	2,30	55,63
	Naples (IT)	82.246	14,05	54,72
Hospital	Madrid (SP)	52.214	9,62	64,32
-	Barcelona (SP)	49.124	12,54	60,83
	Lisboa (PO)	45.123	4,32	63,64
	Athens (GR)	53.184	15,63	59,68
	Coimbra (PO)	50.471	8,32	54,63
Age range	18 to 39	4283	2,48	66,78
	40 to 64	72.755	5,02	67,66
	65 to 74	69.262	4,33	56,75
	>75	186.062	4,78	59,76
Pay ticket	exemption	134.481	6,82	59,42
	partial	179.118	3,32	58,34
	full	18763	4,12	57,43

<b>Table 2.</b> Medical patient by LTIK Status – 202	Table 2. I	Medical	patient	by EE	IR Status	-2022
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Source: Source: Our Elaboration on Eurostat 2019 - 2022

A total of 159859 surgical and 332362 medical patients, RID dataset, were included. Table 1, surgical patients display 2.7% were treated with no EHR, 57.8% were treated with partial EHR, and 39.7% with full EHR. The surgical patients with a major number of acute diagnoses are NSTEMI and CATAM (see legenda table 1). In

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these two diagnoses, NSTEMI displays no EHR, 3.70, partial, 52 and full 43.3, and CATAM displays no EHR 2.85, partial, 55.7 and full 41.3. Furthermore, also in other three acute diagnoses: STEMI, ANG e VEFI, and EHR use, display the same trend, with full modality always as last place. The cities with the major number of acute diagnoses considered (see legenda Table 1) are Napoli (Italy), Madrid (Spain), and Barcelona (Spain). These three cities, in two different European Member States, confirm other considered cities also share the last place in full EHR and this trend. The age range displayed is 40 to 64 and >75, with significant numbers of population (N). Following the trend, also in this case full EHR is the last place. Pay ticket display as first modality, partial payment with exemption at second. Also, in this case full EHR is the last modality. Table 2, medical patients, 2.3 were treated in a hospital with no EHR, 59.7 patients were treated with partial EHR, and 37.9 with full EHR. Naples (Italy), with 13 hospitals, is the first city in the Campania Region, and the first in the ranking of population (N) affected to acute diagnosis considered. In these hospitals, full EHR is the last modality and this position is the same in all considered Hospitals in the cities of ranking. Population after Naples displays the following ranking: Madrid (Spain), 9 hospitals, N = 52214, Athens (Greece), 8 hospitals, N= 53184, Coimbra (Portugal), 7 hospitals, N = 50471, Barcelona 5 hospitals, N = 49124 and Lisboa, 2 hospitals, N = 45123. The cities considered, have the major numbers of Hospitals in each Region, Madrid (Spain) and Athens (Greece) display a major percentage of partial EHR. Assessing the population with a variable age range, full EHR is the last modality, and partial ticket payment is the first modality linked to population (N). In this case, full EHR is the last amount percentage for all variables. Table 3, cross-sectional analyses, surgical and medical patients treated with full EHR and mortality rates (1.5) more than patients treated with partial EHR (1.3) but treated with no EHR (1.5) (*R-value* 0.0084). Emergency, with full EHR rates (11.9) is more than both partial and no EHR, (R-value 0.0006). Planned with full EHR rates (3.7) is more than partial and no EHR, (R value <0.0001). Day Hospital, shorter length of stay, with full EHR (7.1) less than partial and no EHR (*R-value* <0.0001).

Condition	Group	No EHR	Partial EHR	Full EHR	R value
	Total	1.54	1.35	1.55	0.0084
	NSTEMI	1.52	2.22	2.36	0.0963
	STEMI	10.78	11.67	13.87	0.1213
	ANG	3.04	3.03	3.07	0.7118
Died %	PUE	2.12	1.55	1.65	0.8655
	CATAM	1.16	0.70	0.84	0.2812
	VEFI	1.07	0.07	0.08	0.0234
	Total	11.46	10.30	11.93	0.0006
	NSTEMI	14.62	14.65	14.67	0.8202
Emergency %	STEMI	0.00	17.63	20.32	0.0534
	ANG	10.34	11.46	12.43	0.3520
	PUE	7.23	11.46	9.75	0.0174
	CATAM	11.65	10.45	11.34	0.8446
	VEFI	11.03	9.08	9.07	0.0122
	Total	3.22	3.07	3.74	<0.0001
Planned %	NSTEMI	4.35	6.27	7.35	< 0.0001
	STEMI	3.13	12.16	13.23	0.2054
	ANG	2.35	3.43	4.54	0.4133
	PUE	3.65	4.13	4.33	0.5321
	CATAM	4.62	3.49	3.86	0.1614
	VEFI	1.62	1.10	1.27	0.0545
	Total	7.69	7.85	7.18	<0.0001
	NSTEMI	14.35	10.27	10.55	< 0.0001
	STEMI	13.13	12.16	12.23	0.9054
Day Hospital %	ANG	4.35	3.23	3.24	0.3133
	PUE	9.65	7.13	6.33	0.0021
	CATAM	7.62	6.49	5.86	0.0014
	VEFI	3.62	3.10	3.27	< 0.0001

Table 3. Cross-sectional univariate analysis of surgical and medical patient condition by EHR Status - 2022

Source: Source: Our Elaboration on Eurostat 2019 - 2022-

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Cities and hospital patients (see Table 4) display that the first condition (dead) is within a range of 0.11 with *an R-value* of 0.0096; the highest percentage is linked to full EHR (1.7). Emergency displays at the last place partial EHR and full EHR at first place but the difference with no EHR is 0.19, *R-value* 0.0075. Planned, display no EHR with 3.2, partial 3.0 and full 3.7 with *R-value* <0.0001. Day hospital, display with no EHR 7.2, partial with 7.4 and full EHR 7.3, *R-value* <0.0001. These last two conditions display differences between the three modalities of EHR (no, partial and full), particularly in planned condition (0.50) while in Day hospital is 0.09 with the same *R-value*.

Condition	Group	No EHR	Partial EHR	Full EHR	R value
	Total	1.64	1.55	1.75	0.0096
	Naples (IT)	1.82	2.33	2.42	0.0982
Died %	Madrid (SP)	10.67	16.77	10.87	0.1236
	Barcelona (SP)	13.04	13.73	11.57	0.9116
	Lisboa (PO)	2.82	11.58	1.63	0.8456
	Athens (GR)	1.13	0.60	0.74	0.2721
	Coimbra (PO)	1.77	0.67	0.07	0.0225
	Total	12.54	11.34	12.73	0.0075
	Naples (IT)	14.22	14.15	14.17	0.8292
	Madrid (SP)	10.70	13.63	21.32	0.0634
Emergency %	Barcelona (SP)	20.34	21.46	22.43	0.5720
	Lisboa (PO)	17.23	12.47	11.77	0.0197
	Athens (GR)	13.65	11.45	14.44	0.8668
	Coimbra (PO)	21.03	8.08	10.07	0.0128
	Total	3.22	3.07	3.74	<0.0001
	Naples (IT)	4.75	6.37	7.15	< 0.0001
	Madrid (SP)	13.13	12.16	13.23	0.2134
Planned %	Barcelona (SP)	2.55	3.13	4.54	0.4133
	Lisboa (PO)	3.65	4.23	4.13	0.6321
	Athens (GR)	4.82	3.79	3.46	0.1662
	Coimbra (PO)	1.82	1.34	1.87	0.0845
	Total	7.29	7.45	7.38	<0.0001
	Naples (IT)	15.35	13.27	10.55	< 0.0001
	Madrid (SP)	9.13	8.16	9.23	0.8064
Day Hospital %	Barcelona (SP)	5.35	5.23	6.24	0.5133
	Lisboa (PO)	8.65	8.13	6.37	0.0121
	Athens (GR)	9.62	8.49	7.86	0.0214
	Coimbra (PO)	5.62	6.10	4.27	< 0.0001

Table 4.	Cross-sectional	univariate a	analisys of	cities and	hospital patient	condition by E	HR Status – 2022
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Source: Source: Our Elaboration on Eurostat 2019 - 2022-

In Table 5, multiple regression analysis, there was no statistically significant difference in the two groups: medical and surgical patients. Among medical patients, the first condition (died) displayed in the case of "Full EHR vs no EHR" 0. 96, Odds Ratio (OR) 0.87 and Confidence Interval (CI) 1.0, R-value 0.4729, similar evaluation can be presented to "Partial EHR vs no EHR" with OR 0.9 and CI 1.1, R-value 0.9477.

 Table 5. Association between Medical and Surgical Patient and EHR Implementation Status\* - 2019/2022

Group	Condition	Full EHR vs no EHR OR (CI)	<i>R</i> value	Partial EHR vs no EHR Or (CI)	R value
Medical	Died	0.966 (0.87; 1.05)	0.4729	1.003 (0.93; 1.13)	0.9477
Medical	Emergency	0.971 (0.94; 1.04)	0.2748	0.985 (0.97;1.08)	0.8796
Medical	Planned	1.067 (0.88; 1.33)	0.7156	1.145 (0.95; 1.43)	0.2413
Surgical	Died	1.247 (0.97; 1.67)	0.1467	1.256 (0.96; 1.68)	0.1798
Surgical	Emergency	1.039 (0.97; 1.27)	0.5506	1.044 (0.96; 1.16)	0.5164
Surgical	Planned	1.233 (1.00; 1.53)	0.0454	1.113 (0.93; 1.33)	0.2687

Source: Source: Our Elaboration on Eurostat 2019 - 2022

\*All models were elaborated for age, gender pay ticket, group, hospital size and hospital city; CI=confidence interval, EHR=electronic health record, OR=odds ratio, CI = 95%

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There are statistical differences between medical and surgical, "died" rates and *R-value*, both "Full EHR vs no EHR" and "Partial EHR vs no EHR". There are no statistically significant differences in emergency rates among surgical patients treated at hospitals with "Full versus no EHR" or partial versus no EHR. No statistically significant differences exist between rates and *R-value* in emergency conditions linked to "Full versus no EHR" or partial versus no EHR. Medical planned display between Full versus no EHR" or partial versus no EHR a difference of 0.78 with no relevant differences in terms of CO and CI. The same trend, with no relevant differences, is in the group surgical and planned condition. The differences between two groups and the same condition are not statistically relevant to Full versus no EHR" or partial versus no EHR. In Table 6, cities hospital and condition patients, the conditions that emerged are: day hospital and planned there are correlations with emergency. The "dead" condition, for obvious reasons, has not been assessed. The cities, display statistically significant, "Day Hospitals" for Naples (Italy), Madrid (Spain), Lisboa (Portugal) and "Planned" for Barcelona (Spain), Athens (Greece), Coimbra (Portugal).

Cities	Condition	Full EHR vs no EHR OR (CI)	R value	Partial EHR vs no EHR Or (CI)	R value
Napoli	Day Hospital	0.921 (0.82; 1.15)	0.4745	1.013 (0.83; 1.23)	0.94667
Bari	Day Hospital	0.951 (0.92; 1.14)	0.2784	0.975 (0.87;1.18)	0.8776
Reggio C.	Planned	1.027 (0.78; 1.03)	0.7177	1.175 (0.85; 1.33)	0.2423
Palermo	Planned	1.222 (0.87; 1.37)	0.1424	1.288 (0.86; 1.38)	0.1768
Potenza	Day Hospital	1.019 (0.87; 1.47)	0.5518	1.032 (0.86; 1.26)	0.5123
Cagliari	Planned	1.133 (1.00; 1.23)	0.0436	1.121 (0.83; 1.23)	0.2697

Table 6. Association between Hospitals (Cities) and Condition Patient and EHR Implementation Status\* - 2019/2022

Source: Source: Our Elaboration on Eurostat 2019 - 2022

\*All models were elaborated for age, gender pay ticket, group, hospital size and hospital city; CI=confidence interval, EHR=electronic health record, OR=odds ratio, CI = 95%

There is evidence of reduced risk of surgical patients in hospitals that had fully implemented EHRs from 2019 to 2022. These analyses found statistically significant evidence of an effect in only one case, Coimbra (Portugal), with "Full EHR vs no EHR". In all other cases (group, condition) and modality, "Full EHR vs no EHR" or "Partial EHR vs no EHR", there are no statistically significant correlations.

This study tested the level of EHR implementation in inpatient settings, surgical and medical patients, across 6 large and diverse cities in southern Europe. The results provided a preliminary foresee of EHR use. Cross-sectional analysis shows significant differences in mortality rates, in emergency and day hospitals, between patients with full EHR or partial EHR compared to hospitals without EHR. It is interesting to note that EHR adoption was not associated with improving quality delivery care. Notably, in the "Emergency" case, both surgical and medical, but also in "Planned" and "Day Hospital" conditions, there is no statistically significant correlation. The implementation status linked to the hospital (cities) highlights only in the city of Coimbra (Portugal) as statistically substantial evidence in the case of the "Planned" condition. This outcome has been reached in one year (2019-2020). Although EHR implementation is thought to improve the quality of service, this study, only in southern Europe, suggests that in their actual implementation, EHRs have yet to begin to reach targets and have a minor impact than expected on hospital organizations. A possible reason for this is that EHRs have very little to do with clinical aspects and that the use of STEMI; CATAM; VEFI, but also in the other three cases, notifications of access and discharge are transmitted, and all post-discharge dressings are reported, but the anatomic-pathological report is rarely transmitted.

Furthermore, data suggests that technological solutions are possible and ready to use; probably, the health care organization, its modality to delivery service should be reorganized considering the opportunities that technology offers, in the awareness that these technologies represent a challenge in terms of change for the current

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organization of hospital medical work and service delivery. Our study has some limitations. The first concerns the geography area: only southern Europe, even if the 6 cities considered are metropolitan areas and regional capitals. In any case, the regional data of these cities collect the most significant number of patients. In addition, this study uses data to identify the level or adoption of the EHR, without assessing if external factors may facilitate the implementation of the EHR.

#### 5. Discussion

The results highlight different useful points of knowledge accumulation and response to RQ. Understanding the relationship between ICT and EHR regarding sustainability and its implementation is a complex phenomenon divided into European Policy, Technological Innovation Trajectories, and Educational Investments points. The European Policy linked to sustainability and its implementation is related to the relationship between Information and Communication Technology (ICT) and Electronic Health Records (EHR). The GDPR sets (see 1.1 European contexts) out regulations for protecting personal data, including health data, within the EU. It establishes strict guidelines for collecting, storing, and processing health information, ensuring privacy and security in using EHRs. Compliance with GDPR requirements is crucial in implementing ICT-enabled healthcare systems, including EHRs, to protect patient confidentiality and promote trust. South Europe must pay more attention to interoperability and data exchange across European healthcare systems. South European countries, including Spain, Italy, Greece, and Portugal, have recognized the importance of seamless data sharing and collaboration among healthcare providers. Efforts are being made to establish common standards and protocols for EHR systems, enabling interoperability within and across borders.

The technological innovation trajectories linked to sustainability and its implementation are related to strengthening initiatives like the European eHealth Digital Service Infrastructure (eHDSI) based on cloud computing, which aims to facilitate cross-border health data exchange in South Europe. Cloud computing and data centres, utilizing cloud-based EHR systems and data centres, can enhance sustainability by reducing the need for on-site hardware infrastructure, minimizing energy consumption, and optimizing resource utilization. Cloudbased EHRs enable scalable and efficient data storage, backup, and retrieval while reducing the carbon footprint associated with traditional server-based systems. These initiatives are strongly linked to educational investments, the third point of sustainability and its implementation, allowing healthcare professionals to access patient data securely across different countries, ensuring continuity of care for patients who seek treatment or receive healthcare services in multiple European countries. Educational investments should focus on providing comprehensive training and skill development programs for healthcare professionals, administrators, and IT personnel. These programs should cover the technical aspects of EHR systems, data management, interoperability, privacy and security, and emerging ICT technologies. Ongoing education and professional development initiatives are essential to keep up with technological advancements and ensure EHR systems' sustainable implementation and utilization. These courses of action linked to the ICT process, which was started later than other Countries and overlapped other structural reforms of the government, made the southern European states recover in terms of service sustainability. The discrepancy between the provision of digital services and the unequal access to and diffusion of the European information society for patients to ensure communication with local hospitals.

Furthermore, South European countries increasingly implement national EHR systems and digital health platforms that promote interoperability. These platforms facilitate the integration of various healthcare information systems, including EHRs, laboratory systems, radiology systems, and prescription systems, to enable comprehensive and holistic patient care. In addition to improving patient care, the emphasis on ICT and EHR interoperability in South Europe also has the potential to support research collaborations and public health initiatives. Access to comprehensive and standardized health data can enhance epidemiological surveillance, facilitate clinical research, and enable evidence-based policymaking in Europe. Addressing these sustainability

issues requires collaboration among healthcare providers, policymakers, technology vendors, and patients. Promoting standardization, data-sharing agreements, and privacy frameworks can enhance interoperability and data exchange. Investing in cyber security measures, privacy-enhancing technologies, and robust governance models can ensure the security and privacy of EHR data.

Additionally, long-term funding strategies, user-centric design principles, and environmental considerations can contribute to the sustainable implementation and use of EHR systems in the European context. Overall, the increasing focus on ICT and EHR interoperability in South Europe represents a significant novelty in the European healthcare landscape. It reflects a shared commitment to harnessing technology to improve healthcare outcomes, and its sustainability, enhance collaboration, and ensure seamless patient care across borders.

#### 6. Conclusion

The research shows, according to European Union, the strategic function of EHR is to develop European ICT and its sustainability. Furthermore, the specific study developed in this paper highlights that EHRs adoption in European southern cities hospitals still needs to be a valid response to the challenge posed by ICT. On the one hand, it requires the development of a European information society, and it is necessary to achieve better service delivery and quality of service. In line with this statement, the European EHR is complex and debatable, particularly in southern Europe. It is interesting to note that, contrary to what was stated by the European Government reform law, applying the ICT and EHR method to southern Europe is very difficult. In this way, an accurate diagnosis of ICT in southern Europe is imperative to understand and implement sustainable solutions. The ICT and EHR are open questions, but it is necessary to execute sustainability actions; with this approach rapidly, it will be possible to improve the system and decisions related to the ICTs adoption in European southern cities hospitals.

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Author Contributions: The authors contributed equally. All authors have read and agreed to the published version of the manuscript.

Alfonso MARINO, professor circular economy and technological innovation, (University of Campania – Luigi Vanvitelli, Italy) degree in business economics with specific competencies in sustainability and circular economy. ORCID ID: <u>https://orcid.org/0000-0003-1722-0539</u>

**Paolo PARISO,** PhD in business economics and technological innovation, (University of Campania – Luigi Vanvitelli, Italy) degree in business economics, subject expert. **ORCID ID**: https://orcid.org/0000-0003-1066-4102

Michele PICARIELLO, PhD student in Industrial Engineering and business economics and technological innovation, (University of Naples Federico II) ORCID ID: <u>https://orcid.org/0000-0002-2481-1559</u>

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Clarivate Analytics

# TOWARDS SUSTAINABLE DEVELOPMENT AND FOOD SECURITY VIA MIXED FODDER PRODUCTION\*

# Salima Mizanbekova<sup>1</sup>, Ainur Kaiyrbayeva<sup>2</sup>, Gulzinat Ordabayeva<sup>3</sup>, Perizat Beisekova<sup>4</sup>

<sup>1,2</sup>Kazakh National Research Agrarian University, Abay Ave., 8, Almaty, Kazakhstan <sup>3</sup>Al-Farabi Kazakh National University, Al-Farabi Ave 71, Almaty, Kazakhstan <sup>4</sup>Esil University, Zhubanova Str., 7, Astana, Kazakhstan

*E-mail:* <sup>1</sup>*salima-49@mail.ru;* <sup>2</sup>*ainur\_eltaevna@mail.ru;* <sup>3</sup>*gulzi200988@mail.ru,* <sup>4</sup>*beisekova\_76@mail.ru* 

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**Abstract.** One of the main strategic tasks facing the industry is to ensure the competitiveness of domestic agricultural products, which can be achieved only based on the development of highly effective innovations in producing mixed fodder. At present in the country, the mixed fodder industry is developing in two directions: the first one includes - capacity building of large enterprises, which fully provide industrial poultry farming and animal breeding with mixed fodder (poultry farms, large livestock complexes for the production of pork, beef and milk), breeding livestock and fish farming, as well as produce and supply agriculture with protein and vitamin supplements (PVS) and premixes. The second includes the production of mixed fodders and fodder mixtures for cattle and pigs in agricultural fodder shops and factories using their raw materials, mineral supplements, and premixes of the industrial output. There are three main groups of production relations: socio-economic, organizational-economic and technological, characterized by both the way of appropriation and the way of organization of agro-industrial production as a whole, hence the whole range inherent in the agro-industrial complex. Organizational-economic relations are the central link in the overall system of production relations since they are formed and function not within but at the junction of production relations and productive forces. Organizational and economic relations are most susceptible to changes in the technical and economic basis of agro-industrial production and the forms of its organization. They have to be shaped to facilitate innovative transition towards sustainable development and food security via strengthening the mixed fodder production industry.

**Keywords:** innovations; food security; agriculture; fodder industry; animal breeding; raw materials; feed grain; enterprises; mechanism; regulation; interaction; products; Kazakhstan

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### 1. Introduction

In recent years, the state of Kazakhstan's agro-industrial complex's mixed fodder industry and new, sustainable trends in its development have attracted the close attention of domestic economists. Domestic mixed fodder production belongs to the agroindustrial complex's dynamically developing and perspective sectors.

More and more Kazakhstani enterprises working in the livestock industry realize that using high-quality, balanced fodder affects the competitiveness of their products (Kaliev & Moldashev, 2021). The volume of fodder production, quality, and cost are the primary factors constraining the accelerated development of domestic livestock breeding. In addition, at the state level, the expansion of mixed fodder production is associated with the solution of the problem of import substitution of livestock products and the development of other related areas of the economy.

Such interrelation of the compound feed industry' with other spheres of agricultural production excludes the possibility of its one-sided study. It makes it necessary to conduct a more detailed analysis of the industry as part of the organizational and economic relations system. Thus, as well as in many other spheres of the economy, in these relations, it is necessary to consider the economic interests of subjects, realized through contractual, price, credit and state regulation (Zhiyentayev & Dosmukhamedova, 2019).

Specifically, in the mixed fodder industry, there are many economic problems, solution of which in conditions of increasing economic opportunities of Kazakhstan, increase of state support of mixed fodder producers, well-thought-out strategy of development of agriculture based on intensification and technological renewal can lead to such growth of mixed fodder industry, which will allow to meet internal needs of agro-industrial complex and turn the country into the largest exporter of mixed fodder and foodstuffs.

It is necessary to bring technical and organizational-technological factors in line with the institutional environment of the agro-industrial complex to achieve long-term success and sustainable economic growth in the feed industry.

The study's relevance is predetermined by scientific and practical interest in many existing research and economic problems in the structure of organizational and economic relations in producing and selling mixed fodder products as a unified system. Existing in a particular economic space, the development of organizational and economic relations in the production and sale of mixed fodder leaves open and needs to fully work out provisions in this area of the agro-industrial output.

### 2. Literature review

Many works of domestic and foreign scientists present theoretical, methodological and applied aspects of the study of feed industry development, structure improvement, and construction of organizational and economic mechanisms of its functioning from different positions.

There is all strand of literature devoted to problems of formation and development of grain-product subcomplex of agroindustrial complex.

In their recent paper, Omarbakiyev et al. (2023) focus on regional integration allowing to enhance sustainable agriculture practices implemented in Kazakhstan's agro-industrial complex to improve food security and reduce the environmental impact of agriculture. They emphasize food security by introducing sustainable agriculture practices, such as crop diversification, conservation agriculture, integrated pest management, and drip irrigation.

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Barde et al. (2022) analyze challenges related to the rational use of resources needed for fodder production and stress the importance of production technologies. Yegorov and Batievskaya (2019) highlight a need for modern feed industry development based on expansion to the granulation process in the conditions of production intensification.

Rodionov et al. (2019) highlight the unique role of innovative development of grain products subcomplexes in enhancing food security.

Svitovyi et al. (2018) stressed that it is necessary to get the maximal added value in the grain industry by developing a grain product subcomplex when the complex development of the subcomplex and agro-industrial complex is integrated. The authors claim that particular attention should be paid to strengthening vertical and horizontal integration and developing cooperation in the grain product subcomplex facilitated by targeted state regulation.

Zghurska et al. (2022) claim substantial unused potential for land, labour, biological and other resources used in agriculture. Novel technologies and information management systems would allow to unleash that potential and enhance the sustainable competitiveness of agriculture.

Zhovnovach et al. (2023) point to the role of accomplishment of an agricultural enterprise's management system and the need for controlling to balance financial flows between all links of the agro-industrial complex.

Problems of formation and development of the grain-product subcomplex of the agroindustrial complex have been discussed in the works of many scientists, e.g. Vermel (1986), Stukach et al. (2022), Pilipuk (2022), Bogomolova & Kotarev (2019), Mizanbekova et al. (2021), Savostin et al. (2021), Gim et al. (2023). Studies in this direction in Kazakhstan are conducted by Kaliev & Moldashev (2021), Satybaldin & Zhunisbekova (2017), Iztaev et al. (2019), Tireuov et al. (2019), Akimbekova et al. (2023), Kalykova (2020), Taubayev et al. (2022).

The authors mentioned above in their studies have extensively covered the theoretical and methodological basis of the problem under consideration. However, many actual questions of the development of mixed fodder production at present, conditions and possibilities of development of connections of mixed fodder industry in grain-product subcomplex, and modern features of interaction of enterprises of mixed fodder industry with branches still need to be studied.

### **3. Research methodology**

Organizational and economic relations should be considered fundamental in the study and analysis of the functioning of any economic system, including the agro-industrial complex because its essential content is always the links through which they are realized.

As a rule, three main groups of production relations are distinguished: socio-economic, organizational-economic and technological. They characterize the appropriation and the organization of agro-industrial production, hence the whole range inherent in the agro-industrial complex.

Organizational-economic relations are the central link in the overall system of production relations since they are formed and function not within but at the junction of production relations and productive forces (Stukach et al., 2022; Aslaeva, 2022).

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It is organizational-economic relations that are most susceptible to changes in the technical and economic basis of agro-industrial production and forms of its organization and are sensitive to them and, in turn, directly affect the improvement of productive forces.

These relations are formed as a complex system of interaction between diverse subjects of economic activity (individual producers, collectives, social groups, regions, states) concerning various kinds of production resources, including the appropriation and subsequent organization of their production, exchange, distribution and consumption. In contrast, the mechanism of realization of economic relations is a system of interconnected organizational and economic levers and incentives between the co-producers, collectives, social groups, regions and states.

Organizational and economic relations in the agro-industrial complex have many features. First, they reflect and improve the interaction at all stages of the production process and thus contribute to the orientation of each industry involved to the final goals. Secondly, these ties mediate not only relations of exclusively economic order but also production organization and management relations. Moreover, this aspect of economic inter-branch ties is increasingly intensified with the division of labor, specialization and concentration deepening.

At the basic level, specialization and concentration of production determine the development of a vast and complex system between production units - agricultural, industrial, procurement, trade and others, interacting to achieve a high final result and constituting the organizational and production basis of the agro-industrial complex.

At the same time, enterprises, having economic independence and carrying out their activities in the interaction process, strive to achieve and realize internal interests. Consequently, the links between enterprises are designed to promote the realization of the whole group of production-economic relations. Economic relations of economic entities in the agro-industrial complex, by the nature of their content, can be divided into: relations of commodity producers with the state, relations between enterprises within the industry and relations between the spheres of the agro-industrial complex.

By the nature of production relations with agriculture, the feed industry is unique. Receiving from producers of agricultural products the central part of raw materials processed by it, it almost wholly directs its production to agricultural production.

The interaction under consideration can be subdivided into closed and open-ended. The first type of interaction is understood as one in which mixed fodder is fully returned to those agricultural enterprises that supply feed grain for its production.

The second type is more complicated: raw materials for mixed fodder production are supplied by some enterprises, and others receive mixed fodder. Earlier, at the centralized distribution of mixed fodders, both types of interaction took place. Raw materials were mainly centrally distributed between enterprises of mixed fodder industry and mixed fodders between farms. In conditions of a market economy, the second type of interaction prevails. In conditions of deepening of territorial specialization of agriculture, it is possible to expect, on the one hand, the formation of more specialized grain farms, commodity products of which will be not only food, and sometimes mainly fodder grain; on the other hand, deeply specialized intensive livestock farms, which do not have resources of fodder grain, but consume significant masses of mixed fodder. The problem of economic interaction between agriculture and the compound feed industry comes down to the sustainable provision of compound feed factories with grain and other agricultural raw materials and obtaining from them the necessary quantity of assortment and quality of compound feed products. An increase in the share of feed grain in the balance of fodder is characteristic of most economically developed countries of the world in specific periods of their development (Petrikov, 2018; Akimbekova et al., 2023).

This process is based on two factors. One of them is the increase in the share of grain-consuming branches of livestock breeding, pig breeding and poultry farming (Yesengalieva et al., 2021). The other factor is the intensification of all livestock breeding units, a part of which is the transition to intensive feeding. In the abundant rations of livestock and poultry, the role of grain fodder is determined by the fact that an increased content of energy and digestible nutrients per weight unit of feed characterizes them.

The volume of processed grain raw materials in the feed industry is small, a significant part of the forage grain. Utilization of production capacities in regions of the country fluctuates in limits 55 - 88 %, which specifies the presence of unused reserves on an increase of production of mixed fodders at operating enterprises. The efficiency of grain raw materials utilization at processing is caused by protein additives and the structure of raw materials allocated for processing. The structure of grain-forage raw materials used in mixed fodder needs to be more rational and correspond to the necessary animal breeding of the republic, taking into account the structure of the herd (Tireuov et al., 2020).

Thus, in the total balance of grain components, the specific weight of corn is only 6 %, leguminous crops 0.1 %, against 35 and 5 % according to the norms, which meets the need for them by 34 and 42 %, respectively (Tireuov et al., 2020).

As a result, they are usually replaced by other types of grain crops. Using high-protein Kazakhstani wheat, a valuable food raw material and export commodity, for fodder in conditions of unsatisfied demand for it seems economically unwise.

### 4. Results and discussion

Feed grain, being the basis of livestock production and a constituent predominant part of raw materials for the feed industry, thereby forms inter-branch proportions of agro-industrial output, determines the development of the entire grain market and has a high socio-economic significance both for the country and for its regions, regardless of whether they are producers or consumers of feed grain.

High efficiency of feed grain utilization with a simultaneous increase in the volume of its domestic consumption in economically developed countries, their active protectionist export policy contributes to the rise in their production of livestock products for their large-scale export and building up grain export potential.

The feed grain market can be characterized as a set of organizational and economic relations through which it is bought and sold. It covers all types of transactions for selling feed grain with the participation of sellers and buyers to better provide livestock grain and fodder resources by maximizing the use of its production potential of a particular territory and rational organization of feed grain promotion from the producer to the consumer.

It follows that the market of forage grain is a rather complex multifunctional, multi-purpose and dynamically developing economic system, operating primarily within the boundaries of a specific territory, on which the system of economic relations and dependencies between economic entities of the market is carried out, taking into account the characteristic regional features of economic development, grain farming, livestock and fodder production, the level of income of the population and its solvent demand for food products.

Since grain-forage crops are relatively less demanding to cultivation conditions, the area of distribution of their main species is much broader than that of food crops (Tireuov et al., 2020; Savostin et al., 2021) This determines the possibility of achieving a higher level of self-sufficiency of the regions, and, consequently, relatively less dependence of the internal regional market of feed grain on the development of interregional exchange. However, in the system of

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grain production in all regions of grain cultivation, forage crops, in comparison with food crops and especially bread crops, as a rule, are assigned a secondary role. But even with this "discriminatory" position, their yields exceed many food crops' levels, indicating a relatively high potential for fodder crops. At the same time, everywhere in the sphere of commodity circulation and interregional exchange receives a significantly smaller part of the gross harvest of grain-forage crops than food crops because about one-third of grain-forage remains in farms for intra-production consumption.

The feed grain market's peculiarity is that it depends to a greater extent on implementing domestic socioeconomic and agro-food policy (Tireuov et al., 2020; Radchenko et al., 2023). Demand for feed grain is derived from the need for food products of animal origin, which, in turn, unlike the demand for bread and bakery products, and hence for food grain, has a high elasticity of prices and incomes of the population. If, in conditions of a sharp decline in revenues of the population, consumption of bakery products remains relatively stable with stable demand for food grain, the need for feed grain drops significantly due to a decrease in the level of consumption of food products of animal origin, reduction of livestock and poultry. There are also many specific features of the feed grain market related to the nature of its use.

Thus, the volume and structure of grain forage consumption have a relatively well-defined sectoral specificity, which is determined, on the one hand, by the level of livestock production and biological characteristics of the animal organism, and on the other hand, by the possibilities of satisfying the needs of livestock in high-grade fodder through the development of all fodder sources. At the same time, the efficiency of feed grain utilization is in close interrelation and interdependence with the level of development of the markets of mixed fodder, cake and meal, meat-bone and fish meal, protein-vitamin mineral supplements, and premixes. Specific features of grain forage are also expressed in the system of indicators for comparative assessment of fodder qualities of certain types of grain crops and efficiency of concentrated fodder utilization.

The state can use economic measures to improve the structure of raw materials for the feed industry (Tireuov et al., 2020). For example, a practical effort is the stimulation of expansion of sowing of legume-grass mixtures, rape, soybean, lupine, pea and other fodder crops. They give comparatively balanced forage in terms of protein, reducing the consumption of concentrates in the structure of the diet, exceeding the recommended norms by one and a half to two times, but increasing the marketable resources of feed grain. As the quality and cost of mixed fodders, to a great extent, depend not only on the optimum presence of vegetables but also animal protein, the granting of privileged credits or state subsidies for the construction of shops on utilization of wastes in the enterprises of meat and dairy industry and their deliveries to mixed fodder plants can become an effective measure.

An important direction of state regulation should be the strengthening of material and technical base and promoting the introduction of achievements of scientific and technological progress in producing and processing fodder grain (Zhiyentayev & Dosmukhamedova, 2019). Moreover, these measures should cover the enterprises of the first sphere of the grain-product subcomplex, supplying it with the necessary means of production for which differentiated tax and credit privileges can be provided. One of the tasks of state regulation of the feed grain market is to create conditions for grain-producing farms that would minimize the possibility of all types of risk (Kalykova, 2020).

One of the ways to solve this problem is to expand insurance of production activity, for which it is necessary to strengthen the organization of insurance state or commercial companies, which would assume part of the risk and reimbursement of losses to farms in the performance of their activities, which occurred due to the occurrence of certain adverse circumstances. The feed industry in Kazakhstan today is one of the most dynamically developing. In 2022, there was a growth of about 260% (compared to 2021) in exports of mixed fodder.

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There is approximately twofold growth based on the dynamics of external supplies in January-February of this year. At that, the industry has enormous unrealized potential, first of all, on consumption inside the country. There is a vast potential for the production of mixed fodder inside Kazakhstan. Many farmers in farms try to produce fodder for animals themselves. At first glance, mixed fodder seems more expensive, but its use is much more profitable - costs are lower, and the digestibility of animals is higher; as a result, the cost of meat is lower. However, it is more profitable for farmers to sell grain and buy mixed fodder for animals; in this case, the domestic market of mixed fodder will develop more widely, and rural producers will receive sums for grain and meat (due to reduced production costs).

The most important task of the state is to promote the use of grain forage only in processed form and to reduce the cost of mixed fodder, which can be solved in two main directions: through the promotion of the organization of integrated associations and technical re-equipment and modernization of mixed fodder enterprises. The creation of integrated formations uniting producers of grain and mixed fodder, poultry farms, and livestock complexes (farms) will allow to reduce overhead costs significantly, adapt the structure of production of fodder grain to the system of needs in it, to provide guaranteed sales of products, to link payment for mixed fodder with the increase in productivity of livestock and poultry from their use. Realizing the second direction is connected with the perfection of technology in manufacturing mixed fodders, improving their quality, and increasing of payback of output of animal breeding production (Satybaldin & Zhunisbekova, 2017).

The sustainable functioning of the association requires solving the following problems: conducting marketing research; carrying out decoupling of non-payments among participants; coordinating commodity flows of production and also to stimulate production and realization of its surplus outside the association; introducing the system of the state order with the use of bills of exchange and securities, other issuers of the market; to distribute rationally the budgetary funds directed on support of agricultural commodity producers; to attract to cooperation with the agricultural producers.

The creation of such an association allows to solve more effectively the questions of increase in the volume of sale of forage grain by its producers to the fodder enterprise; expansion of raw material zone; improvement of mutual settlements between the fodder enterprise and grain-producing farms; increase of profitability of all participants of the association. However, between producers and consumers of mixed fodders, normative indicators should be worked out defining guarantees of sellers and protection of the economic interests of consumers of mixed fodders (Vermel, 1986). First, such economic relations can be established between mixed fodder enterprises and large consumers of mixed fodder - poultry farms, pig breeding complexes, fattening and breeding farms. Thus for the association of mixed fodder enterprises with large agricultural consumers, it is possible to recommend three primary variants of economic relations.

As applied to poultry farms, for example, they look as follows: a mixed fodder factory supplies full-fledged mixed fodders to a poultry farm, which uses them without finalization; an assorted fodder factory supplies unbalanced mixed fodders to a poultry farm, which has its protein raw material and finalizes them on the principle of one recipe calculation; a mixed fodder factory supplies to a poultry farm an address protein-vitamin concentrate, based on which full-fledged mixed fodders are produced in a fodder shop of a poultry farm.

For the industry to develop actively and systematically, the state must stimulate farmers' use of industrial mixed fodder for some time. It is necessary for buyers to feel the benefit and return from mixed fodder to create this market. In this regard, it is required to subsidize farmers' purchase of industrial mixed fodder.

In the Taiynshinsky district of the North-Kazakhstan region, a new feed mill with a capacity of 72 thousand tons of finished products per year is functioning. High-protein fodder and balanced ration are the basis for obtaining quality milk and meat; a new direction is being developed due to the opening of new production facilities.

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Opening the new plant will provide local rural producers with mixed fodder without importing products from outside. "Karaganda-Osetr" Company 2022 operated a mixed fodder plant to produce, and process granulated enriched green fodder for fish and farm animals.

The capacity of the enterprise is 365 thousand tons of products per year. The cost of the project is estimated at 27 billion tenge for 2021-2022; up to 1 thousand jobs have been created at the plant; in Ushtobe village, the enterprise "Karaganda-Osetr" with the capacity to supply up to 5 tons of caviar and 100 tons of meat of marketable sturgeon fish per year.

By 2023 it is planned to increase the output volume to 20 tons of caviar and 300-350 tons of sturgeon meat per year. A new feed mill was opened in Yesil district (Akmola region). The main direction of activity of the partnership "Rau Agro" - is crop and livestock farming, agricultural lands are sown with oilseeds and grain crops, and the number of livestock is more than 400 heads.

The capacity of the new feed mill is 2.5 tons per hour; they produce a complete ration of mixed fodder for all types of livestock. Raw materials for production are delivered from the fields of agricultural enterprise, which significantly affects the cost of finished products; the equipment was purchased in Germany and Russia, the purchase of which was invested to the amount of more than 370 million tenge, the production of mixed fodder in a loose form, in the future transition to pelletized production.

All processes at the plant are automated, and seven people are involved in the work. Despite small volumes of production, the new mixed fodder plant is popular among the population of the Akmola and Kostanay regions of Kazakhstan.

In the North-Kazakhstan region, a new mixed fodder plant - a large enterprise in the country, its production capacity - 360 thousand tons of finished products per year - was launched. Due to the commissioning of the plant and the launch of the second line at the resumed last year "Biokhim", the region expects to process more than 1 million tons of grain this year. KAZMEAL's feed mill is located in Novoishimskoye (North Kazakhstan region).

The project was implemented entirely at the expense of private investment; the project cost amounted to 4 billion tenge. Half of the funds were invested by PRC investors, in the region of 600 thousand tons was grain processing; due to this enterprise annual volume of processing will be much higher, will be increased grain processing capacity at the plant "Biochem", launched a second line, will double the volume of grain processing. The international quality standard ISO 22000 in the field of food industry safety has been implemented at the plant, the characteristics of mixed fodder have been checked in the laboratory, trial batches have been delivered to the PRC, and they meet their requirements.

World and domestic experience show that with the population's increased consumption of food products of animal origin, the country's grain supply shifts from its food part to the feed component.

Earlier, the passport "Creation of feed mill" was added to the mechanism of subsidizing for reimbursement of part of the costs incurred by the subject of agro-industrial complex in the course of investment investments. The share of repayment of investment investments amounted to 25%. The mixed fodder plant of "BaiserkeAgro" LLP (Almaty region) produces products which are a complex, homogeneous mixture of purified and ground to the required coarseness of various fodder products, providing for an optimal combination of components, at which gluten is provided among the highest effective utilization of the nutrients contained in them.

In a mixed fodder shop, the production is produced without introducing proteins or vitamin additives into mixed fodder, which provides an opportunity to reduce the cost of production. According to the customer's requests,

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pilot batches of mixed fodder (for birds, cattle) can be produced in the prescribed manner. The mixed fodders are produced as a loose mass of the required coarseness. The monthly capacity is 3000 tons.

An essential part of the relationship in the production of agricultural products is the realization of feed grain to feed mills and mixed fodder to agriculture.

The conditions of these supplies are primarily determined by the size of feed mills and their location in relation to the raw material base and consumers of mixed fodder.

In the mixed fodder industry, more than one-third of capacities fall on the share of enterprises with 300-600 t/day productivity. In the country, the enterprises of mixed fodder industry prevail, the percentage of which in production has reached almost 88%. The existing distribution of grain production and livestock supply of raw materials for mixed fodder production is carried out mainly by farms in Northern Kazakhstan, and the central part of consumers of fodder grain-mixed fodder plants are located in other zones of the republic. In this connection, significant volumes of intra-republican transportation of grain forage are inevitable.

The placement of the fodder industry does not correspond to the number of livestock in different regions, which leads to irrationality, increasing the cost of production and transportation of mixed fodder. Constant targeting of enterprises to search for the most efficient production options is the main advantage of the competitive market system. Enterprises produce what consumers demand, applying perfect technology and available product enrichments—the market system of economic management functions without state regulation (Table 1).

Possible production relations and interrelations of grain-producing farms and large feed milling enterprises serving them are developed. These industrial relations have found specific realization in the practical activity of the enterprises. In prospect, in the process of improvement of mechanisms, the appearance of new technical means of production, and expansion of raw material base for the production of protein-vitamin additives (PVA), these offers should receive broader development and provide needs of industrial animal breeding and poultry farming for all age groups and species.

One of the strategic tasks facing the industry is to ensure the competitiveness of domestic agricultural products, which can be achieved based on mastering highly effective innovations in the production of mixed fodders, which account for up to 70% of the costs in the cost of poultry and livestock production (Mizanbekova et al., 2019, 2022). Table 1 shows the recommended possible variants of using fodder grain of farms for processing into mixed fodder in modern conditions.

Forms of attraction of fodder grain of farms for processing into	Possible options of using fodder grain of farms for the production of
mixed fodder at large specialized feed mills (shops)	mixed fodder, or exchange for mixed fodder
1. Purchase of feed grain from farms for mixed fodder	1. Grain processing at in-house feed mills using enrichment mixtures
production	
2. Exchange of mixed fodder for fodder grain of farms	2. Processing of farm grain at inter-farm feed mills
3. Processing of grain of farms on tolling terms	3. Grain processing at large
	specialized feed mills (shops) on tolling terms
4. Production of enrichment mixtures and their supply to feed	4. Exchange of grain for mixed fodder at large specialized feed mills
mills of farms	(shops)
5. Sale of mixed fodder to other farms	5. Realization of grain and purchase of mixed fodder at feed mills
	(shops) or through intermediaries

Table 1. Proposed main directions of the utilization of fodder grain of farms for mixed fodder production

Source: Compiled by the authors

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At present in the country, the mixed fodder industry is developing in two directions: The first one is capacity building of large enterprises, which fully provide industrial poultry and livestock farming (poultry farms, large livestock complexes for pork, beef and milk production), pedigree livestock breeding and fish farming with mixed fodder, as well as produce and supply protein and vitamin supplements (PVS) and premixes to agriculture; the second - production of mixed fodders and fodder mixtures mainly for cattle and pigs in agricultural fodder shops and factories using own raw materials, mineral supplements, premixes of the industrial output.

Quality resource support is the component of the proportionally-balanced development of economic entities of grain-processing and livestock farms as constituent structural elements of grain and meat-product subcomplexes. It should be noted that the connecting link of these subcomplexes along the line of the functional-technological chain is feed production.

Different raw materials are used to manufacture mixed fodders: vegetables, animals, and minerals, based on the production of microbiological, chemical and organic synthesis. The primary raw material for mixed fodder production in Kazakhstan is fodder grain.

In recent years, Kazakhstan actively develops dairy cattle breeding and poultry farming, so the need for fodder will grow. A significant share of mixed fodder is consumed by the poultry industry (53%), pig breeding (39%), cattle (Cattle) and small cattle (5% and 2%, respectively) (Tireuov et al., 2020).

However, the prospects of the feed industry in Kazakhstan are more comprehensive than the domestic market. Among the opportunities for industry development are supplies to China, Central Asian countries, Iran, and Turkmenistan.

As tools for the development of these markets - substitution of raw material exports (wheat, barley, corn) in the importing countries by ready mixed fodder through the return of subsidies for transportation costs, obtaining permission from the state services of China for the import of mixed fodder, the development of appropriate infrastructure (pelleting) and diversification of formulas. (Mishurov et al., 2019). Increasing livestock production is one of the main tasks of Kazakhstan for the next decade. The main in its fulfilment is the organization of industrial livestock breeding based on strengthening of fodder base and mixed fodder industry.

More than 70 kinds of raw materials are used to manufacture mixed fodders. This level of mixed fodder production does not satisfy the needs of livestock in quantitative and qualitative terms. Their specific weight in the total consumption of concentrated fodder does not exceed 20%, while about 3 million tons of grain are used in milled form or as grain mixtures.

The basis of mixed fodder is grain raw material, about 60-65%. Grain crops it is wheat, barley, corn, oats, and millet and; the peculiarity is high content of carbohydrates - 70%, and low content of protein - 10-15%; use grain legumes: peas, beans, soybeans, lupine - high-protein crops - 25-45%. Oilseeds are used: sunflower, cottonseed, rape, mullein, and ginger, introduced into mixed fodders in the form of their waste (cake, meal). The composition of recipes can also include waste from grain processing into groats and flour, food industry wastes, animal fodder, rough fodder (Tireuov et al., 2020).

The assortment of mixed fodders in foreign countries is extensive; up to 50 and sometimes more recipes are circulated at some large enterprises. The productivity of feed mills and their location are closely connected with assortment. Large plants producing 100 to 400 thousand tons of mixed fodder per year are built where cheap transportation can be found for raw materials and shipment of finished products and in areas with large livestock and poultry farming (Nekrasov et al., 2018).

Feed mills have laboratories to determine the quality of raw materials, the coarseness of grinding ingredients and the quality of finished products. At large plants, laboratories are equipped with appropriate devices and equipment for determining moisture, ash content, protein, fat, crude fibre, starch, calcium, phosphorus, vitamin A, antibiotics, acidity, amount of mould, degree of grinding and other indicators.

Developing the compound feed industry in different countries could have been more balanced. This is because the feed industry, as a new production branch, began to develop in some countries a little earlier and in others later. Thus, in the USA, Canada, partly in England and some other countries, the compound feed industry by 1957 already created; therefore, compound feed production growth was the least (accordingly 25, 27 and 45%). On the contrary, in the countries where before 1957 there was almost no compound feed industry, the growth of compound feed production was maximum (Spain-1767%, Greece - 550%, Japan - 391%, Colombia - 339%, Venezuela - 307%). Significant increase in compound feed production was in Italy - 202%, Mexico - 176%, FRG - 120%, and France - 111% (Tireuov et al., 2020).

In England and the USA, the percentage of mixed fodders for cattle is noticeably higher than in other countries, as intensive fattening of young calves is applied on a large scale. In the Netherlands, with a large export of pork, a significant specific weight is occupied by mixed fodders for pigs. Japan stands out by the specialization of mixed fodder production for poultry, although in other countries, this branch of mixed fodder production is much more developed than others.

Feed volumes are increasing annually in all countries while resources for this purpose decrease. Many components of compound feeds have become scarce, and some are used for other purposes (for ethanol, biogas production, etc.). Search for new types of fodder products and creating rational technology to utilize raw material resources effectively are urgent.

Many problems of fodder grain production and its market development, which accounts for about one-third of the gross harvest of grain crops, still need to be solved. The production volumes, quality and assortment of produced grain forage needed to meet the needs of livestock in nutritious and affordable concentrated fodder. The low quality of the fodder base leads to a decline in production volumes and worsens the provision of the population with food of animal origin (Savostin et al., 2021).

The multifactor complex of problems of the grain and fodder market development is supplemented by the growing need to improve the population's nutrition in many countries and transition to biofuel energy resources. Under these conditions, feed grain production, a source of concentrated fodder for livestock, becomes the most important branch of agriculture. Subjects of this industry should be subjected to intensive measures of regulation of development processes, building competitiveness at regional and national levels.

Forage crop is one of the leading products to support agricultural needs (Petrikov, 2018). Fodder products have the necessary microelements in their composition, allowing them to maintain a proper diet of agricultural and domestic animals.

Fodder occupies a significant cost (over 50%-80%) in the cost of livestock production. Kazakhstan has its production of mixed fodders and additives, but high-tech additives (amino acids, vitamins) that increase the efficiency of fodders are imported from abroad. Animals of imported breeding are susceptible to feeding conditions and compliance with the required ration.

The main sown areas for fodder crops are in the country's north - Kostanay, Akmola, and SKO. The presence of chestnut, chernozem, forest loamy soils, and temperate climate characterizes these regions. Production and technical base of farms is increasing, work on improvement of irrigated lands is being carried out.
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The average annual growth of gross output of fodder crops in the Republic of Kazakhstan for 2012-2020 amounted to 9.7%. In 2020, the gross production of fodder crops will reach 967.6 million USD. The share of fodder crops in the country's GDP will equal 0.6% by the end of 2020. In 2020, investment in agriculture, forestry and fisheries increased by 12.6% over the previous year, amounting to USD 1.4 million. The average annual growth rate for 2016-2020 is 22.8% (Figure 1).



Figure 1. Production of forage root crops in the Republic of Kazakhstan Source: CEIC https://www.ceicdata.com/en/kazakhstan/agriculture-production-annual/agricultural-production-forage-crops-allenterprises-hay-ow-one-year-grasses

The central grain-growing regions of North Kazakhstan, Akmola and Kostanay regions directed 585.4 million dollars to the industry, which amounted to 42% of total investment in agriculture, forestry and fishery. This amounted to 42% of agricultural, forestry and fishery investments. 88% of investments in fixed capital of agricultural, forestry and fishery enterprises were directed to cultivating one- or two-year crops (CEIC, 2020).

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### Conclusions

Quality resource support is the component of the proportionally balanced development of economic entities of grain-processing and livestock farms as constituent structural elements of grain and meat-product subcomplexes. It should be noted that the feed industry is the connecting link of these subcomplexes along the line of the functional-technological chain.

In the production of mixed fodder, use types of raw materials: vegetable, animal, and mineral, based on products of microbiological, chemical and organic synthesis and others. Forage grain is the primary raw material for mixed fodder production in Kazakhstan.

An increase in livestock production is one of the main tasks of Kazakhstan for the nearest decade. The main in its fulfilment is the organization of industrial livestock breeding based on strengthening of fodder base and mixed fodder industry. The basis of mixed fodder is grain raw material; it makes approximately all mixed fodder 60-65%.

In laboratories of mixed fodder, plants are engaged in defining the quality of raw materials, coarseness of grinding of ingredients and quality of ready production. At large plants, laboratories are equipped with appropriate devices and equipment for determining moisture, ash content, protein, fat, crude fibre, starch, calcium, phosphorus, vitamin A, antibiotics, acidity, mould amount, grinding degree and other indicators.

Low quality of fodder base entails a drop in production volumes with deterioration of provision of the population with food of animal origin. The growing supplements the multifactor complex of problems of grain and fodder market development problems would improve the population's nutrition and accelerate countries' transition towards biofuel energy resources.

Under these conditions, forage grain production, a source of concentrated feed for livestock, becomes the most important branch of agriculture. The subjects of this industry should be subjected to intensive measures of regulation of development processes, building competitiveness at regional and national levels, which ultimately would lead to sustainable competitiveness and enhanced food security.

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Salima MIZANBEKOVA, Doctor of economic sciences RK, RF, Professor; Kazakh National Agrarian Research University; professor of the Department of Management and Organization of Agribusiness; Abay Ave., 8, Almaty, Kazakhstan. ORCID ID: https://orcid.org/0000-0002-7602-9710

Ainur KAIYRBAYEVA, candidate of economic sciences, Professor, Kazakh National Agrarian Research University, Professor of the Department of Management and Organization of Agribusiness; Abay Ave., 8, Almaty, Kazakhstan. ORCID ID: <u>https://orcid.org/0000-0002-2435-1636</u>

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**Gulzinat ORDABAYEVA,** master of technical sciences, Al-Farabi Kazakh National University, Senior Teacher of the Department of Information Systems, Al-Farabi ave., 71, Almaty, Kazakhstan ORCID ID: <u>https://orcid.org/0000-0001-9952-1620</u>

**Perizat BEISEKOVA,** master of economics, Esil University, Senior Lecturer of the Department, Zhubanova str., 7, Astana, Kazakhstan ORCID ID: <u>https://orcid.org/0000-0003-2578-7797</u>

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# FROM CLEANER PRODUCTION TO GREEN COMPETITIVE ADVANTAGE: EVIDENCE FROM EGYPT

# Shereen Aly Hussien Aly Abdou

Department of Business Administration, Faculty of Commerce and Business Administration, Helwan University, Egypt

*E-mail:* <u>shereenghazala6@gmail.com</u>

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**Abstract.** The study investigates the green competitive advantage in the Egyptian business environment. A qualitative analysis used primary data from the first quarter of 2023. It allowed us to answer the questions that tackle the motives of cleaner production, the reflection of cleaner output on the green brand image, and estimate the impact of the green brand image on the competitive advantage. The study found a mediating role of a green brand image between cleaner production and green competitive advantage. In addition, the significant motives for cleaner production at Egyptian companies were regulatory rules, consumer pressures, and green creativity. Finally, a green brand image substantially reinforces the green competitive advantage of Egyptian companies. The results may be instrumental for companies seeking a faster transition towards green competitive advantage.

Keywords: cleaner production; green brand image; green competitive advantage; emerging countries; Egypt

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JEL Classifications: Q5

#### **1. Introduction**

In the contemporary business environment, corporations face mounting demands to integrate sustainable practices into their operations to ensure viability and prosperity. As ecological issues gain greater prominence and responsible resource utilization becomes imperative, enterprises increasingly acknowledge the significance of attaining a competitive edge by implementing environmentally friendly approaches (Jones & Smith, 2020; Miller & Thompson, 2019; Robinson & Brown, 2018; Smithson & Johnson, 2021).

In sustainable business practices, the mediating role of green brand image is a powerful force that links cleaner production and green competitive advantage. Companies prioritizing eco-consciousness gain a competitive edge as the world increasingly embraces environmentally friendly initiatives. This article delves into the intricate connections between cleaner production, green brand image, and achieving sustainable competitive advantage.

Cleaner production involves implementing processes and practices that minimize waste, pollution, and resource consumption. Companies transitioning towards cleaner production methods aim to reduce environmental impact while optimizing resource efficiency. Organizations actively contribute to a greener future by embracing cleaner production and mitigating their ecological footprint.

Cleaner production offers a multitude of benefits beyond environmental sustainability. It enhances costeffectiveness by reducing waste disposal expenses and optimizing resource usage, ultimately improving profitability. Moreover, adopting cleaner production practices fosters a positive corporate image, attracting environmentally conscious consumers and investors.

A green brand image signifies a company's reputation and perception regarding its environmental responsibility. Brands that successfully cultivate a positive green image are seen as committed to sustainability and eco-friendliness. Such an image attracts environmentally conscious consumers and influences their purchasing decisions.

Transparent communication about sustainable practices and initiatives fosters trust and credibility among consumers. Engaging in environmental initiatives, supporting green causes, and consistently practising eco-friendly measures contribute significantly to building a robust green brand image.

The mediating role of a green brand image becomes evident in how it connects cleaner production with a green competitive advantage. As companies prioritize cleaner production practices, their green brand image is bolstered. This, in turn, enhances their reputation as environmentally responsible entities, leading to increased brand loyalty and positive consumer perception.

Previous studies have mostly looked into what motivates green production (Li et al., 2020; Spielmann, 2021; Wang & Fahad, 2023); green human resources (Meng et al., 2023); green purchase intention and green consumption (D'Souza et al., 2006; Moslehpour et al., 2022; Ali et al., 2023); marketing of green products under social media activities (Wagdi et al., 2022; Chuang & Chen, 2023; Oncioiu et al., 2023) and green supply chain management (Kholaif & Ming, 2023; Novitasari, 2023).

In emerging economies, the notion of green competitive advantage holds substantial significance. These economies, marked by their swift economic expansion and industrial progress, encounter pressing demands concerning sustainable development and ecological conservation. Accordingly, organizations operating in these environments must navigate unique challenges and capitalize on emerging opportunities to secure a competitive edge, advance their market standing, and foster long-term prosperity.

Emerging countries have seen a spectacular shift in the quantity and structure of their consumption in recent years. The environment is being stressed by people's insatiable desire for more and more things. This study examines the connection between Egyptian clients' environmental consciousness and their propensity to buy environmentally friendly goods in Egypt's status as a significant rising economy in North-East Africa. The current study aims to analyze the green competitive advantage in the Egyptian business environment by examining empirical studies and theoretical frameworks. Therefore, the present study is similar to Zameer et al. (2020), Mugoni et al. (2023) and Sharma et al. (2023).

# 2. Literature review and hypotheses development

Academics, experts, and regular people have recently shown enthusiasm for environmental protection (Behnam et al., 2018). Similarly, organizations shifted toward eco-friendly manufacturing in response to a widespread desire from stakeholders. "Green product" does not mean completely pollution-free; instead, it describes those gentlest

in the environment (Junior et al., 2018). Green production is an industrial method that deliberately avoids or significantly reduces adverse environmental effects.

Internal and external stakeholders interested in the product's environmental impact significantly impact the product's production and consumption decisions (Huang et al., 2016 a,b; Biswas and Roy, 2015). Many have speculated on the best ways for businesses, governments, and customers to work together to ensure environmental sustainability (Yasmeen et al., 2019; Ranaweera, 2022). According to research by Wei et al. (2021), businesses' reactions to ecological concerns depend on the intensity of inside and outside pressure. Freeman's (1984) stakeholder theory, as cited by Donaldson and Peterson (1995), describes how clients' needs and worries significantly affect a company's long- and short-term choices and operations. Businesses need to understand customer demand to make proactive strategic environmental commitments based on environmental performance, organizational structure, and competitive advantage from the past (Hart, 1995). According to Mugoni et al. (2023), that green reverse technology significantly affects the operational efficiency and long-term competitive advantage of sustainable organizations. However, there are many motives for adopting cleaner production between three main justifications, including operative reason, environmental regulation, market forces, and corporate environmental responsibility (Alves & Rozenfeld, 2022; Feng et al., 2022; Gao et al., 2022; Hu et al., 2022; Kim et al., 2022; Rehman et al., 2022).

According to Salah et al. (2022), Egypt plays a crucial role in the worldwide transmission of energy as one of the largest economies on the African continent. However, the country's energy industry still struggles to meet domestic demand. If traditional power-generating methods fulfil Egypt's energy needs, the country's CO2 emissions will rise roughly 125% between 2012 and 2035. Egypt may plot a course toward the NET ZERO goal, which the globe hopes to achieve within several decades (Piccinetti et al., 2023).

From the preceding, the study poses the following research question:

What are the motives for adopting cleaner production in Egypt?

Three hypotheses can be formulated under the literature review as follows

- H<sub>1</sub>. There is no significant impact of regulatory pressure to adopt cleaner production in Egypt.
- H<sub>2</sub>. There is little impact of customer pressure to adopt cleaner production in Egypt.
- H<sub>3</sub>. There needs to be more impact of green creativity to adopt cleaner production in Egypt.

In addition, the fourth hypothesis is as follows:

H<sub>4</sub>. The importance of motives for adopting cleaner production in Egypt is similar.

According to prior studies in green business practices, "green brand image" refers to a product's or brand's environmental qualities. According to Kotler, a customer's perception of a brand consists of their thoughts, feelings, and assumptions about that brand. The same holds for products; when eco-friendly features are included, consumers associate that brand with being environmentally conscious. A green brand image consists of two parts: the practical and measurable and the intangible and psychological. These two things are equally crucial. The customer's experience with a product or brand influences their understanding of the item's practical and emotional merits. Customers' impression of a brand is formed through their interactions with it. A company's green brand image is the total of its eco-friendly actions. Companies have made more environmentally friendly products due to consumer demand, as Esmaeili et al. (2017) reported.

According to Hanaysha et al. (2014), it is suggested that Malaysia's automobile sector will benefit from green production practices. However, they looked at things from the passengers' point of view. In contrast, we leverage the customer and business viewpoints in our research on China's equipment manufacturing sector. Wahyuni (2019) also found a correlation between green production and positive brand perception. He employs a small sample size (120 people) to conclude the Indonesian population. This calls for fresh proof related to China's industrial industry. They also highlighted the value of eco-friendly advertising and manufacturing. In other words, for their goods to be seen as environmentally friendly, businesses need to make green marketing a top priority.

The assumption that green production contributes to a green brand image is not unreasonable. Furthermore, Zameer et al. (2019) claim that customers research products and services online and offline before purchasing. According to Ghodeswar and Kumar (2015), Nassar and Tvaronavičienė (2021), customers aware of the benefits of green production are more likely to buy the goods since their conscience drives them to do so.

How much of an organization's manufacturing and distribution processes are eco-friendly measures how seriously it takes environmental concerns. Its goal is to lessen people's environmental impact and increase the availability of eco-friendly goods. Establishing a "green" reputation relies on adhering to these standards. Businesses that go green in their operations and public image enjoy greater brand favorability and find it easier to identify and develop their competitive edge. The creation of environmentally friendly goods and the promotion of "green" brand identity are inextricably linked in the eyes of consumers. Environmentally responsible actions, such as "green production," are crucial for companies to build a positive brand identity and move toward long-term sustainability (Famiyeh et al., 2018).

In conclusion, the green brand image reflects the company's green value orientation. It reflects the company's commitment to producing environmentally friendly goods and operating socially responsibly. The company's ecofriendly reputation may help it become the buyer's first pick. Once a positive association with environmental friendliness has been established for a brand, customers are more likely to embrace subsequent products released under that banner.

According to Tan et al. (2022), a favorable correlation exists between effective green marketing strategies and ecologically solid attributes, motivating customers to make such purchases. Furthermore, green marketing strategies directly and substantially affect green credibility and image. The previous result is consistent with the results of Wagdi et al. (2022)

Based on the preceding discussion, the study found a research question as follows:

# What is the impact of green production on reinforcing the green brand image of Egyptian companies? The following hypothesis has been developed:

# H<sub>5</sub>. Green production has little impact on reinforcing Egyptian companies' green brand image.

Corporate strategy and management expertise are critical in responding to the rise of green production technology. According to Dai et al. (2017), Helfat and Martin's (2015) research highlighted the importance of management abilities in establishing, growing, and adjusting a company's means of sustenance. Knowledge acquisition and cooperation with environmental specialists have been shown to boost green product development, the quality and productivity of new products, the speed of development cycles, and the company's competitiveness. The emphasis of their research has been on technological advancement rather than environmentally friendly manufacturing. In contrast, our study focuses on how ecologically responsible manufacturing may boost business success. The traditional green production strategy promotes organizational sustainability and protects the environment. However, not much data supports the claim that becoming green increases a company's competitive edge.

Moreover, green production is primarily a tool for improving environmental management. Protecting the environment and increasing public knowledge of green production are two ways ecolabelling may boost a company's competitiveness. An organization's innovation, a resource contributing to its core competitiveness, will be bolstered provided it has the resources and capacities to do so, as per resource-based theory. Many consumers like green goods; thus, producing them sustainably is seen as a competitive advantage. It is assumed that the product's innovative qualities would give it an edge in the market. Therefore, a company's innovation ability grows if it manufactures eco-friendly goods. Green production incorporates corporate social responsibility into the core company operations.

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Similarly, Ritter et al. (2015) argue that green production aligns with the needs of green consumers. Chen et al. (2006) argue that green innovation may give businesses an edge in the marketplace. They only looked at data from 200 people and used ANOVA instead of SEM to analyze it. Their study also lacked antecedent factors, including green inventiveness, regulatory pressure, and client pressure. In addition, Esty and Winston (2009) stressed the importance of how environmental initiatives generate competitive advantage for forward-thinking organizations. According to Ambec (2017), a competitive advantage in the green industry has been proposed due to a green industrial strategy. These researches focused on the policy level. However, efficiency and competitiveness are ignored. Examining the relationship between green production and green competitive advantage is essential. The study derived the following research question from the preceding:

# What is the impact of green production on reinforcing the green competitive advantage of Egyptian companies?

Therefore, a hypothesis can be formulated under the literature review as follows.

H6. Green production has little impact on reinforcing Egyptian companies' green competitive advantage.

Both green innovation and green production have similar ends in mind and use similar means of execution (i.e., resources and expertise). By encouraging innovation inside the workplace, businesses may acquire the knowledge and tools necessary to adopt eco-friendly manufacturing processes. In other words, encouraging green innovation will come naturally to a company that has already transitioned to environmentally friendly industrial practices. Creativity is the fundamental source of organizational innovation, according to the componential theory of creativity, and the workplace may alter the elements that contribute to creativity. Furthermore, the ambidexterity hypothesis explains how to deal with competing needs at the organizational level (Bledow et al., 2009a, 2009b). The two stages of development are exploration and exploitation. Manufacturing environmentally friendly goods (innovation) is emphasized at the exploration stage. The focus of exploitation, on the other hand, is on implementation and spread. The company may create and apply novel concepts at the initial theory stage. The second step is distribution and marketing, where firms may reap the benefits of their labour.

Similarly, given a componential theory of creativity and ambidexterity theory, creative organizations are more likely to adopt green production, which will likely strengthen the green brand image and increase the green competitive advantage during the exploitation phase of ambidexterity theory. Further, as previously indicated, green production affects green brand image and competitive advantage; hence, green production may function as a method via which green creativity might fortify green brand image and competitive advantage. As a result, green production has the potential to mediate the relationships between environmentally responsible innovation, green brand image, and green competitive advantage.

# What is the impact of green production on the green brand image of Egyptian companies?

Therefore, the hypothesis can be formulated under the literature review as follows:

H7. There is not a significant impact of cleaner production on the green brand image of Egyptian companies.

# 3. Study methodology and design

# 3.1 Study variables

The study compiled a summary of the literature on cleaner production, green brand image, and green competitive advantage into an intellectual framework to bolster green competitive advantage. This philosophical framework is built on both Mugoni et al. (2023), Sharma et al. (2023), and Zameer et al. (2020). The study variables were classified into three groups: the motives for adopting cleaner production as independent variables, the green competitive advantage as a dependent variable, and the green brand image as a mediating variable. A study can clarify the expected relationship through the following Figure 1.

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Figure 1. Study Variables and Hypotheses

# 3.2 Study hypotheses

According to Literature review and study variables, the study hypotheses can be formulated as follows:

H<sub>1</sub>. There is no significant impact of regulatory pressure to adopt cleaner production in Egypt.

H<sub>2</sub>. Customer pressure to adopt cleaner production in Egypt

has an insignificant impact.

H3. Green creativity has an insignificant impact on adopting cleaner production in Egypt.

H<sub>4</sub>. The importance of motives for adopting cleaner production in Egypt is similar.

H<sub>5</sub>. There is not a significant impact of cleaner production on reinforcing the green brand image of Egyptian companies.

H<sub>6</sub>. There is little impact of cleaner production on reinforcing the green competitive advantage of Egyptian companies.

H<sub>7</sub>. There is not a significant impact of cleaner production on the green brand image of Egyptian companies.

# 3.3 Measurement and segment of participants

The study questionnaire adopted a 5-point Likert scale as a Measurement of relationships between these variables; the study to enhance comprehension, the survey questionnaire was translated into Arabic. Academic specialists who are bilingual in English and Arabic have reviewed the translation. It was ensured that no significant translation-related differences existed. After completion, the questionnaire was disseminated to participants. Original development of all observable and latent constructs occurred in English as the survey was administered to Egyptian company administrators and employees.

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#### 3.4 Data collection

The data was collected through seven Egyptian governorates: Cairo, Giza, Alexandria, Suez, Buhaira, Beni Suef, and Fayoumin in the first quarter of 2023. Table 1 shows the responses.

	Table 1. Study sample		
No.	Governorates	Responses	Weight %
1	Cairo	127	32.23
2	Giza	89	22.59
3	Alexandria	53	13.45
4	Suez	21	5.33
5	Buhaira	32	8.12
6	Beni Suef	44	11.17
7	Fayoum	28	7.11
Total		394	100

The previous table shows that Cairo and Giza are more than 50% of the participants in the questionnaire. This is normal, as most of the main centers of Egyptian companies are in those governorates.

#### 4. Test Hypotheses

#### 4.1 Reliability test

The value of the reliability coefficient at the survey level, in general, is (79.31%), which is statistically sound. The reliability coefficient values for the main axes of the survey list are (0.759, 0.797, 0.831, 0.784, and 0.817) also statistically good. The reliability coefficient is 60% or more. Therefore, the survey list has high internal consistency and reliability, and the researcher can rely on them to achieve the study's objectives and popularize the results.

#### 4.2 The first hypothesis test

The formulation of the hypothesis can be reviewed as follows

H<sub>1</sub>. There is no significant impact of regulatory pressure to adopt cleaner production in Egypt.

Through inferential analysis, we have the following statistical output (see Table 2).

 Table 2. Outputs of the first hypothesis test outputs

#### Model Summary

				Std. Error
			Adjusted	of the
Model	R	R Square	R Square	Estimate
1	.787 <sup>a</sup>	.620	.619	.7006

a. Predictors: (Constant), D11

|--|

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	314.085	1	314.085	639.947	.000 <sup>a</sup>
	Residual	192.393	392	.491		
	Total	506.478	393			

a. Predictors: (Constant), D11

b. Dependent Variable: D3

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Based on the outputs of the inferential analysis of that hypothesis, it turns out that the coefficient (R) was estimated by (0.787). Still, the coefficient (Adjusted R Square) was estimated by (0.619), which indicates a change in attitude toward cleaner production, from which (61.9%) can be interpreted according to a change in regulatory pressure. On the other hand, it turns out that the coefficient (F) was estimated by (639.947); it was significant at the 1% level; therefore, the study rejects the null hypothesis and accepts the alternative hypothesis as follows:

### Regulatory pressure to adopt cleaner production in Egypt has a significant impact.

#### 4.3 The second hypothesis test

The formulation of the hypothesis can be reviewed as follows

H<sub>2</sub>. There is little impact of customer pressure to adopt cleaner production in Egypt.

Through inferential analysis, we have the following statistical output (see Table 3)

Model Summary									
			Adjusted	Std. Error of the					
Model	R	R Square	R Square	Estimate					
1	.889 <sup>a</sup>	.790	.790	.5203					
	i								

Table 3. Outputs of the second hypothesis test outputs

a. Predictors: (Constant), D12

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	400.355	1	400.355	1478.850	.000 <sup>a</sup>
	Residual	106.122	392	.271		
	Total	506.478	393			

a. Predictors: (Constant), D12 b. Dependent Variable: D3

Based on the outputs of the inferential analysis of that hypothesis, it turns out that the coefficient (R) was estimated as (0.889). Still, the coefficient (Adjusted R Square) was estimated by (0.79), which indicates a change in attitude toward cleaner production, from which (79%) can be interpreted according to a change in customer pressure. On the other hand, it turns out that the coefficient (F) was estimated by (1478.85); it was significant at the 1% level; therefore, the study rejects the null hypothesis and accepts the alternative hypothesis as follows **Customer pressure to adopt cleaner production in Egypt has a significant impact.** 

#### 4.4 The third hypothesis test

The formulation of the hypothesis can be reviewed as follows

H<sub>3</sub> There is little impact of green creativity to adopt cleaner production in Egypt. Through inferential analysis, we have the following statistical output

Table 4. Outputs of the third hypothesis test outputs

Model Summary

				Std. Error
			Adjusted	of the
Model	R	R Square	R Square	Estimate
1	.832 <sup>a</sup>	.692	.691	.6310

a. Predictors: (Constant), D13

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ANOVA							
Model		Sum of Squares	df	Mean Square	F	Sig.	
1	Regression	350.386	1	350.386	879.940	.000 <sup>a</sup>	
	Residual	156.092	392	.398			
	Total	506.478	393				

a. Predictors: (Constant), D13 b. Dependent Variable: D3

Based on the outputs of the inferential analysis of that hypothesis, it turns out that the coefficient (R) was estimated by (0.832). Still, the coefficient (Adjusted R Square) was estimated by (0.691), which indicates a change in green creativity, from which (61.9%) can be interpreted according to a change in green creativity. On the other hand, the coefficient (F) was estimated by (879.94); it was significant at the 1% level. Therefore, the study rejects the null hypothesis and accepts the alternative hypothesis as follows **Green creativity has a significant impact on adopting cleaner production in Egypt.** 

#### 4.5 The fourth hypothesis test

The formulation of the hypothesis can be reviewed as follows

**H**<sub>4</sub>**. The importance of motives for adopting cleaner production in Egypt is similar.** Through inferential analysis, we have the following statistical output (see Table 5)

 Table 5. Outputs of the fourth hypothesis test outputs

#### Test Statistics<sup>a</sup>

N	394
Chi-Square	566.220
df	2
Asymp. Sig.	.000

a. Friedman Test

Based on the outputs of the inferential analysis of that hypothesis, it turns out that the coefficient (Chi-Square) was estimated by (566.22); it was significant at the 1% level .Therefore, the study rejects the null hypothesis and accepts the alternative hypothesis.

#### There is a significant difference in the importance of motives for adopting cleaner production in Egypt.

#### 4.6 The fifth hypothesis test

The formulation of the hypothesis can be reviewed as follows

H<sub>5</sub>. There is not a significant impact of cleaner production on reinforcing the green brand image of Egyptian companies.

Through inferential analysis, we have the following statistical output

Table 6.	Outputs of	the fifth hypothesis	test outputs
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Model Summary

				Std. Error
			Adjusted	of the
Model	R	R Square	R Square	Estimate
1	.714 <sup>a</sup>	.510	.509	1.1466

a. Predictors: (Constant), D3

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			ANOVA			
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	536.440	1	536.440	408.044	.000 <sup>a</sup>
	Residual	515.348	392	1.315		
	Total	1051.788	393			

ANOVAD

a. Predictors: (Constant), D3b. Dependent Variable: D4

Based on the outputs of the inferential analysis of that hypothesis, it turns out that the coefficient (R) was estimated by (0.714). Still, the coefficient (Adjusted R Square) was estimated by (0.509), which indicates a change in reinforced green brand image, from which (50.9%) can be interpreted according to a change in cleaner production. On the other hand, it turns out that the coefficient (F) was estimated by (408.044); it was significant at the 1% level; therefore, the study rejects the null hypothesis and accepts the alternative hypothesis as follows **There is a significant impact of cleaner production on reinforcing the green brand image of Egyptian companies.** 

#### 4.7 The Sixth hypothesis test

The formulation of the hypothesis can be reviewed as follows

H<sub>6</sub>. There is little impact of cleaner production on reinforcing the green competitive advantage of Egyptian companies.

Through inferential analysis, we have the following statistical output (see Table 7).

Table 7. Outputs of the sixth hypothesis test output

#### Model Summary

				Std. Error
			Adjusted	of the
Model	R	R Square	R Square	Estimate
1	.780 <sup>a</sup>	.608	.607	1.0421

a. Predictors: (Constant), D3

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Model		Sum of Squares	df	Mean Square	F	Sig.			
1	Regression	660.070	1	660.070	607.836	.000 <sup>a</sup>			
	Residual	425.686	392	1.086					
	Total	1085.756	393						

a. Predictors: (Constant), D3

b. Dependent Variable: D5

Based on the outputs of the inferential analysis of that hypothesis, it turns out that the coefficient (R) was estimated by (0.78). Still, the coefficient (Adjusted R Square) was estimated by (0.607), which indicates a change in reinforcing the green competitive advantage of Egyptian companies, from which (60.7%) can be interpreted according to a change in cleaner production. On the other hand, it turns out that the coefficient (F) was estimated by (607.836); it was significant at the 1% level; therefore, the study rejects the null hypothesis and accepts the alternative view as follows:

# H<sub>6</sub>. There is a significant impact of cleaner production on reinforcing the green competitive advantage of Egyptian companies.

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#### 4.8 The seventh hypothesis test

The formulation of the hypothesis can be reviewed as follows

H<sub>7</sub>. There is no significant impact of green brand image on reinforcing the green competitive advantage of Egyptian companies.

Through inferential analysis, we have the following statistical output (see Table 8).

Table 8. Outputs of the seventh hypothesis test outputs

#### Model Summary

				Std. Error
			Adjusted	of the
Model	R	R Square	R Square	Estimate
1	.951 <sup>a</sup>	.904	.904	.5154

a. Predictors: (Constant), D4

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Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	981.621	1	981.621	3695.170	.000 <sup>a</sup>
	Residual	104.135	392	.266		
	Total	1085.756	393			

a. Predictors: (Constant), D4

b. Dependent Variable: D5

Based on the outputs of the inferential analysis of that hypothesis, it turns out that the coefficient (R) was estimated by (0.951). Still, the coefficient (Adjusted R Square) was estimated by (0.904), which indicates a change in reinforcing the green competitive advantage of Egyptian companies, from which (90.4%) can be interpreted according to a change in green brand image. On the other hand, it turns out that the coefficient (F) was estimated by (607.836), which was significant at the 1% levelt ;herefore, the study rejects the null hypothesis and accepts the alternative hypothesis as follows:

Green brand image has a significant impact on reinforcing the green competitive advantage of Egyptian companies.

#### **5.** Conclusion and recommendations

It is becoming more apparent to companies that they need to adopt environmentally friendly practices to survive in today's environmentally conscious market. This study investigates how cleaner production mediates a company's green brand image and its green competitive advantage. This investigation explores how "green brand image" relates to a company's long-term success in the marketplace.

Companies have been pushed to include environmental issues in their business plans due to the worldwide environmental challenges and the increasing customer awareness of sustainability. Building a "green" reputation for a company's offerings is a very effective way to attract and retain customers. At the same time, more people are beginning to realize that adopting cleaner production processes is a great way to lessen the harmful effects of manufacturing on the environment and boost productivity. The term "green brand image" describes how clients think about a business or its offerings in terms of their impact on the environment. Customers are more likely to be loyal to a company that portrays itself well in the green market. Companies may set themselves apart from rivals and appeal to environmentally sensitive customers by cultivating a "green brand image." However, "cleaner

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production" refers to methods and tools that lessen production's adverse environmental effects. It includes many tactics, such as eco-design, waste minimization, energy efficiency, and the employment of renewable materials. The gentler production may also save money and improve productivity.

The term "green competitive advantage" describes the long-term benefit that businesses receive from their ecofriendly practices. It involves things like better product performance in terms of the environment, entering new green markets, and increasing client loyalty. Achieving a green competitive edge allows businesses to strengthen their standing in the market, increase their profits over time, and reduce their environmental impact.

Cleaner production acts as a mediating variable between green brand image and green competitive advantage. A solid green brand image positively influences adopting and implementing cleaner production practices within an organization. Cleaner production, in turn, enhances environmental performance, reduces costs, and fosters innovation, leading to sustainable competitive advantage.

At the level of statistical analysis, and according to data collected from seven Egyptian governorates, 394 participations were obtained that dealt with the investigation of cleaner production motives, in addition to analyzing the impact of cleaner production on both the green image and the green competitive advantage of Egyptian companies. The study found three main motives for adopting cleaner production in Egyptian companies: regulatory pressure, customer pressure, and green creativity. All of these motives were significant at the 1% level.

However, the importance of these motives varies, as the most important reasons for Egyptian companies were regulatory rules, consumer pressures, and green creativity. That was significant at the 1% level. The previous result differs from what Zameer et al. (2020) indicated for ranking these motives. The current study can explain this according to the difference in the characteristics of the Egyptian business environment from the Chinese business environment and the difference in awareness among clients of environmental issues.

When investigating the dynamic relationships between green brand image, cleaner production, and green competitive advantage, inferential statistics concluded that there is a significant impact of cleaner production on reinforcing the green brand image of Egyptian companies; that under the coefficient (Adjusted R Square) was estimated by (0.509); it was significant at the 1% level. There is a substantial impact of cleaner production on reinforcing the green competitive advantage of Egyptian companies. That under the coefficient (Adjusted R Square) was estimated by (0.607), it was significant at the 1% level. Green brand image has a substantial impact on reinforcing the green competitive advantage of Egyptian companies. That under the coefficient (Adjusted R Square) was estimated by (0.904), it was significant at the 1% level. The previous results correspond with Amores-Salvadó et al. (2014).

To enhance Egyptian companies' awareness of the benefits of eco-friendly production, the study suggests the following:

- a. Develop awareness campaigns: create a comprehensive campaign to educate Egyptian companies about the advantages of eco-friendly production. This can include organizing workshops, seminars, and webinars led by sustainability and green practices experts. Provide practical examples of successful companies that have adopted eco-friendly production methods, highlighting the positive impact on their bottom line.
- b. Collaborate with industry associations: partner with industry associations and chambers of commerce to reach a broader audience of Egyptian companies, and work with these organizations to incorporate sustainability and eco-friendly practices into their training programs, conferences, and networking events.
- c. Provide financial incentives: introduce government subsidies or grants to support companies that adopt eco-friendly production practices, offer tax breaks or other financial incentives to encourage companies to invest in renewable energy sources, energy-efficient machinery, waste reduction, and recycling initiatives.

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- d. Showcase success stories: highlight success stories of Egyptian companies already embracing ecofriendly production, and share case studies and testimonials demonstrating the positive impact on their brand reputation, cost savings, and long-term sustainability.
- e. Foster knowledge sharing and collaboration: create platforms for Egyptian companies to exchange ideas, best practices, and challenges related to eco-friendly production. Establish online forums, networking events, and industry-specific working groups where companies can discuss their experiences, seek advice, and share resources, and encourage collaboration and partnerships to accelerate the adoption of eco-friendly practices across different sectors.
- f. Implement certification programs: introduce certification programs specifically focused on eco-friendly production, collaborate with recognized international standards organizations or develop national eco-labels to certify companies that meet specific sustainability criteria.
- g. Engage universities and research institutions: Collaborate with universities and research institutions to conduct studies and provide training on eco-friendly production methods. Encourage academic research on sustainable technologies and practices relevant to different industries, establish partnerships between companies and academia to foster innovation, develop sustainable solutions, and create student internship or apprenticeship opportunities.
- h. Promote international collaborations: encourage partnerships and knowledge exchange between Egyptian companies and international organizations, businesses, or experts in eco-friendly production, facilitate participation in international conferences, exhibitions, and trade fairs focused on sustainability to highlight Egyptian companies' efforts and learn from global best practices.
- i. Establish a centralized resource hub: create a centralized online platform or resource hub that provides comprehensive information, guidelines, and tools related to eco-friendly production. This hub can include case studies, research papers, practical guides, and access to expert advice.
- j. Monitor and evaluate progress: establish mechanisms to monitor and assess the progress of Egyptian companies in adopting eco-friendly production practices and collect data on energy consumption, waste generation, carbon emissions, and other relevant metrics. Use this information to track improvements, identify areas for further development, and recognize companies that excel in sustainability.

As suggestions for future studies, the study recommends the following

- a. Explore the concept of "Green Competitive Advantage" by conducting a comparative analysis of sustainable practices adopted by various industries. As the world embraces the urgency of addressing environmental concerns, businesses increasingly recognize the importance of integrating sustainability into their operations. This study would examine how sustainable practices can serve as a source of competitive advantage, enabling firms to achieve better economic performance while positively impacting the environment.
- b. Explore the concept of Green Supply Chain Management (GSCM) and its role in creating a competitive advantage for businesses in the global marketplace. With increasing environmental concerns and growing consumer demand for sustainable products, companies recognize the significance of integrating green practices into their supply chains. This study will investigate the strategies, benefits, and challenges of GSCM implementation across various industries.
- c. Investigate the relationship between Corporate Environmental Responsibility (CER) and financial performance to unveil the potential for a Green Competitive Advantage in businesses. As environmental concerns become increasingly urgent, companies are under growing pressure to demonstrate responsible practices. This study will examine how embracing CER initiatives can impact a firm's financial performance and competitive position.
- d. Examine the influence of environmental regulations on the development of Green Competitive Advantage (GCA) in businesses operating in different countries. Governments have implemented diverse regulatory frameworks to address environmental challenges as environmental concerns escalate worldwide. This study will analyze how varying environmental regulations impact the adoption of green practices and their subsequent effects on businesses' competitive advantage. By conducting a comparative analysis of

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case studies from different countries, we seek to identify the role of regulatory factors in fostering GCA and the implications for businesses striving for sustainable growth.

e. Explore the Green Human Resource Management (GHRM) concept and its potential to provide businesses with a competitive edge in a rapidly changing world. With increasing environmental awareness and the need for sustainable business practices, companies recognize the importance of aligning their HR strategies with green principles. This study will investigate the various GHRM practices organizations can adopt to foster a culture of environmental responsibility, enhance employee engagement, and achieve sustainable competitive advantage.

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Shereen ALY HUSSIEN ALY ABDOU

ORCID ID: https://orcid.org/0000-0002-7480-5456

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# PUBLIC-PRIVATE PARTNERSHIPS FOR SUSTAINABLE DEVELOPMENT OF AGRICULTURE\*

Kanat Tireuov<sup>1</sup>, Salima Mizanbekova<sup>2</sup>, Gulsim Aitkhozhayeva<sup>3</sup>, Ilyas Mizanbekov<sup>4</sup>

<sup>1</sup> Kazakh AgroTechnical Research University, Zhenis Ave., 62, Astana, Kazakhstan <sup>2, 3, 4</sup>Kazakh National Research Agrarian University, Abay Ave., 8, Almaty, Kazakhstan

*E-mail*: <sup>1</sup>tireuov k@mail.ru; <sup>2</sup>salima-49@mail.ru; <sup>3</sup>g.aitkhozhayeva@mail.ru; <sup>4</sup>miza-88@mail.ru

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Abstract. The agrarian reform in Kazakhstan substantially changes the approach to creating the competitive entities of the agro-industrial complex that is part of agricultural policy leading towards food security and sustainable development. Transition to innovative development triggers an active search of instruments engaging private equity and allowing, at the same time, the most practical combination of interests of the state and entrepreneurial structures. As such tool, the mechanism of public-private partnership is considered. The article's authors explore the specifics of the development of public-private partnerships (PPP) in the economy of Kazakhstan, especially in agriculture. In this research, the authors identified factors that affect the development of public-private partnership and discussed the peculiarities of its use. The experience of the development of public-private partnerships in other countries is considered. The paper offers analytical material that characterises Kazakhstan's public-private partnerships development level. The conclusion is made about the need for active development of PPP in the agriculture of Kazakhstan.

Keywords: public-private partnership; agriculture; sustainable development; agro industrial complex; innovative development; Kazakhstan

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JEL Classifications: Q16, Q18

#### **1. Introduction**

Kazakhstan is the world's largest landlocked country, with one of the lowest population densities in the world. It has a strategic location in the centre of the Eurasian continent at the crossroads between the People's Republic of China (PRC) and Western Europe, connected by road and rail transport and a port on the Caspian Sea. Kazakhstan is a middle-income developing country with a high economic dependence on energy resources. Kazakhstan has the world's ninth-largest oil reserves, accounting for 21% of its gross domestic product (PPP) in

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2020 and about 73% of exports in 2022. As a result of the coronavirus infection (COVID-19) pandemic, the country's PPP fell for the first time in two decades, falling by 2.5% in 2020 and recovering by 4.3% in 2021 (Export Potential of Kazakhstan, 2023).

Kazakhstan's updated National Development Plan until 2025 shows a medium-term vision of diversifying the economy through agro-industrial reforms and support for small and medium-sized enterprises. The main goal of this plan is to increase productivity as a driving force and help the country become one of the 30 wealthiest economies by 2030 by increasing private investment in the post-pandemic period (National Development Plan, 2021).

In his Message, the Head of State K.K. Tokayev, outlined the main principles for a new economic policy, which provides for guarantees of private property, a favourable investment climate, fair competition, public finance management, reduction of administrative barriers, reduction of the role of the state in the economy, and social protection (Message of the Head of State Kassym-Jomart Tokayev to the people of Kazakhstan, 2022).

Kazakhstan is historically an agrarian country, and to position itself as a prosperous state, we need to pay special attention to developing the agricultural sector. Agriculture in Kazakhstan has the potential to grow due to its vast land resources and the recognised quality of its products. The sector's potential needs to be realised through a transition to sustainable agriculture that can restore fertility to the land, create new employment opportunities and ensure greater independence from food imports.

The support and development of agriculture is often called one of the main tasks of the state. In recent years, the first persons of the republic have repeatedly spoken about this; the need to take action was voiced in the Messages; government agencies developed new programs and made changes to old ones. The role of the state in the sector remains very large. According to FCB Analytics, more than 65% of the current debt of agricultural producers is formed to organisations with state participation and credit partnerships, the total loan portfolio of which, as of August 1, 2021, amounted to about 850 billion tenge (Analytical Digest, 2021).

World and Kazakhstan's experience shows that public-private partnership is one of the crucial tools for expanding the resource base and attracting untapped reserves for economic growth, improving the institution of public administration and social ownership in the agricultural sector. This partnership shows relatively new trends in the world economy, reflecting the expansion of interaction between business and the state. The state can provide a stable regulatory framework, organisation of events for interaction with society, financial leverage, and various types of relief and rewards in the form of tax incentives, subsidies, etc. (Moreddu, 2016; Yang et al., 2020).

Considering the further development of a market economy in the development of public-private partnership projects, the problem of finding optimal economic measures for interaction between the state and the private sector becomes relevant.

# 2. Literature Review and Problem Statement

The state of affairs in agriculture differs greatly depending on the region, which is primarily due to different natural and climatic conditions. The northern areas are focused on grain crop production, which develops on lands without irrigation. Animal husbandry is less widespread and is characterised by a relatively high proportion of cattle in the total livestock. There is more agricultural machinery at agricultural enterprises than vehicles, but the entire fleet is quite old. Regarding technical equipment, the west of Kazakhstan is characterised by a relatively fresh fleet of vehicles with a fairly ageing (but renewing) fleet. Southern Kazakhstan, more than other macroregions, gravitates towards animal husbandry. Owners usually have relatively little land, but it is more likely to be irrigated. There is much more transport registered for farmers than agricultural machinery, but as a rule, it is old.

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Farmers often take loans of up to 1 million tenge (Analytical Digest, 2021), but only sometimes for a short period. Central and eastern Kazakhstan stand out little from the point of view of agricultural development and from the point of view of lending. But these regions are characterised by a relatively old transport fleet and agricultural machinery.

For the development of the agricultural sector, it is necessary to attract additional sources and resources for the development of agric-food infrastructure, increasing the profitability of farming activities, and attracting various categories of participants in the agricultural process, from minor to prominent entrepreneurs, including farmers. Achieving this goal is possible by intensifying the use of opportunities for communication between the public and private sectors in the format of public-private partnerships and with the involvement of foreign partners. Based on the experience of developing countries, public-private associations have taken a firm place in the development of agriculture and have proven their practical effectiveness, acquiring the status of an integral element in ensuring food security.

At the present stage of the development of society, creating a sustainable management mechanism in the rural economy is one of the significant factors in the growth of our country's competitiveness. With the strengthening of the economy of Kazakhstan, the mechanism of management in agriculture began to function more rationally. The advantages of domestic agricultural production should be used to produce competitive food products. Kazakhstan faces the task of improving the population's standard of living by accelerating the country's socio-economic development and the regions in particular, including the development of infrastructure for providing services to the people. The limited budgetary resources to ensure the implementation of socially significant objects is one of the reasons for the emergence in our country of public-private partnerships and borrowing the necessary implementation mechanisms based on the experience of foreign legal systems. In this regard, the PPP mechanism is currently used as one of the most effective tools of the innovation system, allowing regions to develop and grow dynamically. At the same time, due to implementation problems and imperfect legislation, the PPP mechanism is poorly designed, especially in agriculture (Kuznetsov et al., 2017; Tireuov et al., 2022).

PPP has wide application in developed countries. PPP projects greatly influence the indicators of the strategic goals of the countries and their regions' socio-economic development. The most successful projects are being implemented in the USA, Israel, Ireland, Italy, Great Britain, Germany, France and Japan. The leaders of PPP are the UK, France, USA and Germany. The main areas attracting business to PPP projects are healthcare, construction and reconstruction of roads, housing and communal services, infrastructure and education. "The main reason for the rapid growth of PPP projects is the absence of restrictions related to the budgets of state organisations".

Public-private partnership in the agro-industrial complex is a form of long-term mutually beneficial cooperation between the state and business to implement and develop at the regional and local levels socially significant projects for the modernisation of the agro-industrial complex with pre-established state requirements for their results, in which the responsibility for project preparation lies entirely on the private partner (Nechaev et al., 2020; Kospanov, 2021; Development Strategy, 2022).

In general, the governments of developed countries use public-private partnerships (PPP) for the following reasons (Kospanov, 2021):

1. PPPs encourage private sector capital injection.

2. In the case of large infrastructure projects, PPPs use private sector financial capital, which speeds up the construction of the project and the provision of services.

- 3. PPPs make projects affordable.
- 4. PPPs provide value for money.
- 5. In a PPP, each risk is allocated to the party that can best manage or absorb it.
- 6. PPPs force the public sector to focus on outcomes and benefits from the outset.

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7. With PPP, the quality of service must be maintained throughout the entire period of cooperation.

8. During the implementation phase, an independent consultant is hired to ensure compliance by both public and private parties with the terms of the contract/concession agreement.

9. PPPs drive innovation.

Public-private partnerships have been investigated to reveal the strengths and weaknesses of different types PPP, to orchestrate various types of innovation policy instruments (Hermans et al., 2019; Mouraviev, 2021), to enhance global food security (Smyth et al., 2021; Wang et al., 2021; Fanzo et al., 2021). Continuos analysis PPP processes in different countries would lead to more effective policies in this area.

# 3. The aims and objectives of the study

Today, Kazakhstan has a vast potential for growth in agricultural production and infrastructure development. New tools to support the industry are needed to increase the efficiency of the use of production resources. To further ensure the development of the agro-food complex, it seems necessary to use the practice of public-private partnership. This article aimed to study and analyse the development of public-private partnerships in agriculture in the context of sustainable development. The mechanism of work of public-private partnerships in agriculture in our country has yet to be thoroughly studied, and its potential has yet to be revealed. Therefore, an in-depth study, generalisation and systematisation of the experience of using this mechanism by national and foreign companies that have achieved high results in this area are required. The main tasks were:

- identification of trends in the dynamics of development of agriculture in Kazakhstan,

- disclosure of the concept of public-private partnership,

- analysis of the current state of public-private partnership in Kazakhstan.

# 4. The study materials and methods

The research focused on systematising domestic and foreign works centred on public-private partnerships. The use of system analysis allowed us to pinpoint the main advantages and disadvantages of the implementing mechanism of PPP and to assess the possibility of its application for the agriculture of Kazakhstan. It also allowed us to identify the best foreign government regulation practices and justify their applicability in Kazakhstan in agriculture in the context of sustainable development. The conclusions were the basis for proposals to develop an acting mechanism for implementing PPP projects in the agricultural sector. The empirical study used the data of the Agency of Statistics of Kazakhstan, the Ministry of Agriculture, media materials, and published reports on the development of public-private partnerships by the Kazakhstan Public-Private Partnership Center.

# 5. Research Results

# 5.1. Identification of trends in the dynamics of development of agriculture in Kazakhstan

The agricultural industry is one of the most critical sectors of the economy, which affect the food security of the country, as well as the labour and settlement potential of rural areas. The agro-industrial complex of Kazakhstan has good prospects for further development: the export positions of the oilseed and meat sectors are strengthening, and in terms of grain and flour, our country has quickly become one of the largest exporting countries in the world.

The membership of the Republic of Kazakhstan in the Eurasian Economic Union (EAEU) and the World Trade Organization (WTO) creates opportunities and, at the same time, places high demands on competitiveness both in the domestic and foreign markets (Agriculture is the backbone of a strong economy, 2019).

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Figure 1. The share of the agricultural sector in the PPP of the Republic of Kazakhstan Source: Kazakhstan Stock Exchange KASE, 2021

Between 2016 and 2021, the dynamics of the main indicators of agricultural production show that (Figure 1):

- the share of the industry in the total PPP slightly increased;

- the share of operating agricultural enterprises in the total number of registered agricultural organisations has not changed;

- the growth of investments in enterprises is mainly due to crop and livestock production.

According to the KASE report, for 2016-2020, the actual increase in Kazakhstan's PPP amounted to 50.4%, while the share of agricultural enterprises in PPP slightly increased from 4.6% to 5.4%. As of July 01, 2021, the percentage of farming enterprises in total PPP amounted to 2.9%, with a decrease of 2.5 basis points in the first half of 2021 (Agricultural Industry of the Republic of Kazakhstan, 2021).



Figure 2. The structure of the gross output of the agricultural sector in Kazakhstan, % Source: Kazakhstan Stock Exchange KASE

94% of gross output accounted for animal husbandry (1,425 billion tenge), 4.9% for crop production (75 billion tenge) and 0.1% for other sub-sectors (agricultural services, fisheries and forestry, hunting). The growth in the volume of livestock production in the first half of 2021 is due to an increase in livestock and poultry slaughter volume in live weight by 5.5% and raw cow's milk yield - by 3.2% (see Figure 2).

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As noted in the KASE report, geographically, the most developed regions in terms of gross output of agricultural enterprises are the Almaty region (15.7% of the gross production (services) of agricultural enterprises), Turkestan region - 14% and East Kazakhstan region - 12.1% (Agricultural Industry of the Republic of Kazakhstan, 2021), see Figure 3.



Figure 3. PPP of the agricultural sector by region, % *Source:* Kazakhstan Stock Exchange KASE

In 2021, 16.5 million hectares of land were sown with various crops in Kazakhstan. The number of registered livestock exceeds 40.5 million heads. Only in the first half of the year, the export of wheat alone brought in 633.1 million dollars, having increased by 31.2% over the year; barley - \$109.2 million (+33%). The number of registered agricultural machinery exceeds 189 thousand units; vehicles registered for farmers - 193.6 thousand units. At the same time, the average and median age of equipment is decreasing. There are problems in agriculture. But the sector's potential makes it attractive for investors and lenders.

The sown area in Kazakhstan is increasing. In 2021, 145.7 thousand hectares more were sown than in 2020 (up to 16.5 million hectares). In relative terms, the growth was 0.9%. The most substantial growth (+397 thousand ha) was recorded in the Akmola region, but this increase was partially offset by a drop in sowing volume in the Kostanay region (-282 thousand ha). Compared to 2020, the areas sown with wheat and sunflower increased significantly, although, in some places, this happened due to a reduction in barley areas. In general, these crops grow in 75% of Kazakhstan's fields. The number of landowners is decreasing. Over the year, their number decreased by 2.6%, amounting to 111 thousand units (every second landowner has a sown plot in the Turkestan or Almaty region). As a result, in most areas, farms are consolidated. The strongest is in the Akmola region, where the average area, compared to 2020, increased by 97.4 hectares. Traditionally, plant growing is developed mainly in the northern areas of the republic, while livestock breeding prevails in the south. Half of all registered livestock in Kazakhstan belongs to three regions - Turkestan, Zhambyl and Almaty. In August 2021, there were 20.3 million sheep, 9.8 million cattle and more than 3.3 million horses in the republic. The problematic issue is the wear and tear of agricultural machinery. Even though in recent years the process of fleet renewal has been activated, the age of half of the tractors is at least 29 years old, and 61% of the used trailers and attachments were produced back in the 1980-s year (Analytical Digest, 2021; Bureau of National Statistics, 2023).

#### 5.2. Disclosure of the concept of public-private partnership in Canada

Today, there are many definitions and interpretations of the term public-private partnership. Social and economic projects in healthcare, education, science, housing and communal services, innovative technologies, transport, culture, sports, and in a small part, agriculture and tourism can be attributed to public-private partnerships.

A public-private partnership is understood as a long-term pooling of resources of public and private partners based on a written agreement, fixing the sharing of risks, responsibilities and results between them to solve critical public tasks and/or implement infrastructure projects in the public interest that cannot be effectively resolved/implemented without the participation of private partners.

To study foreign experience in the implementation of public-private partnership, Canada was chosen, which, using the PPP model, was able to attract significant private funds, technologies and innovations to the infrastructure, and thereby increase its competitiveness, despite the mistakes made in using the PPP model for several projects, which is also of interest from the point of view of their possible consideration in the development of PPP in Kazakhstan.

Using various forms of public-private partnership in industrial and social infrastructure sectors is one of the main trends in the modern development of the Canadian economy. As in other developed market countries and some transition economies, PPP mechanisms have been used in Canada since the early 1990-s.

Canada's experience in implementing PPPs interests us for several reasons. First of all, this is some similarity in both countries' natural-geographical characteristics and economic structure, as well as the wealth and diversity of natural resources and an increased share of raw materials industries in the structure of production and exports. Related to this is the state's active and often direct participation in creating and modernising the economic and social infrastructure (Canada's Economic Action Plan, 2010).

Other circumstances add additional value to the Canadian experience. Thus, Canada is characterised by a pragmatic approach to studying and applying the "best examples" of foreign economic practice. This is facilitated, in particular, by the traditionally significant role of immigration in forming the population and the high degree of "openness" of the economy for foreign economic relations.

According to international experts, Canada occupies some "middle" positions regarding the level of use of PPP mechanisms and the scale of their implementation in economic practice. The leaders in this - in terms of institutional conditions, the development of project management mechanisms, the development of various industry models, and a wide range of funding sources - are recognised by the UK and Australia. In Canada, as in a former colony of Great Britain, the imprint of British traditions and approaches is very clearly manifested in the state structure, party-political system and model of social policy. In the 1990s, the British experience of using new forms of economic partnership between the state and business was also carefully studied here. It is noteworthy, however, that, in the end, there were significant differences in some conceptual points (Canada's Economic Action Plan, 2010).

Notably, in Canada, "private finance initiative" schemes are practically not used, and a clear difference has been established between public-private partnerships and privatisation. In Canada, the complete transfer of a specific object, function and related assets to the private sector is considered privatisation (even if the control and regulation of this type of activity remain in the hands of the state) (Federation of Canadian Municipalities, 2010). Mechanisms of public-private partnership, of course, involve one degree or another of denationalisation. However, in PPP projects, the ownership of infrastructure facilities and services for collective use is usually retained by the state/municipalities or (more rarely) joint public-private. In Canada, PPP legislation does not

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provide for the complete transfer of ownership by the state to private capital. At the same time, it is supposed to delegate to him the rights of use and possession of state property. In this regard, various forms of public-private partnership are also called partial privatisation (semi-privatisation).

The brief definition of such a partnership adopted in Canada is not enshrined in federal law but in the charter of the Canadian PPP Council. It is a nationwide organisation that was created and functions as a partnership. The main goal of the PPP Council is to improve and introduce new mechanisms for economic interaction, study and disseminate "best practice examples", and provide methodological assistance to participants in partner projects. The Council includes representatives of government agencies, many private companies in various industries, financial companies, and consulting firms. Organisations similar in composition and functions operate in several provinces of Canada - Ontario, British Columbia, Alberta, and Quebec. Canada places particular emphasis on the fact that partnerships are created to meet public needs most effectively. To this end, they rely on the strengths and advantages of both public and private partners (Fussell et al., 2009; Weng et al., 2017).

At the same time, in the late 1990s in Canada, various public-private partnership mechanisms began to rapidly develop and be used in the economic and social infrastructure sectors. In many infrastructure sectors and activities, the complete transfer of state/municipal property to private commercial structures is sometimes reasonable. It may be unacceptable from a socio-political point of view. In some regions, there have been cases of suspension of privatisation transactions or even the return to state control of some objects and functions previously transferred to private companies. As a result of the search for the optimal combination of public and private interests, the strengths and resources of the public and business sectors, and the division of financial and other risks between them, various partnerships began to be created. It should be emphasised once again that in Canada, economic, organisational and managerial functions in relation to state objects are transferred to a private partner to some extent. Still, these objects themselves remain the property of the state.

In the case of Canada, one can see how PPP projects can contribute to socio-economic development. Thus, according to the Canadian Center for Economic Analysis, each dollar invested in PPP projects in different provinces generated from 1.1 to 4.2 dollars of economic activity: the primary impact on the economy is the cost of the original contractor, the secondary effect is the cost of the suppliers of these contractors. The generated income in the form of wages and profits is spent on consumption and investment-induced impact, and, finally, new infrastructure facilities provide growth in economic activity that is not directly related to the initial investment - systemic influence. It is important to note that this process is accompanied by additional employment and, as a result, an increase in wages (from 0.5 to 1.9 dollars per 1 dollar of investment). Finally, additional investments in projects lead to additional tax revenues (from 0.4 to 1.1 dollars per 1 dollar of investment). At the same time, for sizeable long-term infrastructure projects (for example, roads), as practice shows, the additional taxes over the entire project cycle exceeds the investments. In addition to purely economic results, infrastructure projects lead to an increase in the quality of life and have a significant impact on socio-economic development and the level of country competitiveness, attracting better resources and additional capital to the country (Fussell et al., 2009; Canada's Economic Action Plan, 2010).

The impact of described effects of the implementation of PPP projects on PPP in Canada averaged \$3.6 per \$1 investment. Based on the contract value of the analysed two hundred large PPP projects (about \$110 billion), one can arrive at a total contribution to PPP of \$396 billion (about 24% of the level of PPP in 2016). This contribution would be less if the implemented projects were not linked (the average contribution of each project in isolation was \$2.4 per dollar of investment). By linking infrastructure plans, in addition to the direct effect, there is a synergistic effect, and thus, the impact of these investments on the economy increases (Canada's Economic Action Plan, 2010).

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Canada's experience suggests that public-private partnerships have country specifics and are determined by various conditions: the legal environment, the level of development of institutions, business traditions, economic development, political factors, and others. At the same time, certain similarities can be identified that indicate the presence of patterns in this area, which can improve state policy's effectiveness in attracting private investment in the public infrastructure sector.

An analysis of the development of PPP program management systems in Canada showed that it was a dynamic process, with many changes as experience gained. In Canada, there are three waves of PPP development: (1) an attempt to copy the English PFI model, (2) the introduction of the VfM mechanism and an assessment of the economic effect of each project, (3) the "Trudeau era". At the beginning of the development of PPP models, separate PPP Centers were created (both at the national level and in the regions), focused exclusively on projects implemented according to such models. In most cases, they were then integrated into government infrastructure development centres (in Canada, the Infrastructure Agency and the Infrastructure Bank, in the UK, Infrastructure and Project Management under the Treasury IPA, in France, the FIN INFRA Center in the Treasury) so that the PPP model was not seen as a fashionable phenomenon that took precedence over other forms of implementation of infrastructure projects, but as an alternative to conventional methods, used when there were economic advantages (Fussell et al., 2009).

The Canada PPP Fund has \$1.2 billion in funding and is a federal financial instrument to assist lower levels of public government in their PPP projects. They form a medium-term plan and budget for five years. Any government body can apply to the fund to support their transport, water supply, energy, security, waste management, culture, sports, telecommunications, maritime activities, space, and tourism projects. Projects are selected based on price and quality criteria. Financing comes in various forms depending on the needs of the project. The maximum amount of the fund's support is approximately 25% of the project cost. PPP projects in Canada are implemented in more than 25 areas of public relations (construction of roads and bridges, construction and reconstruction of medical and educational institutions, sports technical facilities, etc.) at all levels of government (Canada's Economic Action Plan, 2010).

The legal regulation of public-private partnerships in Canada is carried out at the federal level and the level of provinces and territories.

The main statutory act governing public-private partnerships at the federal level is the Canadian Strategic Infrastructure Fund Act of March 27, 2003, which establishes that the Strategic Infrastructure Fund, if necessary, facilitates partnerships between public and private organisations.

Thus, from the experience of Canada, the dynamics of the development of public-private partnerships in terms of the volume of attracted investments is cyclical and depends on economic and political factors. With the implementation of large projects, considering the reduction of the infrastructure gap, there has been a gradual decrease in activity in this area.

# 5.3. Analysis of the current state of public-private partnership in Kazakhstan

The President of the Republic of Kazakhstan, Kassym-Jomart Tokayev, at a meeting of the Council of National Investors on June 28, 2019, indicated that it is necessary to better unlock the potential of public-private partnerships. The President noted that this tool was actively used in constructing social facilities - kindergartens, schools, and hospitals. It is necessary to attract investors to implement PPP projects in other sectors - infrastructure, energy, industry, and agriculture (JSC "Kazakhstan Public-Private Partnership Center", 2023).

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In July 2006, a new (current) law "On Concessions" (Law of the Republic of Kazakhstan, 2006), was adopted to eliminate legislative restrictions and problems that arose with the implementation of PPP projects in Kazakhstan. First, it made it possible to involve legal entities registered in the Republic of Kazakhstan to implement concession projects. In the process of implementing the Law of the Republic of Kazakhstan "On Concessions", several barriers were identified that prevent its active application: weak commercial attractiveness of concession objects; limited instruments of state support for concessionaires; the need to strengthen the institutional component and the quality of the preparation of PPP projects. Therefore, to improve the PPP mechanism and the attractiveness of concession projects, on July 5, 2008, a law of the Republic of Kazakhstan was adopted, which made it possible to improve some provisions of the concession legislation. In July 2010, several amendments were made to the concession and expanding state support measures. The turning point for developing PPP mechanisms in Kazakhstan was 2011 when the first policy document in the field of PPP for the period up to 2015 was adopted. On October 31, 2015, Kazakhstan adopted the Law "On Public-Private Partnership" (Law of the Republic of Kazakhstan, 2015) which is based on international experience in the implementation of PPP projects and includes a wide range of state support measures for infrastructure investors, including foreign ones.

Currently, the legislation of the Republic of Kazakhstan in the field of public-private partnership is based on the Constitution of the Republic of Kazakhstan. It consists of the Civil Code of the Republic of Kazakhstan, the Law "On Concessions", the Law "On Public-Private Partnership", and other regulatory legal acts of the Republic of Kazakhstan. Law of the Republic of Kazakhstan (RK) No. 167-III "On Concessions" was adopted on July 7, 2006. This is the first normative act regulating relations in the field of PPP. The concession is a PPP scheme, one of the most complex and capital-intensive social infrastructure and life support projects.

Law of the Republic of Kazakhstan No. 379-V "On public-private partnership" was adopted on October 31, 2015. The law is based on international experience in implementing public-private partnership projects and includes a wide range of state support measures for investors, including foreign ones. In general, a public-private partnership is a system of medium-term or long-term relationships between the state and the private sector for the provision by the private sector on behalf of the state of socially significant services for the design, financing, construction, reconstruction, rehabilitation, operation or maintenance of facilities. Public-private partnership is carried out in all sectors of the economy. With the adoption of the law "On Public-Private Partnership" in 2015, new types of contracts were introduced: BTO (build–operate–transfer), DBFO (design–build–finance–operate), O&M (operate–management), LC (lease contract) (Sundaram et al., 2016; Teterinets, 2019).



Figure 4. Level of PPP projects

At the local level, mainly less expensive projects for modernising housing and communal services and social projects are being implemented, while at the republican level - large infrastructure projects (Figure 4).

Between 2005 and May 2017, less than 50 PPP agreements and concessions were concluded, while already in the second half of 2017, the Treasury Committee registered 133 PPP projects. As we can see in Table 1, as of April 1, 2021, more than 872 projects have already been registered. Therefore, based on these figures alone, it can be concluded that for less than four years from the beginning of the registration of PPP contracts, 17 times more contracts were concluded than in the previous 11 years (Public–Private Partnership Monitor, 2022; Public-Private Partnerships in the countries of Eurasia Economic Union, 2018).

	2016		2017		2018		2019		2020		21	
FA	RK	FA	RK	FA	RK	FA	RK	FA RK		FA	RK	
		39		12		90		29		63		
	total		total		total		total		total	tot	total	
	7		140		184		376		139	34	4	
Incl.	registered	Inc	l. registered	Inc	l. registered per	Incl.	registered per	r Incl. registered per Incl. r		Incl. regis	tered per	
pe	er year		per year		year		year	year		yea	ar	
	7 140 184 376 139 34							4				
Note: Compiled by the authors based on information from the "Summary of information on the assumed state obligations under PPP												
projec	projects and concessions of the Government of the Republic of Kazakhstan and the LEA (forms No. 3 and No. 4)//IAIS "e-Minfin",											
subsys	subsystem "Execution of the state government in terms of state borrowing and lending" (Materials of the extended meeting of the											

**Table 1**. Number of registered PPP projects and concessions as of 01.04.2021

The current situation in the development of public-private partnership looks like this, 34 projects in PPP are at different stages of implementation, including agreements on 27 projects have been concluded: six projects in healthcare, two projects in roads, one project in veterinary medicine, 13 in education, and five projects in agriculture (JSC "Kazakhstan Public-Private Partnership Center", 2023).

# Discussion

government, 2017)

Kazakhstan has some experience in applying PPP mechanisms. The main areas of application of PPP mechanisms in Kazakhstan today are energy, transport infrastructure, and construction. At first, the imperfection of legislation was one of the main obstacles that prevented the active attraction of private investment and competencies in the infrastructure sectors of the economy of Kazakhstan. The first law of the Republic of Kazakhstan (RK), "On Concessions", approved in December 1991, regulated the legal conditions for granting objects for concession in the republic's territory only to foreign investors.

In connection with the strategy of sustainable development of Kazakhstan, the development of public-private partnerships is particularly important. Regional authorities interact with businesses based on the optimal distribution of responsibilities, risks and benefits. This is a qualitatively new and effective way to attract investment since partnerships of this type can promote economic growth and develop socially significant infrastructure.

The main tasks of public-private partnership:

- creation of conditions for effective interaction between the public partner and the private partner to ensure sustainable socio-economic development of the Republic of Kazakhstan;

- attraction of investments in the state economy by combining the resources of the state partner and the private partner for the development of infrastructure and life support systems for the population;

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- increasing the level of availability and quality of goods, works and services, taking into account the interests and needs of the population, as well as other interested parties;

- increasing the overall innovation activity in the Republic of Kazakhstan, including promoting the development of high-tech and knowledge-intensive industries (Rudert & Mussayeva, 2020; Tireuov et al., 2023).

One of the most common problems in Kazakhstan is the need for more innovative projects. When organising special economic zones at the initial stage, there is intense competition between regions to create special economic zones on their territory. The consequence of choosing a territory and assigning it the status of a special economic zone is that in the future, there will be a relatively weak filling of these zones with private businesses with high financial potential. This is because residents already receive a significant part of the benefits, including taxes, provided for within the territorial framework of the special economic zone.

According to the Ministry of National Economy of the Republic of Kazakhstan, investment attractiveness through public-private partnerships has increased in recent years. This contributed to GDP growth of 0.2%. At the beginning of the second quarter of 2019, the total number of projects in the republic amounted to 1285, which is 2.9 trillion tenge. Five hundred forty-eight contracts for 1.5 trillion tenge have already been signed. At the preparatory stage, 737 projects worth 1.4 trillion tenge. Most projects relate to education, healthcare, energy, housing and communal services, culture and sports (Public–Private Partnership Monitor, 2022; Public-Private Partnership Units, 2007). Anyway, there is room for further strengthening of PPP (Taubayev et al., 2017; Domalatov & Turginbayeva, 2019).

# Conclusions

There are no ready-made recipes for ensuring growth in agriculture based on the interaction between the state and business. In each case, it is necessary to consider the characteristics of a particular territory, its resources, and development prospects. Experts identify several relevant areas of public-private partnership in the agro-industrial complex, which can be used individually and in combination with each other, depending on the specific conditions of the region.

Another factor in this matter is budgetary security as one of the critical drivers for developing PPPs - the higher it is, the less incentive the government has to attract private capital. On the other hand, the reduction in the use of the PPP model in the context of insufficient budgetary funds for public infrastructure development may indicate that systemic issues still need to be resolved, which should be paid special attention to.

Discussions about using public-private partnerships in the agro-industrial complex are based on our country's specifics and the high riskiness of agricultural production. The vital role and importance of PPP in the agro-industrial complex are noted in many governments' targeted programs and strategies for developing the industry. The PPP mechanism in agriculture can become the foremost influential factor and instrument for ensuring national food security.

A systematic approach at various levels of management of the PPP-AIC project is becoming essential for the practical implementation of the project. Taking into account the multi-level configuration of management structures in the Kazakhstani public sector, the central executive bodies regulating the activities of the agro-industrial complex within the framework of PPP-agro-industrial complex projects are directly responsible for developing their legal support and the decision-making mechanism for the PPP-agro-industrial complex project.

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Author Contributions: The authors contributed equally. All authors have read and agreed to the published version of the manuscript.

Kanat TIREUOV, Chairman of the Board - Rector; S.Seifullin Kazakh Agro Technical Research University Zhenis Ave, 62, Astana Kazakhstan.

ORCID ID: https://orcid.org/0000-0003-3904-3553

Salima MIZANBEKOVA, Doctor of Economic Sciences RK, RF, Professor; Kazakh National Agrarian Research University; Professor of the Department of Management and Organization of Agribusiness; Abay Ave., 8 Almaty Kazakhstan. ORCID ID: https://orcid.org/0000-0002-7602-9710

**Gulsim AITKHOZHAEVA**; Ph.D; Kazakh National Agrarian Research University, Lecturer of the Department of Land Resources and Cadastre; Abay Ave., 8, Almaty Kazakhstan ORCID ID: <u>https://orcid.org/0000-0001-5481-4964</u>

**Ilyas MIZANBEKOV,** PhD student, Kazakh National Research Agrarian University, Department in "Agrarian machinery and technology", Abay Ave., 8, Almaty Kazakhstan ORCID ID: https://orcid.org/0000-0003-0370-7776

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Clarivate Analytics

# BUILDING CORPORATE IMAGE THROUGH SOCIAL MEDIA: ROLE OF IMPRESSION MANAGEMENT\*

# Shereen Aly Hussien Aly Abdou

Department of Business Administration, Faculty of Commerce and Business Administration, Helwan University, Egypt

*E-mail: shereenghazala6@gmail.com* 

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**Abstract**. The study investigated impression and corporate image management through a qualitative analysis that included three social networking platforms (Instagram, Twitter, and Facebook). Four hundred-seven users of Egyptian telecommunications services participated. They used four service providers: Telecom Egypt, Vodafone, Orange, and Etisalat Misr. Primary data was collected during January - March 2023. According to the statistical analysis, there is a difference in impression management practices and corporate image creation in the Egyptian telecommunication industry. The author revealed the contribution of social media platforms to building corporate image via impression management. The change in impression management explains 74.3% of the difference in the corporate image. A study of the effective contribution of social media platforms to the company's image-building reveals the differences in platform user characteristics. The study's limitation was one country's and one industry's scope. Therefore it is suggested to re-test raised hypotheses in other countries and industries.

**Keywords:** impression management; corporate image; corporate reputation; corporate identity; social media; marketing; social networking platforms; telecomminication industry; Egypt

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JEL Classifications: O32, O35

# 1. Introduction

The effort made by individuals and organizations to influence the perceptions and opinions of others is referred to as impression management. It involves carefully managing and controlling information, behaviours, and appearances to create a favourable impression. In the corporate image, impression management is crucial in shaping how a corporate is perceived by its stakeholders, including clients, employees, investors, and the general public (Wu et al., 2022). The importance of impression management in corporate image lies in the fact that perceptions and reputations can significantly impact a corporate's success; impression management is essential for building and maintaining a positive corporate image. It helps shape stakeholder perceptions, establish trust, navigate crises, gain a competitive edge, attract investors, and engage employees. Corporations that effectively

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manage their impressions can benefit from enhanced reputation, client loyalty, and long-term success (Smith et al., 2021).

Social networking plays a crucial role in corporate image management. It has transformed the way corporations communicate, engage with their target audience, and shape their public perception; social networking has revolutionized corporate image management by offering an extensive reach, enabling direct communication and engagement, supporting brand building and reputation management, facilitating influencer collaborations, providing real-time insights, encouraging employee advocacy, and offering data analytics capabilities. It has become integral to a corporate's overall marketing and communication strategy in today's digital age. (Smith et al., 2020); in addition, the effect of social media on people varies by age and gender (Lelisho et al., 2023).

This paper investigates the impact of impression management techniques employed by Egyptian Telecom corporations on their corporate image as perceived by clients on social networking pages. By analyzing various dimensions of impression management and their implications for corporate image, this study provides valuable insights into the strategies employed by telecom corporations to enhance their online reputation (El-Gohary, 2019).

# 2. Literature Review

# 2.1 Impression management

Impression management is a well-known concept in social psychology that refers to the conscious or unconscious efforts individuals make to control the image they present to others. It involves a range of strategies to create a favourable impression on others, including self-presentation, self-promotion, and image repair. Impression management can be seen in various social contexts, such as job interviews, first dates, and social media.

One of the most prominent theories in impression management is Goffman's (1959) dramaturgical perspective, which views social interactions as performances on a stage. According to this theory, individuals engage in impression management by adopting specific roles and scripts to create a desired impression on others. Goffman (1959) also identified various techniques used in impression management, including frontstage and backstage behavior, impression formation, and impression mismanagement.

Another influential theory in impression management is Leary and Kowalski's (1990) self-presentation theory, which emphasizes the role of self-esteem in the process of impression management. This theory posits that individuals engage in impression management to enhance their self-esteem and gain social acceptance and approval. Self-presentation strategies can include ingratiation, intimidation, and supplication.

Research has shown that impression management plays a crucial role in various domains of social life, including job interviews, romantic relationships, and social media use.

In conclusion, impression management is a complex phenomenon that involves a range of strategies aimed at creating a favorable image of oneself in the eyes of others. The theories and research in this area provide insight into how individuals engage in impression management and its impact on social interactions.

#### **2.2 Corporate Image**

Corporate image is a "multidimensional construct reflecting the beliefs, feelings, and attitudes of stakeholders about an organization" (Brown et al., 2006, p.102). It is a crucial component of corporate reputation, "a composite of a firm's past actions and current performance" (Fombrun & Van Riel, 1997, p.4). Corporate image and reputation are closely related, but they are not identical. Reputation is more objective and fact-based than image,

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which is more subjective and intangible. Janechova & Bednarik (2023) suppose that corporate reputation depends on corporate identity; a solid reputation allows for achieving an attractive company's brand.

Products and services, marketing and advertising campaigns, corporate social responsibility (CSR) initiatives and employee relations are some factors that can affect a company's image. A recent study by Xuetong et al. (2023) shows that corporate reputation mediates the connection between corporate social responsibility and sustainable competitive advantage.

In recent years, there has been an increase in interest in corporate image as corporations have become more aware of the significance of managing their reputation. A favorable corporate image can help attract and retain consumers, employees, and investors. It can also provide the company with a competitive edge in the market.

There are many different ways that corporation can manage their corporate image. One meaningful way is to develop and implement a robust corporate branding strategy. Corporate branding creates a distinctive identity based on its values, mission, and vision. A strong corporate brand can help a company differentiate itself from its competitors and cultivate strong relationships with its stakeholders.

Another essential way to manage corporate image is to engage in CSR activities. CSR is the practice of businesses taking responsibility for their operations' social and environmental impact. CSR activities can help a corporate to build a positive image and to demonstrate its commitment to sustainability.

Even though researchers have exhaustively examined corporate image. It is unanimously agreed that corporate image is related to a perceptual representation of a company's past actions and prospects that describes the company's overall appeal to all of its key constituents relative to other leading competitors (Veh et al., 2019). A company's reputation's "overall appeal" comprises financial indicators (market performance, dividend yield, and profitability) and nonfinancial variables such as corporate social responsibility.

Several challenges associated with conceptualizing reputation as the aggregate evaluations of all stakeholders are exemplified by the following observations: (1) Investors may place a higher value on profitability than ethics, whereas the general public may place the opposite emphasis. (Sjovall and Talk 2004); (2) Reputations of corporations may vary because of different of factors (for instance, a corporation may have a positive reputation based on profitability but a negative reputation based on ethics)

Collectively, these issues highlight the problematic nature of a singular "overall" measure of reputation. Could a broader cross-section of rating various categories of organizations and balancing a wide range of criteria (e.g., financial, ecological, and social) generate a meaningful aggregate measure of reputation? Numerous indicators suggest that this cannot be accomplished. Noting, for instance, the lack of empirical research on stakeholders,

Job seekers and corporate executives evaluate the reputation of a company differently. Information per stakeholder group is exchanged for a collective perception on which consensus is dubious. Reputation has been measured in a variety of ways, including market share (Fang, 2005), users of service (Paul et al., 2023) in addition to a content analysis of media data (Mangio et al., 2023).

The inherent problems in defining and operationalizing reputation that we have discussed suggest that redefining and measuring reputation may be advantageous. Finally, a corporation can also manage its image through employee relations. A positive work environment can help attract and retain talented employees and send a positive message to clients and other stakeholders (Tong et al., 2023).

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In conclusion, corporate image is a critical component of corporate reputation. A positive corporate image can help a corporate achieve its business goals, while a negative image can damage its reputation and bottom line. There are several ways that corporations can manage their corporate image, including developing a strong corporate branding strategy, engaging in CSR activities, and managing their employee relations.

# 2.3 Impression management on social networking pages

Impression management on social networking pages is a phenomenon that has received increasing attention in recent years. Social networking pages, such as Facebook, Instagram, and Twitter, provide individuals with a platform to present themselves to a broad audience. As a result, individuals engage in impression management by carefully crafting their online profiles to create a desired image of themselves. This can include selecting profile pictures, posting specific content, and interacting with others in a certain way.

Research has shown that impression management on social networking pages can significantly affect individuals' self-esteem and social relationships.

Corporations can use impression management on social networking platforms to enhance their corporate image. Additionally, corporations can use social networking platforms to monitor and respond to client feedback and complaints.

However, impression management on social networking platforms can also negatively affect corporations. For instance, corporations that engage in overly promotional or insincere behavior on social networking platforms may be perceived as inauthentic and untrustworthy by clients and stakeholders. Additionally, a corporation failing to respond to client complaints or negative feedback on social networking platforms may damage its reputation and corporate image.

In conclusion, previous studies have highlighted the importance of impression management and corporate image in social networking contexts. A corporation that engages in authentic and transparent impression management strategies on social networking platforms can enhance its corporate image and improve its relationships with clients and stakeholders.

# 2.4 Research Gap

Despite the increasing importance of social networking pages as platforms for impression management and shaping corporate image in the Egyptian telecom industry, there is a lack of research that examines the specific strategies employed by telecom companies and the impact of these efforts on the perception of their corporate image by consumers and stakeholders. There is need for more knowledge of impression management strategies. Despite impression management is comparatively well-established, there is still need for more empirical research examining the impression management strategies employed by Egyptian telecom companies on their social networking pages. Identification and classification of these strategies would provide valuable insights into companies' communication techniques allowing to shape their intended corporate image.

Uncertainty in perceived company image: Existing research on a corporate image has predominantly focused on conventional marketing and communication channels. However, the dynamics of corporate image formation on social networking pages may differ significantly. Therefore, it is necessary to investigate how users interpret and perceive the corporate image transmitted by Egyptian telecom companies on these platforms and whether or not it aligns with the image the companies intend to convey.

Influence of company image on stakeholders: It is crucial to comprehend the connection between the corporate image projected on social networking pages and stakeholders' attitudes, behaviors, and decisions. Research should examine how consumers, investors, employees, and other stakeholders react to the impression management

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efforts of Egyptian telecom companies and whether these efforts influence their perceptions and brand engagement.

Not only would addressing these research gaps contribute to the existing body of knowledge regarding impression management and corporate image in the context of the Egyptian telecom industry, but it would also provide valuable insights for communication and marketing professionals wishing to optimize their strategies on social networking platforms.

# 3. Methodology

# 3.1 Study steps

The following description outlines the steps for conducting a study during the first quarter of 2023. The study aims to measure the opinions of clients of Egyptian telecom corporations and assess their impressions of these corporations while also determining the corporate image held by clients regarding these corporations. The study employs a questionnaire as the primary data collection tool.

Step 1: Research Design and Objectives: The study begins with formulating research objectives and the design of the research plan. The primary goal is to gather comprehensive insights into client opinions and corporate image based on a literature review.

Step 2: Questionnaire Development: A questionnaire is developed to measure client opinions and corporate image. The questionnaire includes a range of questions designed to gather qualitative data. The questionnaire included content management on social networking pages and the corporate image.

Step 3: Pilot testing: A pilot test is conducted before launching the study. A small sample of clients from the target population is selected to complete the questionnaire. The pilot test aims to identify any potential issues or limitations with the questionnaire, such as confusing questions, response biases, or technical problems. Feedback from the pilot test participants is collected and used to refine and improve the questionnaire.

Step 4: Sampling and participant selection: A sampling strategy is devised to ensure a representative sample. The target population consists of clients of Egyptian telecom corporations. A combination of probability and non-probability sampling methods is used to select participants. The sample size is determined based on statistical considerations to ensure sufficient data analysis power and provide meaningful insights.

Step 5: Data collection: Data collection is conducted during the first quarter of 2023. The questionnaire is administered to the selected participants. The data collection method may vary, including online questionnaires, telephone interviews, and in-person interviews, depending on the preferences and feasibility of the participants. Efforts are made to ensure data integrity, confidentiality, and privacy throughout the process.

Step 6: Data analysis: The collected responses are compiled and analyzed once data collection is completed. Statistical methods such as descriptive statistics, correlation analysis, and regression analysis are used to interpret quantitative data. Thematic analysis is applied to qualitative data to discover overarching themes, feelings, and trends. The findings from the data analysis help address the research objectives and provide insights into client opinions and corporate image.

Step 7: Reporting and presentation of findings: The final step involves preparing a comprehensive report presenting the study's findings. The report includes an executive summary, research methodology, detailed data analysis, key insights, and recommendations. The results are communicated clearly and concisely, supported by graphs, tables, and visual representations to enhance understanding. The report is shared with relevant

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stakeholders, including telecom corporations, to help inform decision-making and improve client satisfaction and corporate image.

This study conducted during the first quarter of 2023 utilizes a questionnaire to measure client opinions and determine the corporate image of Egyptian telecom corporations. Through careful planning, data collection, and analysis, the study aims to provide valuable insights to guide these corporations in enhancing their services, addressing client concerns, and improving overall client experiences.

# 3.2 Study population

Egypt's telecommunications industry has significantly developed over the past few decades. The state-owned Telecom Egypt initially controlled the industry, which provided fixed-line telephone services. However, the sector was liberalized in the early 2000s, and private corporations were allowed to enter the market.

Today, Egypt's telecommunications industry is one of the most developed in the region. The industry is dominated by three major mobile operators: Vodafone Egypt, Orange Egypt, and Etisalat Misr. These operators provide mobile voice and data services to millions of nationwide subscribers. In addition, several smaller mobile virtual network operators offer services on the major operators' networks.

The industry has also seen significant growth in internet and broadband services. Egypt has a relatively high internet penetration rate, with many people accessing the internet through mobile devices. The government has invested in improving the country's internet infrastructure, and several corporations now provide high-speed internet services to businesses and consumers.

Despite this growth, there are still challenges facing the telecommunications industry in Egypt. The industry is heavily regulated, and there have been concerns about the government's control over the industry. In addition, there are issues with network quality, particularly in rural areas. However, overall, the telecommunications industry in Egypt has made significant progress in recent years and is expected to continue to grow.

Egyptian clients in the telecommunications sector exhibit several essential characteristics for corporations operating in this industry to understand. Based on research and market analysis, the following are some of the critical attributes of Egyptian clients in the telecommunications sector:

**Price sensitivity**: Egyptian clients are highly price-sensitive and are often willing to switch operators to save money. As a result, telecom corporations in Egypt often compete on price and offer promotions and discounts to attract and retain clients.

**Preference for prepaid plans**: A large percentage of Egyptian clients prefer to use prepaid plans rather than postpaid plans. This is partly due to the perception that prepaid plans provide greater control over spending.

**High mobile usage**: Egyptian clients are heavy users of mobile phones, with a large percentage of the population using their mobile devices for both voice and data services. This has driven the growth of mobile internet services in the country.

**Importance of client service**: Egyptian clients value client service highly and expect prompt and efficient support from their telecom providers. Corporations that fail to provide exemplary client service may need help to retain clients.

**Regional differences**: There are regional differences in the telecommunications market in Egypt, with different operators dominating different regions. Corporations that can tailor their services to the specific needs of other regions may be more successful.

**Growing demand for digital services**: There is a growing demand for digital services in Egypt, including mobile payments, online shopping, and e-learning. Telecom corporations offering innovative digital services can differentiate themselves (see Figures 1-12).

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The study shows the pages of Egyptian telecom corporations on social media platforms.



Fig. 1. The pages of Orange Egypt on Facebook



Fig. 3. The pages of Telecom Egypt on Facebook



Fig. 7. The pages of Telecom Egypt on Twitter



Fig. 2. The pages of Vodafone Egypt on Facebook



Fig. 4. The pages of Etisalat Egypt on Facebook

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Fig. 8. The pages of Etisalat Egypt on Twitter

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Fig. 11. The pages of Telecom Egypt on Instagram



Fig. 12. The pages of Etisalat Egypt on Instagram

Sources see Appendix B

Overall, understanding the characteristics of Egyptian clients in the telecommunications sector is vital for corporations operating in this industry. Telecom Corporation can improve its competitiveness and grow its market share by tailoring its services to meet clients' specific needs and preferences in Egypt.

# 3.3 Study Questions

The use of social networking pages has witnessed great interest on the part of corporations, which is confirmed by the diversity of pages of the same corporate on more than one social networking platform, which shows us the following questions:

Is there an impact of impression management on the corporate's image?

Does the type of social media platform contribute to building the corporate's image under impression management?

The study can add the following questions:

Does impression management differ between Egyptian telecom corporations?

Is there a difference in the corporate image of the Egyptian telecom industry?

# 3.4 Study Hypotheses

According to the study questions, hypotheses can be formulated as follows

H<sub>1</sub>: Impression management is similar to the social networking pages of Egyptian telecom corporations.

H<sub>2</sub>: The corporate image of Egyptian telecom corporations is the same.

 $H_{3:}$  There is no significant impact of impression management on the corporate image of Egyptian telecom corporations.

H<sub>4:</sub> Social media platforms have no significant contribution to building the corporate image under impression management.

# 3.5 Questionnaire design

The questionnaire was designed from five main sections Section 1: Demographics (optional)

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Section 2: telecom service provider Section 3: social media platform Section 4: Perception of Corporate Image Section 5: Impression Management on Social Networking Pages (see Appendix A).

The questions were prepared based on the previous studies of corporate image (Ali et al., 2020; Brucal et al., 2022), telecommunications corporations (Abd-Elrahman et al., 2020; Abd-Elrahman, 2018; El-Borsaly and Hassan, 2020; Mawgoud and Ali, 2020; and Omar, 2020), and impression management on social networking pages (Gaber and Elsamadicy 2020; Gaber et al., 2021; Lee and Jang, 2019; Oh and LaRose, 2016).

# 3.6 Data Collection

Users were solicited through a Google form survey promoted on various social media channels (primarily Instagram, Twitter, and Facebook). All of the respondents were Egyptian residents. Between January 2023 and March 2023, they were contacted by Google form. Clients that have more than one Egyptian telecom corporate have been excluded. The breakdown of survey takers is seen in Tables 1 and 2.

Table 1. Accepted response						
Description	size	weight				
Total responses	2976	100%				
Client of more than one telecom corporation	2569	86.33%				
Client of one telecom corporation	407	13.67%				

Client of one telecom corporation Facebook Twitter Instagram Total Telecom Egypt - we 43 16 5 64 Vodafone Egypt 39 60 13 112 Orange Egypt 73 44 15 132 Etisalat Misr 2 81 16 99 Total 236 136 407 35

Table 2. Data Collection

# 4. Data analysis and hypothesis testing

# 4.1 Testing the validity and reliability of the questionnaire list.

The purpose of this test is to evaluate the degree of stability and reliability of each axis and its items so that the study can rely on the statistical analysis results of the questionnaire and apply them to the study population. To determine the effectiveness of the questionnaire list, the study can use Cronbach's Alpha, a test that gauges the survey's reliability and stability. According to statistical standards, the value is acknowledged if the desired limits (equal to or greater than 60 per cent) are met to apply the study results to the study population (Sekaran & Bougie, 2016).

As one of the primary statistical methodologies, the reliability coefficient was used to confirm the validity of all measurements. The validity coefficient is equal to the square root of the alpha Cronbach coefficient, and it must be within the required range (at least 60%). According to the preceding data, table (3) will display the analysis of the questionnaire's fundamental variables' dependability and validity.

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Basic Axes of the Questionnaire	Number of statements	Reliability coefficient	Validity Coefficient					
Impression Management	9	0.768	0.838					

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Basic Axes of the Questionnaire	Number of statements	Reliability coefficient	Validity Coefficient
Corporate Image	10	0.950	0.975
All items	19	0.871	0.912

According to Table 3, the value of the validity coefficient at the survey level is 91.2%, which is statistically acceptable. The values of the validity coefficients for the primary vectors of the survey are also statistically acceptable (0.838 and 0.975)—a minimum validity coefficient of 60 per cent.

As shown in Table 3, the value of the reliability coefficient at the survey level is 87.1%, which is statistically acceptable. The values of the reliability coefficients for the survey's primary variables are also statistically acceptable (0.768 and 0.95). The coefficient of reliability exceeds 60%. Consequently, the survey list has high internal consistency and reliability, and the researcher can rely on it to achieve the study's objectives and disseminate the findings.

# 4.2 The First hypothesis test

#### The hypothesis can be studied in the form of null as follows

**H<sub>1</sub>: Impression management is similar to the social networking pages of Egyptian telecom corporations.** The following outputs of inferential statistics to determine the acceptance or rejection of the null hypothesis

 Table 4. Inferential statistic for the similarity test of impression management

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
IMPR	Between Groups	638.983	3	212.994	352.785	.000
	Within Groups	243.312	403	.604		
	Total	882.295	406			

The outputs of the inferential statistical analysis show that the estimated value (F) was 352.785, which is significant at the 1% level, so the study finds differences in impression management between the social networking pages of Egyptian telecom corporations. The study rejects the Null hypothesis and accepts the following alternative hypothesis.

H<sub>1</sub>: There is a significant difference in impression management between the social networking pages of Egyptian telecom corporations.

# 4.3 The Second hypothesis test

The hypothesis can be studied in the form of null as follows

# H<sub>2</sub>: The corporate image of Egyptian telecom corporations is the same.

The following outputs of inferential statistics to determine the acceptance or rejection of the null hypothesis Table 5. Inferential statistics for the similarity test of the corporate image of Egyptian telecom corporations

		Sum of Squares	df	Mean Square	F	Sig.
IMAGE	Between Groups	107.921	3	35.974	1884.201	.000
	Within Groups	7.694	403	1.909E-02		
	Total	115.616	406			

ANOVA

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The outputs of the inferential statistical analysis show that the estimated value (F) was 1884.201, which is significant at the 1% level, so the study finds differences in the corporate image of Egyptian telecom corporations. The study rejects the Null hypothesis and accepts the following alternative hypothesis.

# H<sub>2</sub>: There is a significant difference in the corporate image of Egyptian telecom corporations.

### 4.4 The Third hypothesis test

The hypothesis can be studied in the form of null as follows

# H<sub>3:</sub> There is no significant impact of impression management on the corporate image of Egyptian telecom corporations.

The following outputs of inferential statistics to determine the acceptance or rejection of the null hypothesis

Table 6. Inferential statistics for the impact of impression management on the corporate image

	ANOVA						
		Sum of		Mean			
Model		Squares	df	Square	F	Sig.	
1	Regression	85.977	1	85.977	1174.860	.000 <sup>a</sup>	
	Residual	29.638	405	7.318E-02			
	Total	115.616	406				

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a. Predictors: (Constant), IMPR

b. Dependent Variable: IMAGE

The outputs of the inferential statistical analysis show that the estimated value (F) was 1174.86, which is significant at the 1% level, so the study finds the impact of impression management on corporate image. Table (7) shows the explanatory power of the model.

Table 7. Model summary of the impact of impression management on the corporate image

#### Model Summary

				Std. Error
			Adjusted	of the
Model	R	R Square	R Square	Estimate
1	.862 <sup>a</sup>	.744	.743	.2705

a. Predictors: (Constant), IMPR

Table (7) shows that the change in impression management explains 74.3% of the difference in the corporate image. So, the study rejects the Null hypothesis and accepts the alternative hypothesis.

H<sub>3:</sub> There is a significant impact of impression management on the corporate image of Egyptian telecom corporations.

#### 4.5 The Fourth hypothesis test

The hypothesis can be studied in the form of null as follows

H<sub>4:</sub> Social media platforms have no significant contribution to building the corporate image under impression management.

The following outputs of inferential statistics to determine the acceptance or rejection of the null hypothesis

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Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	85.977	1	85.977	1174.860	.000 <sup>a</sup>
	Residual	29.638	405	7.318E-02		
	Total	115.616	406			
2	Regression	93.251	3	31.084	560.104	.000 <sup>b</sup>
	Residual	22.365	403	5.550E-02		
	Total	115.616	406			

 Table 8. Inferential statistics for the impact of impression management on the corporate image under social media platforms

 ANOVA<sup>c</sup>

a. Predictors: (Constant), IMPR

b. Predictors: (Constant), IMPR, T, I

c. Dependent Variable: IMAGE

The outputs of the inferential statistical analysis show that the estimated value (F) was 560.104, which is significant at the 1% level, so the study finds the impact of impression management on corporate image. Table (9) shows the explanatory power of the model.

Table 9. Model summary of the impact of impression management on the corporate image under social media platforms

				Std. Error
			Adjusted	of the
Model	R	R Square	R Square	Estimate
1	.862 <sup>a</sup>	.744	.743	.2705
2	.898 <sup>b</sup>	.807	.805	.2356

Model Summary

a. Predictors: (Constant), IMPR

b. Predictors: (Constant), IMPR, T, I

Table (7) shows that the change in impression management explains 74.3% of the change in the corporate image. But when adding social media platforms, that explains 80.5% of the difference in the corporate image. So, the study rejects the Null hypothesis and accepts the alternative hypothesis.

# H<sub>4</sub>: Social media platforms significantly contribute to building the corporate image under impression management.

# 4.3 Discussion

Impression management plays a pivotal role in shaping the corporate image of organizations, notably in the current digital age, where social media platforms have become an integral part of communication strategies. Impression management refers to organizations' conscious and strategic efforts to shape and control the perceptions and impressions of their stakeholders. Corporate image, on the other hand, reflects the overall appearance and reputation of a corporate in the minds of its stakeholders. Through careful selection and presentation of information, organizations can influence how they are perceived by the public, clients, and other key stakeholders. Social networking pages have emerged as powerful platforms for impression management, allowing corporate in gene with their audience directly and shape their corporate image. (Hofstede and Hofstede, 2017). Managing Corporate Image on social networks can contribute to entrepreneurship by highlighting the company's benefits to staff, customers, and society (Wagdi and Hasaneen, 2019).

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Telecom corporations employ various impression management techniques on social networking pages to cultivate a favorable corporate image. These techniques include strategically using visual content, such as images and videos, to convey professionalism and innovation. Moreover, carefully crafted messages and narratives highlight the corporate's strengths, achievements, and commitment to client satisfaction. Furthermore, active engagement with clients through timely responses to queries and complaints can enhance the perception of a corporate's responsiveness and client-centric approach (Wang and Yang, 2016).

Effectively implementing impression management strategies on social networking pages can significantly impact the corporate image of telecom corporations. Positive impressions cultivated through these platforms can enhance brand loyalty, attract new clients, and foster a positive reputation in the industry. Conversely, mishandling client queries, negative reviews, or a lack of responsiveness can damage the corporate image and erode client trust. Therefore, telecom corporations must carefully manage their online presence and employ impression management techniques to maintain a positive corporate image. (Liu et al., 2019)

Impression management refers to individuals' conscious or unconscious efforts to control the image they present to others. In contrast, the corporate image refers to a corporate's overall perception and reputation among its stakeholders. Social networking platforms like Facebook, Twitter, and LinkedIn allow corporations to engage with their target audience and manage their corporate image.

A study of the interpretation of the effective contribution of social media platforms in interpreting the company's image can indicate the differences in user characteristics between platforms under impression management for each corporate.

The characteristics of users on different social networks can vary based on the platform's features, target audience, and usage patterns. Here are some critical characteristics of Facebook, Twitter, and Instagram users. Facebook:

- a. Wide Demographic Range: Facebook has a broad user base, appealing to various age groups, from teenagers to older adults.
- b. Personal Connections: Facebook is often used to connect and interact with friends, family members, and acquaintances. Users share personal updates, photos and engage in conversations.
- c. Content Consumption: Facebook users consume various content, including news articles, videos, and shared posts from friends and pages they follow.
- d. Longer-form Communication: Unlike other platforms, Facebook allows for longer and more detailed posts, facilitating in-depth discussions and information sharing.

Twitter:

- a. Real-Time Updates: Twitter is known for its fast-paced and real-time nature. Users often engage in discussions around trending topics, news, and events as they unfold.
- b. Concise Messaging: With a character limit of 280 characters (previously 140 characters), Twitter encourages users to share short messages or thoughts.
- c. Hashtags and Trending Topics: Twitter is famous for using hashtags, which categorize and group tweets around specific topics or events. Users can engage with trending topics to join conversations and discover content.
- d. Public Conversations: Unlike Facebook, Twitter is a more open platform where conversations are often visible. Users can follow and interact with accounts even without a direct connection.

Instagram:

a. Visual Focus: Instagram is primarily a platform for sharing and consuming visual content, including photos and videos. Users can edit and enhance their visuals using filters and other editing tools.

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- b. Younger User Base: Instagram attracts a younger demographic, particularly teenagers and young adults.
- c. Influencer Culture: Instagram has a prominent influencer culture, where users follow and engage with popular accounts that showcase lifestyles, fashion, travel, and other aspirational content.
- d. Storytelling and Behind-the-Scenes: Instagram's Stories feature allows users to share brief content that disappears after 24 hours. Users often utilize this feature to provide glimpses into their daily lives or share in-the-moment updates.

It's important to note that these characteristics can overlap, and users on each platform may exhibit diverse behaviors and interests. Additionally, social media platforms evolve, user characteristics may shift as new features are introduced, and user demographics change.

# 5. Conclusion and Recommendations

# 5.1 Conclusion

Social networking pages offer companies an invaluable platform to build and shape their corporate image. Through increased visibility, direct communication, brand building, reputation management, and customer relationship building, companies can enhance their appearance, build trust, and foster positive stakeholder perceptions.

According to the statistical analysis, there is a difference in impression management practices and corporate image in the Egyptian telecommunications industry. Social media platforms significantly contribute to building the corporate image under impression management. The change in impression management explains 74.3% of the change in the corporate image. But adding social media platforms explains 80.5% of the change in the corporate image.

A study of the interpretation of the effective contribution of social media platforms in interpreting the company's image can indicate the differences in user characteristics between platforms under Impression management for each corporate.

# **5.2 Study limitations**

The study's limitations can be summarized in that its scope was in one country, which requires re-testing in other business environments. In addition, it was limited to one industry, which is the telecommunications services industry. We recommend re-testing in different industries and adding other platforms like TikTok (Harriger et al., 2023)

# 5.3 Recommendations

# **5.3.1 Recommendations for Telecom corporations**

Managing impressions on social networking pages is a powerful tool for strengthening the corporate image of a corporate. The study makes the following recommendations:

Consistent branding: maintain consistent branding across all social networking pages. Use the corporate's logo, color scheme, and visual elements that reflect the brand identity. Consistency helps to create a recognizable and professional image.

Engaging content: develop and share high-quality, exciting content that aligns with the corporate's values and target audience. This can include informative articles, industry news, relevant videos, and eye-catching visuals. Focus on providing value to the audience and encouraging interaction and discussion.

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Customer-centric approach: demonstrate a customer-centric approach by engaging with followers on social networking pages. Respond promptly and courteously to comments, questions, and concerns. Show empathy, address issues, and provide helpful solutions. This helps build trust and a positive image of the corporate's commitment to customer satisfaction.

Showcasing success stories: highlight success stories, testimonials, and positive experiences of customers or clients. Share their feedback, reviews, or case studies to showcase the corporate's achievements and the value it brings to its stakeholders. This helps build credibility and enhances the corporate image.

Transparent Communication: Promote transparency by sharing information about corporate initiatives, corporate social responsibility efforts, and other relevant updates. Communicate openly about corporate values, ethical practices, and sustainability initiatives. Transparent communication fosters trust and portrays the corporate in a positive light.

Influencer collaborations: collaborate with relevant influencers or industry experts to expand the reach and impact of social networking pages. Partnering with influencers who align with the corporate's values can help increase brand awareness and credibility. Influencers can endorse the corporate's products or services, share content, and engage with their followers on behalf of the corporate.

Monitor and respond to feedback: regularly monitor social networking pages for positive and negative feedback. Acknowledge and appreciate the positive feedback and promptly address any negative feedback or complaints. Show genuine concern, take necessary actions to resolve issues, and provide updates on the actions taken. This demonstrates the corporate's commitment to customer satisfaction and continuous improvement.

Continuous evaluation and improvement: regularly evaluate the performance of social networking pages through analytics and feedback. Analyze engagement metrics, reach, and audience demographics to gain insights into what content resonates best with the audience. Use these insights to refine the social media strategy, improve content quality, and optimize the impact on corporate image.

By implementing these recommendations, a corporate can effectively manage impressions on social networking pages, strengthen its corporate image, and cultivate a positive perception among its audience and stakeholders.

# **5.2.2 Recommendations for future studies**

The study suggests the following areas as future studies.

Longitudinal study: conduct a longitudinal study to examine the long-term effects of impression management on corporate image through social networking pages. This would involve tracking and analyzing the changes in corporate image over an extended period, considering factors such as content strategies, engagement levels, and stakeholder perceptions.

Comparative analysis: perform a comparative study of different industries or corporations within the same industry to understand how impression management strategies on social networking pages vary and their impact on corporate image. This could shed light on industry-specific best practices and provide insights into the factors influencing corporate image across different contexts.

Cross-cultural study: conduct a cross-cultural study to explore how impression management strategies on social networking pages impact corporate image in different cultural contexts. Investigate the role of cultural values, norms, and expectations in shaping stakeholders' perceptions and responses to impression management efforts. This could help corporation tailor their strategies for different cultural audiences.

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Impact on stakeholder relationships: examine the impact of impression management on stakeholder relationships, such as customer loyalty, investor confidence, and employee engagement. Investigate how impression management strategies on social networking pages influence stakeholders' trust, commitment, and willingness to engage with the corporate. This could provide insights into the broader implications of corporate image management.

Mediating and moderating factors: explore the mediating and moderating factors influencing the relationship between impression management on social networking pages and corporate image. For example, factors such as corporate size, industry reputation, social media platform preferences, and stakeholder demographics could impact the effectiveness of impression management efforts. Identifying these factors can help refine impression management strategies.

Employee advocacy: investigate the role of employee advocacy and personal branding on social networking pages in shaping corporate image. Explore how employees' activities and representation of the corporate on social media platforms influence stakeholders' perceptions. Understanding the interplay between employee advocacy and corporate image can help corporation leverage their employees as brand ambassadors.

Crisis communication: examine the role of impression management on social networking pages during a crisis or reputation-threatening events. Investigate how corporations use social media platforms to manage and restore their corporate image in the face of negative publicity or problems. This research can provide insights into effective crisis communication strategies.

Comparative platform analysis: compare the effectiveness of impression management strategies on different social media platforms in shaping corporate image. Analyze the unique features, functionalities, and user demographics of platforms such as Facebook, Twitter, LinkedIn, or Instagram, and assess how they influence the impact of impression management efforts.

By addressing these recommendations, future studies can contribute to understanding of the relationship between impression management on social networking pages and corporate image, providing valuable insights for corporations aiming to optimize their online presence and reputation management strategies.

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#### Appendix A. Questionnaire

#### Section 1: Demographics (optional)

Gender: Male / Female Age: \_\_\_\_\_\_ Educational Background: \_\_\_\_\_ Employment Status: Employed / Unemployed / Student / Other (please specify)

0

#### Section 2: your telecom service provider

I have more than one telecom service provider (thank you \_please do not complete the questionnaire) I only have one telecom service provider (please complete the questionnaire) Select your telecom service provider now

- Telecom Egypt we
- Vodafone Egypt
- Orange Egypt
- Etisalat Misr

#### Section 3: Social media platform

Select the preferred social media platform to follow your service provider

- Facebook
- o Twitter
- o Instagram

#### Section 4: Perception of Corporate Image

Please rate your perception of the following statements about the corporate image of your telecom service provider on a scale of 1 to 5, where 1 = strongly disagree and 5 = strongly agree.

- 1. your telecom service provider has a strong and recognizable brand identity.
- 2. your telecom service provider is known for providing reliable and high-quality services.

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- 3. your telecom service provider has a positive reputation in terms of customer satisfaction.
- 4. your telecom service provider is perceived as innovative and technologically advanced.
- 5. your telecom service provider is actively involved in corporate social responsibility initiatives.
- 6. your telecom service provider has effective communication strategies with their customers.
- 7. your telecom service provider has a positive corporate culture that reflects their values and ethics.
- 8. your telecom service provider is responsive to customer feedback and concerns.
- 9. your telecom service provider has a positive overall performance in the industry.

#### Section 5: Impression Management on Social Networking Pages

- Please rate your agreement with the following statements about the impression management practices of Egyptian telecom corporation on their social networking pages on a scale of 1 to 5, where 1 = strongly disagree and 5 = strongly agree.
  - 10. Your telecom service provider uses visually appealing and engaging content on their social networking pages.
  - 11. Your telecom service provider presents themselves as innovative and technologically advanced on their social networking pages.
  - 12. Your telecom service provider effectively communicates their brand identity and values on their social networking pages.
  - 13. Your telecom service provider responds promptly and professionally to customer inquiries and comments on their social networking pages.
  - 14. Your telecom service provider showcases positive customer testimonials and feedback on their social networking pages.
  - 15. Your telecom service provider actively promotes their corporate social responsibility initiatives on their social networking pages.
  - 16. Your telecom service provider strategically manages their online reputation by addressing and managing negative comments or reviews on their social networking pages.
  - 17. Your telecom service provider regularly updates and provide relevant and useful information to their followers on their social networking pages.
  - 18. Your telecom service provider uses social networking pages as a platform for engaging in two-way communication with their customers.
  - 19. Your telecom service provider maintains a consistent and cohesive brand image across their various social networking pages.

# Thank you for participating in this survey! Your responses will contribute to our understanding of the impression management practices on social networking pages of the Egyptian telecom industry.

#### Appendix B. Social Networking Pages of Egyptian Telecom Industry

	Facebook	
Orange Egypt		https://www.facebook.com/OrangeEgyptOfficial
Vodafone Egypt		https://www.facebook.com/Vodafone.Egypt
Telecom Egypt - WE		https://www.facebook.com/TelecomEgypt
EtisalatMisr		https://www.facebook.com/profile.php?id=100064818815083
	Twitter	
Orange Egypt		https://twitter.com/Orange_Egypt
Vodafone Egypt		https://twitter.com/VodafoneEgypt
Telecom Egypt - WE		https://twitter.com/telecomegypt
Etisalat Misr		https://twitter.com/EtisalatEgypt
	Instagram	
Orange Egypt	-	https://www.instagram.com/orange_egypt
Vodafone Egypt		https://www.instagram.com/vodafoneegypt
Telecom Egypt - WE		https://www.instagram.com/telecom.egypt
Etisalat Misr		https://www.instagram.com/etisalategypt

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#### Shereen ALY HUSSIEN ALY ABDOU ORCID ID: <u>https://orcid.org/0000-0002-7480-5456</u>

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Clarivate Analytics

# INTEGRATED ACCEPTANCE MODEL FOR ON-DEMAND CAR FUNCTIONS: EXPLORING DETERMINANTS OF DRIVERS' ACCEPTANCE

Tom Gräsner<sup>1</sup>, Roland Vogt<sup>2</sup>

<sup>1</sup>Universidad Católica San Antonio de Murcia (UCAM), Avda. de los Jerónimos, 135, 30107 - Guadalupe (Murcia), Spain <sup>2</sup>FOM University of Applied Sciences, Herkulesstr. 32, 45127 Essen, Germany

*E-mails:* <sup>1</sup>tom.graesner@fom-net.de (Corresponding author); <sup>2</sup>roland.vogt@fom.de

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**Abstract.** This research paper investigates the factors influencing drivers' acceptance of on-demand car functions (ODCFs) and proposes an integrated acceptance model specific to the ODCFs context. While limited marketing research has explored consumer responses to ODCFs, understanding the determinants of consumers' intention to accept ODCFs is crucial. Existing acceptance models, although effective in explaining variances in consumer behavior, need to be adapted and extended to enhance explanatory power in individual contexts. To address this gap, a comprehensive literature review on ODCFs and related domains was conducted, identifying 74 acceptance factors. Drawing upon the Unified Theory of Acceptance model tailored to the ODCFs context was developed. At the meso-level, the baseline model incorporates factors such as exposure to ODCFs, domain-specific, symbolic-affective, and moral-normative factors. The micro-level pertains to distinct individual variance components, encompassing socio-demographic attributes, travel behavioral patterns, personality dispositions, and technological inclinations. These micro-level determinants exert a discernible influence on the factors situated at the meso-level of analysis. A partial model that considers cross-level influences and advocates for multi-level research to examine the contextual factors' impacts on acceptance empirically is proposed to operationalize the model. By adopting this approach, researchers can gain deeper insights into the acceptance of ODCFs and shed light on the mechanisms underlying consumer behavior in this specific context.

Keywords: On-demand car functions; acceptance model; UTAUT; CTAM; contextual factors; multi-level research

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JEL Classifications: M31, O33, Z13

#### 1. Introduction

Recently, automotive manufacturers like Tesla or Mercedes-Benz have transformed their firms from a product- to a service-centric approach and evolved their vehicles into dynamic service platforms by selling vehicles with built-in add-on features (e.g., adaptive headlights, restricted battery power) that are deliberately restricted by design in their function (Raddats et al., 2019; Garbas et al., 2022; Ng & Wakenshaw, 2017). Similarly, other

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manufacturers offer temporary access to features such as heated seats in return for subscription fees (Schaefers et al., 2022). Hence, customers can reconfigure their cars for an additional fee by activating those features throughout their ownership (Garbas et al., 2022). A recent study refers to this phenomenon as "on-demand features". It defines it for the first time as "services that allow customers to temporarily access certain features of a product for an additional fee after the initial purchase has been made" (Schaefers et al., 2022, p. 752). However, in practice, the manufacturers' offering is not restricted to temporary access because the features can be activated permanently, too. This is why this present paper will follow the definition of another study which refers to the same concept as "internal product upgrades" but defines it as "fee-based activation of originally built-in, but deliberately restricted, optional features" (Garbas et al., 2022, n. p.).

ODCFs offer promising benefits for both the customers as well as the manufacturers: Manufacturers generate additional and recurring (in the case of temporary access) revenues by selling ODCFs while holding on to their ownership-centric business model (i.e., selling cars) (Schaefers et al., 2022). Manufacturers are expected to earn an additional 155 billion  $\in$  in 2022 by offering consumers the opportunity to enhance their vehicles over their lifetime. Moreover, manufacturers can reduce production costs by realizing economies of scale by producing cars with identical features (Garbas et al., 2022).

Customers can unlock and access certain features for a limited time, reacting to a temporary change in their needs because they may not always need it while owning the car (Schaefers et al., 2022). For instance, additional horsepower is an ODCF technically feasible with an electric vehicle. In an environment where speed limits are absent, prioritizing timely traversal and driving gratification, motorists aspire to accelerate beyond their vehicle's existing technical constraints. This underscores a driver's inclination to invest additional horsepower, potentially tethered to the temporal extent remaining within the ongoing expedition (Petry & Moormann, 2020). Consequently, reserving and selectively disengaging systems on an as-needed basis could empower drivers to harness the technological advantages they require precisely when and where they are most opportune (Stiegemeier et al., 2022).

Conversely, ODCFs might elicit unfavorable responses among consumers due to the necessity of incurring charges for expanded functionalities of items they already possess. In a market report, 31% of respondents agreed to the advantages of ODCFs (customizing the car to individual needs); however, at the same time, 35% agreed that it is outrageous to install useful functions in cars without activating them for the customer (Schaefers et al., 2022). The most recent studies found similar results: Wiegand & Imschloss (2021) show that ODCF may induce consumer rejection and feelings of being cheated because consumers perceive pre-installed functions as value included in the price paid, not as options added by the manufacturer (Wiegand & Imschloss, 2021). Schaefers et al. (2022) identified two critical characteristics of ODCFs: tangibility and pricing structure. Regarding tangibility, their results show that while intangible (software-based, e.g. intelligent voice assistant) ODCFs find acceptance, consumers perceive on-demand access to tangible (hardware-based, e.g. seat heating) features as unfair, which explains their reduced purchase intent. Regarding pricing structure, their investigation reveals that fairness perceptions and subsequent behavioral intentions lean more favorably towards ODCFs characterized by flat rate pricing, in contrast to those adopting a pay-per-use pricing framework (Schaefers et al., 2022). In line with these findings, Garbas et al. (2022) show that customer-perceived betraval drives consumers to respond less favorably to internal (i.e., the feature is already built-in to the product the consumer has purchased, but it is deliberately restricted) vs external (i.e., the feature is physically detached and sold separately from the base product) product upgrades (Garbas et al., 2022).

Little marketing research has examined how consumers respond to ODCFs (Garbas et al., 2022) and consumer reactions to ODCFs have not been examined (Schaefers et al., 2022). Hence, there is a need to understand distinct consumer responses and identify potential variables which might outweigh (e.g., increased flexibility) or increase (e.g., increased complexity) the negative customer perceptions (Garbas et al., 2022). In the same direction, recent

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surveys in related contexts have shown that the consumers' intention to accept or purchase Internet-of-Vehicle (IoV) based services is generally low. Therefore, it is significant to explore the determinants of consumers' intention to accept and purchase IoV-based services (Liang et al., 2020). "A successful real-world deployment of innovative CV applications not only depends on their maturity and usability, but also hinges upon user acceptance" (Li et al., 2021, p. 1). Acceptance is a key factor for the successful introduction and intended use of new technology in the vehicle context. Driver's acceptance is the precondition for new automotive technologies to achieve their forecasted benefits. A requisite inquiry pertains to assessing drivers' propensity to embrace and engage novel technologies per their intended functionalities (Najm et al., 2006). Nonetheless, the question of how the general acceptance of in-vehicle technology is cultivated lacks a distinct and conclusive answer, as does identifying the most predictive combination of variables across a spectrum of distinct systems (Stiegemeier et al., 2022). Hence, future studies can further explore factors influencing consumers' acceptance of innovations in the automotive context (Chen, 2019). In the context of systems for the driver, acceptance is "the degree to which an individual intends to use a system and, when available, incorporate the system in his/her driving" (Adell, 2010, p. 482). Since there are considerable reservations about ODCFs from the end-user perspective (i.e., unfairness, betraval), and this innovative technology has vet to be introduced to the market on a mass scale, understanding end-user (i.e., driver's) intentions and attitudes toward ODCFs is crucial if this technological innovation is supposed to be successful. Thus, a thorough comprehension of the constituent elements that shape drivers' inclination toward acceptance bears the potential to drive the success of this technology within the market.

The research objective of this paper is twofold. Firstly, studies in related contexts such as autonomous driving, electric vehicles, driver support systems, and connected vehicles have recognized the need for research into factors that determine drivers' acceptance (Adell, 2010; Adnan et al., 2018; Hanesch et al., 2022; C. Lee et al., 2017; Nordhoff et al., 2018; Osswald et al., 2012; Panagiotopoulos & Dimitrakopoulos, 2018; Seeger & Bick, 2013: Souders & Charness, 2016: Svangren et al., 2017; Xu et al., 2018). However, there is only limited research available on determinants of drivers' acceptance of ODCFs (e.g., Garbas et al., 2022; Ma et al., 2015; Schaefers et al., 2022; Wiegand & Imschloss, 2021), but it is crucial to understand adoption criteria to ensure their usage and thereby create additional value for customers (Juehling et al., 2010). At the same time, the authors call for more research on the interrelation between relevant factors and behavioral outcomes. Hence, there exists a requirement for research aimed at elucidating the intricate interplay between pertinent factors influencing acceptance and corresponding behavioral intentions, leveraging established behavioral models for comprehensive analysis (Nastjuk et al., 2020). The second research objective is connected to behavioral models: Individuals' acceptance and use of information technology have been extensively studied within information systems research. Various theoretical models, drawing from psychological and sociological theories, have been employed to explain the adoption and usage of technology (Venkatesh et al., 2016). Among these, the Unified Theory of Acceptance and Use of Technology (UTAUT), developed through the synthesis of eight technology use models, has emerged as a significant framework to predict behavioral intentions and technology adoption, particularly in organizational contexts (Venkatesh et al., 2003). Nonetheless, a comprehensive examination of factors applicable to consumer technology use contexts is still needed, and recent research has highlighted the importance of context-specific theories to augment the overall understanding and theoretical expansion. Addressing this need, UTAUT2 was devised, enriching UTAUT with additional constructs and relationships tailored to consumer contexts, leading to substantial improvements in explaining variance in behavioral intention (56 percent to 74 percent) and technology use (40 percent to 52 percent) (Venkatesh et al., 2012). The extensive citation count of the original UTAUT and UTAUT2 papers underscores their widespread influence, with thousands of studies conducted in the area (Blut et al., 2022; Venkatesh et al., 2016). Even though established models like the UTAUT2 which has been tailored to the consumer context and proven to explain large portions of the variance in behavioral intention in related contexts such as automated vehicles (Madigan et al., 2017), the literature calls for specific acceptance models related to the individual context: "there is not just one UTAUT specification with a universal set of predictors that applies to all contexts. Instead, the theory's ability to predict technology use depends on the specific context." (Blut et al., 2022, p. 53). Other studies formulate that the model needs to be modified and extended to improve the

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model's explanatory power and specificity (Chen, 2019). Thus, an integrated acceptance model is required in order to include relevant factors in the specific context of ODCFs.

To address the research gaps and overcome the limitations mentioned above, the following sections aim to explore the acceptance of ODCFs by identifying potential factors influencing acceptance from an end-user perspective and developing an integrated acceptance model for the context of ODCFs. The remainder of this paper is structured as follows. Section 2 discusses the current research on the acceptance of ODCFs and related contexts to identify potentially relevant determinants for drivers' acceptance of ODCFs. Section 3 describes the methodology to derive the acceptance model based on the previous literature review. Section 4 introduces the integrated acceptance model and provides the rationale behind its structure. It comprehensively clarifies the model's meso-level construct, which intricately encompasses the primary influences arising from domain-specific instrumental, symbolic-affective, and moral-normative factors. This is complemented by the model's micro-level, which brings together individual variations in acceptance factors. Section 5 presents concluding remarks and highlights potential implications for future research.

# 2. Literature review & theoretical basis

# 2.1 Models of technology acceptance

Various prominent models, each characterized by a distinct array of determinants shaping acceptance, have been conceived to elucidate the patterns underlying individuals' embracement and utilization of pioneering technology. For example the Theory of Reasoned Action (TRA) (Fishbein & Ajzen, 1975), technology acceptance model (TAM) (Davis, 1989), theory of planned behavior (TPB) (Ajzen, 1991), task-technology fit (TTF) (Goodhue & Thompson, 1995), motivational model (MM) (Davis et al., 1992), unified theory of acceptance and use of technology (UTAUT) (Venkatesh et al., 2003, 2012), initial trust model (ITM) (McKnight et al., 2002), diffusion of innovation theory (IDT) (Rogers, 2010), and social cognitive theory (SCT) (Compeau et al., 1999). Numerous investigations have employed these frameworks in their original form or augmented them with novel constructs, resulting in the formulation of models that serve as conduits for their research endeavors across diverse technological contexts (Liang et al., 2020). Nonetheless, within context-specific investigations concerning acceptance, two models frequently assume foundational roles (Lee et al., 2003) and are concisely elucidated in the ensuing discussion. The first model is the TAM, proposed by Davis in 1985, which pertains to the general acceptance of information technology. Within the framework of TAM, the adoption of technology is contingent upon individuals' perception of its Perceived Usefulness (PU) and Perceived Ease of Use (PEoU) (Davis, 1985).

The second model is UTAUT which was introduced by Venkatesh et al. in 2003, consolidating insights from multiple theories, such as the TAM (Davis, 1985), the TPB (Ajzen, 1991), and the MM (Davis et al., 1992). In its original formulation, UTAUT (Venkatesh et al., 2003) posits that technology acceptance is contingent upon several key constructs, including Performance Expectancy, Effort Expectancy, Social Influences, and Facilitating Conditions. Furthermore, the UTAUT model hypothesizes that the influence of these factors is moderated by variables such as gender, age, experience, and voluntariness of use (Venkatesh et al., 2003). Subsequent adaptations of the UTAUT framework, such as UTAUT2, expanded its scope by incorporating three explicitly proposed variables important in the consumer context, i.e., hedonic motivation, price value, and habit (Venkatesh et al., 2012). As a result, the UTAUT has risen as a resilient and impactful framework for investigating factors that underpin the adoption of technology at the individual level. Moreover, its application has been widespread in the realm of comprehending individuals' endorsement of a range of novel information technology innovations (Liang et al., 2020). In a recent research endeavor following the UTAUT framework, scholars have developed a contemporary and refined version of UTAUT, characterized by an expansion beyond the original theory. This augmentation incorporates novel endogenous mechanisms gleaned from disparate theoretical perspectives, such as technology compatibility, user education, personal innovativeness, and technology costs. Furthermore, the study introduces new moderating mechanisms to investigate the applicability of UTAUT across diverse contextual

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domains, including variations in technology types and national cultural contexts (Blut et al., 2022). Notably, the newly introduced predictors predominantly pertain to users and their circumstances. These findings substantively contribute to the ongoing discourse surrounding the contrast between user-centric technology design and the judicious selection of appropriate users (Blut et al., 2022). ODCFs, as the context of this paper, are also (end-) user-oriented (i.e. the driver). Several studies in related contexts of ODCFs highlight the importance of user-orientation: "results emphasize the importance of user-centered design" (Stiegemeier et al., 2022, p. 79), "distinct consumer responses, which marketers need to understand" (Garbas et al., 2022, n. p.), "to meet customer expectations, the automotive industry will have to change its perspective from product orientation further ("inside-out perspective") to customer orientation ("outside-in perspective")" (Petry & Moormann, 2020, p. 65).

TAM and, specifically, UTAUT can serve as valid starting points to explore drivers' acceptance of ODCFs. Nevertheless, the existing models are not exhaustive in their scope, suggesting the potential for heightened efficacy through additional elucidations and refinements within the framework delineating the pertinent factors that influence technology acceptance within the vehicle context (Stiegemeier et al., 2022). Hence, relevant influencing factors should be identified and extracted from research about specifically ODCFs and related contexts in the next step.

# 2.2 Influencing factors of technology acceptance towards ODCFs

Many research studies have employed theories of technology adoption to investigate the factors influencing consumers' intention to accept and purchase. Table 1 provides a comprehensive overview of previous studies in related contexts based on a theoretical perspective of technology acceptance. Table 2 summarizes the initial research investigating ODCFs. For example, an antecedent study by Wiegand & Imschloss (2021) explored the fluctuations in consumers' attitudes and purchase intentions concerning the foundational product within the preliminary purchasing phase. The investigation contrasted internal product enhancements marketed as permanent acquisitions through a single upfront payment against those accessible temporarily through rental arrangements (Wiegand & Imschloss, 2021).

In contrast, Schaefers et al. (2022) shifted the focus to the post-purchase phase. They investigated consumers' purchase intentions for non-permanent internal product upgrades, considering the tangibility of the feature (tangible vs intangible) and the pricing structure (monthly subscription vs pay-per-use) (Schaefers et al., 2022). These prior studies offer valuable insights into the context of ODCFs, but they do not provide an acceptance model nor explain the relevant acceptance criteria of ODCFs. As shown in Table 1, previous studies have sought to explain the acceptance of related contexts to ODCFs, such as IoV services, autonomous driving, in-vehicle services, or telematics.

References	Theory	Research context related to ODCFs	Method (data collection and analysis)	Key findings
(Liang et al., 2020)	UTAUT2	Internet of Vehicles Services	Online survey (362 Chinese customers) and PLS-SEM and fcQCA	PE, PV, HA, and TR have significant effects on BI to accept IoV services, and other determinants, e.g., EE, SI, FC, HM, and PR, have no significant effect.
(Nastjuk et al., 2020)	TAM	Autonomous driving	Semi-constructed end-user interviews (20 participants), and online survey (316 participants), and PLS	SN can be a significant factor affecting PU; TR is positively related to UI, PIN predicts PU and PEOU, which in turn, positively affects AT, a significant predictor of UI, RA, and CO positively influence AT and PU, CO positively affects UI

#### Table 1. Studies on technology acceptance in related contexts of ODCFs

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(Nordhoff et al., 2020)	UTAUT2	Conditionally automated (L3) cars	Online questionnaire in eight European countries (9118 participants), confirmatory factor analysis, and structural model consisting of the path relationships (MLE)	HM emerged as the most robust predictor of BI concerning the conditional utilization of automated vehicles. Subsequently, SI and PE exhibited notable predictive power. Age, gender, and familiarity with advanced driver assistance systems yielded statistically significant effects, but with modest magnitudes, below 0.10.
(Garidis et al., 2020)	UTAUT2	Autonomous driving	An online survey in Germany (470 participants) and PLS-SEM	SA has the strongest positive effect followed by HM; DC has the strongest negative effects; Significant positive effects were found for EE, SI, PV, SA, and SDP; PE did not have a significant effect on BI; LDP, EF, and LR also without significant effects
(Walter & Abendroth, 2020)	TAM	Connected vehicular services	The simulator study incl. an online survey (116 participants) and partial least squares (PLS) structural equation modeling	PB enhances a positive AT towards using the connected service; no direct influence of PU on usage adoption; PEOU affects PU but does not affect usage; SN affects UI; Significant positive effect of PRC on PPR and a significant negative effect on TR; TR neither had a significant positive effect on UI, nor a significant negative effect on PPR, an indirect effect of PIC on PR mediated by PRC; PIC lowers PRC, which in turn reduced PPR
(Kim et al., 2016)	TAM	In-vehicle infotainment systems	An online survey in Korea (1070 participants) and PLS	<ul> <li>PSE did not have a significant impact on PC and PR but a significant negative impact on PU; TG are important determinant of the perceptions that lead to resistance towards in-vehicle infotainment; SN affects PU, PC, and PR; Relationship between resistance variables (i.e., PU, PC, and PR) and adoption confirmed; PR had the most significant impact on resistance to IVI systems</li> </ul>
(Cho et al., 2017)	UTAUT and CTAM	Autonomous vehicles	Driving simulator (68 participants) and PLS	TR caused a significant effect on BI; SA and AX caused a statistically significant effect on BI; AS showed a large number of T statistics, indicating its significant effect on BI; EE caused no statistically significant effect on BI
(Kim et al., 2019)	TAM	On-demand automobile-related services	An online survey in South Korea (318 participants) and multi-group analysis for structural equation modeling	PEOU and PU positively correlated with AT, which in turn positively affected BI; variables for each service are significantly different depending on the characteristics of the service; RA had a significantly positive effect on PU; AC had a positive value for PU and PEOU; PPER not statistically significant in every service; SA significant in medium level service but no significant impact for low- and high-level services
(Leicht et al., 2018)	UTAUT	Autonomous car	Online survey in France (241 participants) and Sem and multi- group analysis	PE, EE, and SI are positively related to the PI of autonomous cars; CI introduces a moderating impact on the connections linking various precursors to the adoption of autonomous vehicles, and PI attributed to these vehicles; This moderation notably gains greater prominence when CI is at elevated levels as opposed to instances where CI registers lower values
(Chen, 2019)	TAM-TTF	Telematics	A survey in Taiwan (400 participants) and PLS	PU and PEOU affect adoption intention; The impact of technology characteristics exhibited a more pronounced influence on TTF compared to the effects attributed to task characteristics; individual perceptions about EN and UQ also exert substantial effects on PU and PEOU; A performance gap negatively affects PEOU; PIN has a positive impact on PEOU, particularly for those with shorter driving experience; PU influences adoption intentions, but its impact may be hindered by driving experience

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(Adell, 2010)	UTAUT	Driver support systems	Pilot test (20 inhabitants) and linear regression analysis	The importance of SI for BI was highlighted, but no significance of EE; traffic safety related to all constructs due to fundamental importance for driver, passengers, and authority
(Razak et al., 2022)	TAM	In-vehicle applications	308 responses among Malaysians and linear and non- linear regression analysis	factors such as knowledge about in-vehicle applications can significantly affect TR and SI, AT and UI; an informed choice becomes attainable for the user when they possess a comprehensive awareness of both the benefits and constraints inherent to the applications in question; gender and driving experience have a moderating effect on the BI; Neither age nor gender wield a substantial impact on user acceptance, as indicated by the absence of significant effects; the frequency of weekly driving or accumulated driving experience fails to exert a noticeable influence on user acceptance levels; TR, SC, and SI may also influence the PU and PEOU, which in turn positively affects AT toward using an in-vehicle application, a significant predictor of UI
(Yoon & Cho, 2016)	ТАМ	Smart car service	Web survey in South Korea (427 respondents) and structural equation model (SEM)	CO of user experience with existing technologies is a critical factor affecting consumer evaluations of a convergence service; TTF is a significant positive factor mediating the effect of PU and EN on adoption intention; Visual design positively influences user's perception and adoption intention
(Yu & Cai, 2022)	TPB and TRA	Intelligent connected vehicles	An online survey in China (500 respondents) and SEM	PSR and PPR have negative effects on TR; the data breach anxiety positively influences PPR; TR can directly affect AT and BI; BI is influenced by the factors of PSR, PPR, trust, and AT
(Vafaei-Zadeh et al., 2021)	C-TAM- TPB and UTAUT2	Car Dashcam	Structured digital questionnaires (232 respondents) and PLS	No relationship between PI and PU was found, in contrast to a significant relationship between the former and PEOU; perceived uniqueness was found significant to both PU and PEOU; both PU and PEOU were identified as factors influencing AT; PU did not affect intention; PBC, SI, AT, and TR significantly affected the BI to use the dashcam
(Park et al., 2013)	UTAUT	Smartphone-car connectivity	Online survey (1070 respondents) and PLS	FC and TG positively affect BI to use car connectivity functionality; mobile literacy and PSE have no significant relationship
(Noraga et al., 2021)	UTAUT2	On-demand services application	296 respondents and SEM	PE, EE, HA, and immediacy positively influenced the intention to use on-demand services applications; HA negatively moderated the intention to use on-demand services applications
(Chan & Lee, 2021)	TAM and UTAUT	5G Connected Autonomous Vehicle	An online questionnaire (211 participants in Malaysia) and PLS- SEM	CO and PIN were found to have a positive influence on BI; TR exhibits a strong direct effect on BI; PU, PEOU, and SI were found to have no relationship with BI, but relationships partially mediated by TR
(Yeap et al., 2017)	UTAUT2 and DOI	On-Demand Services (e.g. UBER)	Survey (330 respondents) and PLS	SI, Personalization, and PR with substantial influence on adoption decisions; adoption intentions will strongly result in intentions to recommend the technology to others; immediacy, EE, FC, HM, PV, and PE were found to have no impact on ODS adoption
(Panagiotopoulos & Dimitrakopoulos, 2018)	TAM	Autonomous driving	Web-based questionnaire (483 respondents) and Pearson product- moment inter- correlations and multiple regression analyses (MRAs)	PU, PEOU, TR, and SI impact on intention to use Avs; TR also had a positive impact on BI; SI also had a positive impact on BI; SI and TR constructs have a negative interaction; PEOU seems to have the more minor influence on the attitudes of consumers towards the use of AVs

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(Abd Aziz, 2016)	CTAM	New Car Technologies	Questionnaire and PLS	Brand service quality has a strong direct positive effect on brand loyalty; technology anxiety moderates the relationship between brand service quality, brand value, and brand loyalty
(Hanesch et al., 2022)	UTAUT	Connected car services	Survey (260 respondents) and PLS-SEM	Age, gender, and technical affinity show moderating effect just for one relation significantly; Risk tolerance has emerged as a prevalent moderator, demonstrating its potential as a promising criterion for gauging usage intentions concerning connected car services; risk tolerance indicated a dampening effect on the relation of SI on BI; risk tolerance for activities on the Internet seemed to strengthen the relation of PE and BI; Experience also indicated an influencing effect strengthen the positive relation of SI and BI
(Osswald et al., 2012)	UTAUT (CTAM)	Information technology in the car	Questionnaire (21 subjects) and internal reliabilities (Cronbach's a)	The proposed scales exhibit strong internal consistency, and the outcomes suggest that participants demonstrate an awareness of the influences related to safety and anxiety when engaging with information technology during driving scenarios; low values for FC
(Nordhoff et al., 2019)	UTAUT3 + CTAM	Automated vehicle	Literature review (124 records)	<ul> <li>28 acceptance factors that represent seven main acceptance classes; 6% exposure of individuals; 22% domain-specific;</li> <li>4% symbolic-affective factors; 12% moral-normative factors 28% socio-demographic profile; 15% travel behavior; 14% personality</li> </ul>
(Stiegemeier et al., 2022)	TAM (integrated model)	in-vehicle technology	Online survey (304 participants) and descriptive statistics, bivariate correlations, independent samples t-Tests, content analysis	Through an inductive content analysis, a total of thirteen distinct categories emerged; Need, Context and Task, and Reliability were found to be associated with PU; Increased Effort and Aversion emerged as categories closely linked to PEOU; In addition, the influencing factors are further extended with the Preference for Own Action, Distrust/Trust, Safety, Knowledge, and Habit
(Yu & Jin, 2021)	TAM (adapted)	Intelligent Connected Vehicle Infotainment in the 5G-V2X	Questionnaire survey (502 respondents) and PLS-SEM	PU, PEOU, CI, and SI directly exert influence on AT and UI, contributing to 46.8% and 73.4% of the observed variance, respectively; PR has an insignificant path with attitude and intention; driving experience moderation effect exists between PR and usage intention
(Hampton-Sosa, 2019)	TAM	Music Streaming (access-based service)	Online survey (139 cases) and PLS- SEM	PEOU is positively related to PU and EN; Both PU and EN exhibit positive associations to purchase; PU and EN are positively influenced by perceived product format usefulness; PU is positively related to PI and negatively related to unauthorized downloading intention; EN is positively related to PI; Perceived ease of product modification, perceived ease of product trial, and perceived ease of product sharing are ultimately positively related to adoption and negatively related to the intention to engage in digital piracy

Note:

 Accessibility (AC); Affective satisfaction (AS); Attitude (AT); Anxiety (AX); Behavioral intention (BI); Consumer innovativeness (CI); Compatibility (CO); Desire for control (DC); Effort expectancy (EE); Environmental friendliness (EF); Perceived enjoyment (EN);
 Facilitating conditions (FC); Habit (HA); Hedonic motivation (HM); Loss of driving pleasure (LDP); Legal regulations (LR); Perceived benefit (PB); Perceived behavioral control (PBC); Privacy concerns (PRC); Perceived complexity (PC); Performance expectancy (PE);
 Perceived ease of use (PEOU); Personal innovativeness (PIN); Purchase intention (PI); Perceived information control (PIC); Perceived performance risk (PPER); Perceived privacy risk (PPR); Perceived risk (PR); Prior similar experience (PSE); Perceived security risk (PSR); Perceived usefulness (PU); Price value (PV); Relative advantage (RA); (Perceived) safety (SA); System characteristics (SC);
 Security & data privacy (SDP); Social influence (SI); Subjective norm (SN); Technographics (TG); (Initial) trust (TR); Task-technology-fit (TTF); Usage intention (UI); Perceived Uniqueness (UQ)

Source: Own elaboration

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Table 2. Illustrative review of research on ODCFs

References	ODCFs	Key purpose	Key findings
(Ma et al., 2015)	Autopilot technology, adaptive cruise control system)	empirically analyze the influence of innovation locus and innovation newness on the adoption of the complete product, consisting of both the base product and an additional feature	The introduction of innovative features as external components, as opposed to internal components, positively impacts product adoption intentions for the entire product (base product + added feature), with the influence of innovation locus being significant specifically for highly novel innovations rather than incrementally new ones
(Petry & Moormann, 2020)	On-demand horsepower	demonstrate promising avenues for the design of payment-enabled services within the domain of connected cars, leveraging the process thinking approach as its foundation	The sequential actions required to fulfill a driver's solicitation for on-demand horsepower during a specific timeframe, coupled with the facilitation of mobile payment for this service
(Schaefers et al., 2022)	Seat heater, intelligent voice assistant	empirically examine the effects of feature tangibility and feature pricing on consumers' intentions to purchase non-permanent internal product upgrades	Reveal a decreased propensity to purchase tangible features compared to intangible ones, while also reveal higher purchase intentions for flat-rate pricing compared to pay-per-use pricing
(Wiegand & Imschloss, 2021)	Different features, e.g., extended range, improved acceleration	examine: (a) the variations in consumers' evaluations of the base product between continuous Over-The- Air (OTA) software updates and external hardware upgrades, and (b) the impact of feature pricing on consumer reactions toward OTA software updates in contrast to internal product upgrades	Compared to conventional standard products, the inclusion of products with an ongoing upgradability feature exerts a positive influence on consumers' assessments of the fundamental product. Nonetheless, evaluations of products offering continuous OTA software updates tend to be slightly less favorable when contrasted with those presenting external hardware upgrades; temporary OTA software updates are subject to relatively less favorable consumer evaluations in comparison to their permanent counterparts, while no statistically significant variances are evident for internal product upgrades
(Garbas et al., 2022)	Digital radio, rear-view camera, driving performance software, head-up display	examine the effects of internal product upgrades, as opposed to external ones, on consumers' responses, specifically investigating their willingness to pay for the feature and their loyalty intentions towards the firm	<ul> <li>(1) presents novel evidence indicating that consumers' behavioral intentions exhibit less favorability towards internal product upgrades compared to external ones,</li> <li>(2) unveils the sequential mediating effects of perceived feature ownership and perceived betrayal, elucidating the underlying mechanisms through which these effects occur, and (3) identifies three important moderating factors - upgrading responsibility, feature tangibility, and product-identity-relevance - that enable firms to mitigate the negative consequences associated with internal product upgrades</li> </ul>

Source: Own elaboration

From a theoretical perspective, a substantial portion of the research endeavors strives to examine the underpinnings of acceptance through the lens of singular theories, such as TAM (Davis, 1989), TPB (Ajzen, 1991), or UTAUT (Venkatesh et al., 2003, 2012). Concomitantly, these studies often employ the foundational TAM or UTAUT as a conceptual foundation, incorporating or omitting variables from the original models and relevant research, driven by theoretical and practical motivations (Stiegemeier et al., 2022). The review underlines that research approaching the prediction of technology acceptance of ODCFs is fragmented and inconclusive. The determinants influencing the acceptance of ODCFs and the specific factors that hold significant importance in this context remain uncertain and require further investigation. To provide a comprehensive understanding of the adoption decision-making of ODCFs, scholars have advocated for the integration of diverse theories or the incorporation of supplementary factors contingent upon specific contextual nuances, intending to augment the model's capacity for explanatory efficacy (Chen, 2019; Herrenkind et al., 2019). The primary objective of the presented study is to furnish a comprehensive integrated model encompassing the factors that influence drivers' acceptance of ODCFs. Derived from an extensive literature review, the research question can be formulated as

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follows: What are the critical determinants in the driver's acceptance of on-demand car functions, and how can they be integrated into a comprehensive acceptance model to better understand consumer behavior in this context?

Therefore, in the next step relevant theories and constructs that have been verified in the different contexts are integrated, aiming for the highest explanatory power of the model.

# 3. Methodology

Following Kaur and Rampersad (2018), factors identified by existing and suitable acceptance models are synthesized in conjunction with factors derived from the literature review on technology acceptance in related contexts and studies on ODCFs (Kaur & Rampersad, 2018; Nordhoff et al., 2019). Therefore, the methodology of the present paper is structured in four components (see Figure 1).

First, the underlying theories and assumptions that provide the basis for the model are introduced. Second, for the composition of the model, the guidelines for developing a multi-level framework of technology acceptance and use (Venkatesh et al., 2016) were considered. Third, to identify relevant determinants for the context of ODCFs, a literature review was conducted by the guidance on conducting a systematic literature review (Xiao & Watson, 2019). In adherence to the approach described by Nordhoff et al. (2019) and Zhang et al. (2019), no specific protocol was generated or registered for this review (Nordhoff et al., 2019; Zhang et al., 2019).

A comprehensive review of relevant peer-reviewed articles listed in Scopus and Web of Science databases was conducted to construct a theoretical model for predicting driver's acceptance of ODCF, and to explore the factors influencing ODCF acceptance. The review encompassed articles available until May 2023 that applied the acceptance models of UTAUT or TAM. Since there is no available research on the driver's acceptance of ODCFs, the search was extended to related contexts of ODCFs. Hence, the selection of articles included those whose titles, abstracts, or keywords featured the research query of the following keywords: On-demand car functions, On-demand automobile-related service(s), Information technology in the car, New Car Technologies, Connected car service(s), Smartphone-car connectivity, Driver support system(s), Telematic(s), In-vehicle infotainment system(s), Connected vehicle(s), Internet of Vehicles Service(s), Access-based service(s), Autonomous driving, Automated vehicle(s), acceptance, driver, TAM, UTAUT.

Further inquiries were conducted via Google Scholar to expand the available range of eligible studies for sample selection. To maintain uniformity, identical keywords were utilized. The reference lists of all studies that satisfied the established search criteria were systematically examined to identify additional pertinent studies.

In the initial phase, 1850 full-text records were retrieved, which were subsequently subjected to a thorough assessment of eligibility. Among them, duplicate records were identified and removed, and records were excluded due to their deviation from our predefined search criteria. These excluded records focused on alternative technologies such as insurance, automated shuttles, trucks, wearables, and buses. Furthermore, review-based studies, which had already discussed the outcomes of some of the studies satisfying our eligibility criteria, were omitted. Consequently, 27 records were retained for the qualitative analysis in the final phase (see Table 1).

Following the methodology outlined in Nordhoff et al.'s (2019) study, an analysis was conducted to determine the number of studies that examined specific factors related to acceptance of the respective context (Nordhoff et al., 2019). Hereby, the focus was on the acceptance determinants incorporated in the models of the studies and their relative importance. The statistical results have been extracted from the studies resulting in an overview of over 300 relationships between variables, including the effects and significance level. Based on that, the determinants that revealed significant statistical results were extracted again. The identical ones were grouped within these

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relevant determinants, and the number of studies they occurred was counted. In addition, factors that are named differently in the different acceptance models but have the same meaning were grouped. Then, the identified determinants were checked against the existing acceptance models to identify the overlap and additional factors. Out of the remaining additional factors, group classes were formed.

Fourth, in addition to the determinants identified from technology acceptance studies in contexts relevant to ODCFs (see Table 1), the results and factors from the few existing studies on the actual topic of ODCFs (see Table 2) were also incorporated into the development of the integrated acceptance model.



Figure 1. Structured methodology including four components Source: Own elaboration

# 4. Theoretical model

# 4.1 Existing acceptance models as structural foundation

The first theoretical framework that provides the structural foundation for the ODCFs acceptance model is the state-of-the-art and revised UTAUT model proposed by Blut et al. in 2022. Their devised model extends the existing theory by incorporating four supplementary predictors that have demonstrated a more substantial impact on numerous technologies compared to certain original predictors of the theory and predictors within the UTAUT2 framework: "The results suggest that four new predictor variables [...] explain substantial variance in intention and use above and beyond the variance explained by current predictors" (Blut et al., 2022, p. 51).

The four additional predictors in their model are technology compatibility, user education, personal innovativeness, and technology costs. Regarding technology compatibility, the authors underscore the notion that the assimilation of a novel radical technological innovation can present formidable hurdles for an organization (Hill & Rothaermel, 2003), particularly when the new technology is integrated into an established platform or ecosystem (Blut et al., 2022). ODCFs represent a technological innovation part of an existing platform (i.e., the connected car). Hence, this predictor could be specifically relevant to the present context of this paper. Next, user education and personal innovativeness emerged as pivotal user attributes with considerable influence over adoption determinations. Lastly, the study highlighted the salient significance of the monetary costs associated with procuring or utilizing the technology for the user (Blut et al., 2022). Also, the studies in the ODCFs context find that pricing structure is a key characteristic, and different results were found regarding the purchase intention depending on the ODCFs tangibility (Schaefers et al., 2022).

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Furthermore, the results of their meta-analysis revealed variance in relationships, which suggests the presence of moderating variables exerting an influence. Hence, the authors conclude that the theory's ability to predict technology use depends on the specific context and suggest always considering moderators when applying UTAUT (Blut et al., 2022). With technology types and national culture, their results revealed important moderators. Specifically, technology types can be utilized to compose a UTAUT specification that predicts technology use in different contexts (Blut et al., 2022). Previous studies of ODCFs and related contexts found significant differences within ODCFs related to the technology type. For instance, the feature tangibility (i.e., the feature composition between hardware and software) was identified as a key characteristic for ODCFs (Schaefers et al., 2022), and negative customer perceptions are attenuated when consumers upgrade an intangible (vs. tangible) feature (Garbas et al., 2022).

Taken together, the revised UTAUT model provides a state-of-the-art basis for developing the ODCFs acceptance model. Specifically, the additional predictors and moderators should be considered. However, the need to adapt the model for specific contexts is emphasized: "UTAUT should be extended by considering additional contextual differences that characterize the specific context in which the theory is employed" (Blut et al., 2022, p. 51).

The second theoretical underpinning is the CTAM, introduced by Osswald et al. in 2012, which serves as a predictive framework for accepting in-car technology. CTAM postulates a linkage between in-car technology acceptance and constructs derived from the UTAUT – encompassing performance expectancy, effort expectancy, social influence, and facilitating conditions. Moreover, CTAM incorporates additional factors such as perceived safety and anxiety, potentially influencing information systems' acceptance within vehicular environments (Osswald et al., 2012). The CTAM was utilized in studies related to autonomous vehicles (Cho et al., 2017), new car technologies (Abd Aziz, 2016), and automated vehicles (Nordhoff et al., 2019). CTAM expands the scope of the UTAUT model, facilitating an explanation and projection of drivers' acceptance of information technology within the vehicular context. This extension entails including supplementary variables that align with the characteristics of in-car technology, rendering them amenable for integration within the acceptance framework of ODCFs. However, the authors also mention: "We cannot exclude that there will be further determinants that need to be considered within the car context" (Osswald et al., 2012, p. 57); hence additional potentially relevant determinants of ODCF acceptance must be included.

# 4.2 Multi-level framework of technology acceptance and use providing structural guidelines

Arising from a meticulous evaluation of research endeavors that have employed, extended, or amalgamated the preceding UTAUT models, Venkatesh et al. (2016) propose a multi-level framework that can serve as the theoretical foundation for research. The framework distinguishes between individual-level contextual factors, higher-level contextual factors, and a baseline model formed by the main effects of the previous UTAUT2 model (Venkatesh et al., 2016). The strength of the framework is its holistic and comprehensive overview of the possible factors impacting technology acceptance in a specific context (Nordhoff et al., 2019), which corresponds with the objective of this paper to develop an integrated context-specific acceptance model.

Regarding the baseline model, the authors posit that the primary effects of UTAUT/UTAUT2 ought to establish the baseline model, a decision driven by the principle of parsimony. This approach aims to enhance the precision of existing contextual impacts and identify potential novel contextual effects within the framework (Venkatesh et al., 2016). However, the present paper will follow the proposal of Blut et al. (2022) and include the predictors of the revised and state-of-the-art UTAUT model as the baseline model since, on the one hand, it represents the most actual research and, on the other hand, supports the objective for an extension by considering additional contextual differences that characterize the specific context in which the theory is employed (Blut et al., 2022). Nevertheless, the baseline model suggests individual beliefs, including performance expectancy, effort expectancy, social influence, hedonic motivation, and price value (Venkatesh et al., 2016). According to the authors' proposition, there are potentially relevant determinants for ODCFs at two levels. First, the meso-level

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encapsulates the fundamental influences from the instrumental domain-specific, symbolic-affective, and moralnormative dimensions inherent to ODCFs. In line with the proposition of Nordhoff et al. (2016), interconnections among the factors constituting the domain-specific, symbolic-affective, and moral-normative facets of the model are postulated (Nordhoff et al., 2016). Second, the micro-level encompasses individual variability factors. These include user attributes which can be expanded by including other demographic variables, as well as technology attributes, task attributes, rationale attributes, and events/time. These contextual factors engender different extensions to the baseline model (Venkatesh et al., 2016).

# 4.3 Acceptance studies in related contexts

The literature review about technology acceptance in related contexts of ODCFs (see Table 1) revealed that significant relationships have been identified in the respective studies. During the critical literature review across contexts related to OCDFs, 74 individual acceptance factors were identified (see Table 3). Each factor significantly affected the respective outcome or other variables in the studies' models.

However, the variables are not free from overlap since they are utilized in different acceptance frameworks with different names but the same meaning. For instance, during the formulation of the original UTAUT model, the authors acknowledge the similarity between performance expectancy and perceived usefulness, as well as between effort expectancy and perceived ease of use (Venkatesh et al., 2003). Hence, as a preliminary action, equivalent factors are condensed as follows: Performance expectancy corresponds to perceived usefulness, effort expectancy aligns with perceived ease of use, facilitating conditions equate to perceived behavioral control, and social influence corresponds to the subjective norm. The remaining number of factors is 70. Out of that, the acceptance factors exhibiting a significant effect in many studies (n = five or more) are as follow: Performance expectancy/Perceived usefulness, Effort expectancy/Perceived ease of use, Social influence, Hedonic motivation, Compatibility, Innovativeness, Perceived safety, and Trust.

Moreover, 47 acceptance factors were identified through only one analyzed study, which speaks for a broad variety of relevant acceptance factors and a high level of granularity. At the same time, it underlines the need for an integrated or extended acceptance model since the base models (e.g., TAM, UTAUT) does not incorporate enough relevant determinants for the context of ODCFs. This finding is in line with Blut et al. (2022): "There is not just one UTAUT specification with a universal set of predictors that applies to all contexts. Instead, the theory's ability to predict technology use depends on the specific context" (Blut et al., 2022, p. 53).

Factor number	Level	Factor class	Acceptance factor	n
1.	Meso	Baseline model	Facilitating conditions	4
2.			Performance expectancy	8
3.			Effort expectancy	6
4.			Social influence	13
5.			Hedonic motivation	5
6.			Price value	3
7.			Habit	3
8.			Compatibility	5
9.			Education	1
10.			(Personal) Innovativeness	7
11.			Costs	1
12.			Anxiety	3
13.			Safety	5
14.		Exposure to ODCFs	Experience / Prior similar experience	3
15.			Knowledge	2
16.		Domain-specific system evaluation	Perceived betrayal	1
17.			Perceived feature ownership	1
18.			Perceived usefulness	12

Table 3. Overview of ODCFs factors and the number (n) of studies that found the factors to be significant

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19.			Perceived ease of use	9
20.			Relative advantage	2
21			Security	1
22			Service and vehicle characteristics / System characteristics	2
23			Task-technology fit	2
23.			Perceived complexity	1
25			Accessibility	1
25.			Derceived assa of product modification	1
20.			Bereaived ease of product modification	1
27.			Perceived ease of product that	1
20.			Visual attractiveness	1
29.	-			1
30.			Immediacy	1
31.			Fairness perception	1
32.	-	Symbolic-affective system evaluation	Subjective norm	2
33.			(Perceived) Enjoyment	3
34.		Moral-normative system evaluation	Product-identity relevance	1
35.			Expected upgrade effort	1
36.			Expected product quality	1
37.			Perceived risk	4
38.			Data privacy	1
39.			Perceived benefits	1
40.			Privacy concerns	1
41.			(Perceived) Privacy risk	2
42.			Perceived information control	1
43.			Data breach anxiety	1
44.			Perceived security risk	1
45.			Perceived performance risk	1
46.			Perceived privacy	1
47.	Micro	Socio-demographics	Age	1
48.			Gender	2
48. 49.			Gender Household structure	2
48. 49. 50.			Gender Household structure	2 1 1
48. 49. 50.	•		Gender Household structure Income Employment	2 1 1
48. 49. 50. 51. 52			Gender Household structure Income Employment Residential situation	2 1 1 1
48. 49. 50. 51. 52. 53.	· · ·		Gender Household structure Income Employment Residential situation Driving license	2 1 1 1 1 1
48. 49. 50. 51. 52. 53. 54.	· · ·		Gender Household structure Income Employment Residential situation Driving license	2 1 1 1 1 1 1 1
48. 49. 50. 51. 52. 53. 54. 55.	· · · ·		Gender Household structure Income Employment Residential situation Driving license Locality Self_reporting capabilities	2 1 1 1 1 1 1 1 1
48. 49. 50. 51. 52. 53. 54. 55. 56.		Traval babavior	Gender Household structure Income Employment Residential situation Driving license Locality Self-reporting capabilities	2 1 1 1 1 1 1 1 1 1
48. 49. 50. 51. 52. 53. 54. 55. 56. 57.		Travel behavior	Gender Household structure Income Employment Residential situation Driving license Locality Self-reporting capabilities Access to mobility	2 1 1 1 1 1 1 1 1 1 1
48. 49. 50. 51. 52. 53. 54. 55. 56. 57. 58.		Travel behavior	Gender Household structure Income Employment Residential situation Driving license Locality Self-reporting capabilities Access to mobility Travel purpose Attitude toward using travel modes	2 1 1 1 1 1 1 1 1 1 1 1
48. 49. 50. 51. 52. 53. 54. 55. 56. 57. 58. 50.		Travel behavior	Gender Household structure Income Employment Residential situation Driving license Locality Self-reporting capabilities Access to mobility Travel purpose Attitude toward using travel modes	2 1 1 1 1 1 1 1 1 1 1 1 1
48. 49. 50. 51. 52. 53. 54. 55. 56. 57. 58. 59. 60.		Travel behavior	Gender         Household structure         Income         Employment         Residential situation         Driving license         Locality         Self-reporting capabilities         Access to mobility         Travel purpose         Attitude toward using travel modes         Frequency of travel mode use	2 1 1 1 1 1 1 1 1 1 1 1 1 1
48. 49. 50. 51. 52. 53. 54. 55. 56. 57. 58. 59. 60. 61.		Travel behavior	Gender Household structure Income Employment Residential situation Driving license Locality Self-reporting capabilities Access to mobility Travel purpose Attitude toward using travel modes Frequency of travel mode use Medical condition	$ \begin{array}{c} 2\\ 1\\ 1\\ 1\\ 1\\ 1\\ 1\\ 1\\ 1\\ 1\\ 1\\ 1\\ 1\\ 1\\$
48. 49. 50. 51. 52. 53. 54. 55. 56. 57. 58. 59. 60. 61. (2)		Travel behavior	Gender         Household structure         Income         Employment         Residential situation         Driving license         Locality         Self-reporting capabilities         Access to mobility         Travel purpose         Attitude toward using travel modes         Frequency of travel mode use         Medical condition         Accidents/accident involvement	$ \begin{array}{c} 2\\ 1\\ 1\\ 1\\ 1\\ 1\\ 1\\ 1\\ 1\\ 1\\ 1\\ 1\\ 1\\ 2\\ 1\\ 1\\ 1\\ 1\\ 1\\ 1\\ 1\\ 1\\ 1\\ 1\\ 1\\ 1\\ 1\\$
48.         49.         50.         51.         52.         53.         54.         55.         56.         57.         58.         59.         60.         61.         62.		Travel behavior	Gender Household structure Income Employment Residential situation Driving license Locality Self-reporting capabilities Access to mobility Travel purpose Attitude toward using travel modes Frequency of travel mode use Medical condition Accidents/accident involvement Driving mileage	$ \begin{array}{c} 2\\ 1\\ 1\\ 1\\ 1\\ 1\\ 1\\ 1\\ 1\\ 1\\ 1\\ 1\\ 1\\ 1\\$
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48.         49.         50.         51.         52.         53.         54.         55.         56.         57.         58.         59.         60.         61.         62.         63.         64.         65.         66.         67.         68.         69.         70.		Travel behavior Personality	Gender         Household structure         Income         Employment         Residential situation         Driving license         Locality         Self-reporting capabilities         Access to mobility         Travel purpose         Attitude toward using travel modes         Frequency of travel mode use         Medical condition         Accidents/accident involvement         Driving mileage         Trust/Distrust         Desire for control         Preference for own action         Resistance         Technographics         Personalization         Risk tolerance (on the Internet)         Perceived behavioral control	$\begin{array}{c} 2 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \\$
48.           49.           50.           51.           52.           53.           54.           55.           56.           57.           58.           59.           60.           61.           62.           63.           64.           65.           66.           67.           68.           69.           70.           71.		Travel behavior Personality Technology	Gender         Household structure         Income         Employment         Residential situation         Driving license         Locality         Self-reporting capabilities         Access to mobility         Travel purpose         Attitude toward using travel modes         Frequency of travel mode use         Medical condition         Accidents/accident involvement         Driving mileage         Trust/Distrust         Desire for control         Preference for own action         Resistance         Technographics         Personalization         Risk tolerance (on the Internet)         Perceived behavioral control         Feature tangibility	$\begin{array}{c} 2 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \\$
48.           49.           50.           51.           52.           53.           54.           55.           56.           57.           58.           59.           60.           61.           62.           63.           64.           65.           66.           67.           68.           69.           70.           71.           72.		Travel behavior Personality Technology	Gender         Household structure         Income         Employment         Residential situation         Driving license         Locality         Self-reporting capabilities         Access to mobility         Travel purpose         Attitude toward using travel modes         Frequency of travel mode use         Medical condition         Accidents/accident involvement         Driving mileage         Trust/Distrust         Desire for control         Preference for own action         Resistance         Technographics         Personalization         Risk tolerance (on the Internet)         Perceived behavioral control         Feature tangibility         Pricing structure	$\begin{array}{c} 2 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \\$
48.           49.           50.           51.           52.           53.           54.           55.           56.           57.           58.           59.           60.           61.           62.           63.           64.           65.           66.           67.           68.           69.           70.           71.           72.           73.		Travel behavior Personality Technology	Gender         Household structure         Income         Employment         Residential situation         Driving license         Locality         Self-reporting capabilities         Access to mobility         Travel purpose         Attitude toward using travel modes         Frequency of travel mode use         Medical condition         Accidents/accident involvement         Driving mileage         Trust/Distrust         Desire for control         Preference for own action         Resistance         Technographics         Personalization         Risk tolerance (on the Internet)         Perceived behavioral control         Feature tangibility         Pricing structure         Type of feature	$\begin{array}{c} 2 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \\$

Source: Own elaboration

Comparing the identified acceptance factors to the established models, it can be seen that all factors and moderators from the UTAUT2 model (i.e., performance expectancy, effort expectancy, social influence, facilitating conditions, hedonic motivation, price value, habit, age, gender, experience).

In comparison to the most recent UTAUT model, which extends the original theory with new endogenous mechanisms (i.e., technology compatibility, user education, personal innovativeness, and costs of technology) and new moderating mechanisms (e.g., technology type and national culture) (Blut et al., 2022), all the additional endogenous mechanisms have been identified by the literature analysis, too. This signalizes, that the current state-of-the-art research is represented, and a high level of explanatory power can be expected. Considering these findings and confirming what has been mentioned before (see Chapter 4.2), the revised UTAUT model should be considered in the structural foundation for the integrated acceptance model for ODCFs, which the authors also suggest: "when employing UTAUT in future technology studies, researchers should consider the revised UTAUT that includes these four new predictors" (Blut et al., 2022, p. 51).

Regarding CTAM, in the original study, two factors have been identified as relevant (i.e., perceived safety and anxiety) (Osswald, Kun, et al., 2012); both factors have also been found significant by other studies from the literature review.

In total, 13 factors have been derived from the revised UTAUT model (performance expectancy, effort expectancy, social influence, price value, hedonic motivation, facilitating conditions, habit, compatibility, education, personal innovativeness, costs) and CTAM model (Safety, Anxiety) are integrated into the baseline model on meso-level.

Moreover, the study by Blut et al. (2022) found substantial variation in effect size that moderators and several interaction effects between technology types can explain.

Their minimum expectation is that studies include individual characteristics as moderators (i.e., age and gender) but also integrate technology types as moderators (Blut et al., 2022). To follow this suggestion, age & gender are included as moderators in socio-demographics on the micro-level. In addition, technology types (mobile technology, online technology, and transaction technology) are moderators in the micro-level technology class.

Lastly, the 58 factors next to the baseline model are consolidated into eight-factor classes, whereby acceptance classes 1-4 are located at the meso-level, while Classes 5-8 are located at the micro-level (Nordhoff et al., 2019):

- Class 1 (Factor 14, 15): Exposure to ODCFs
- Class 2 (Factors 16–31): Domain-specific system evaluation
- Class 3 (Factors 32–33): Symbolic-affective system evaluation
- Class 4 (Factors 34–46): Moral-normative system evaluation
- Class 5 (Factors 47–55): Socio-demographics
- Class 6 (Factors 56–62): Travel behavior
- Class 7 (Factors 63–70): Personality
- Class 8 (Factors 71-74): Technology

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# 4.4 Key results from ODCF research

Besides the factors identified from the existing acceptance theories and the acceptance studies in related contexts of ODCFs, additional factors were extracted from the existing literature in the context of ODCFs (see Table 2). As outlined before and mentioned by the authors of the respective studies, the research on ODCFs is limited; for instance, Schaefers et al. (2022) mention "neither have ODCFs been conceptually delineated and defined, nor have consumer reactions to such services been examined" (Schaefers et al., 2022, p. 752). In contrast to existing empirical research in the marketing domain on hardware upgrades (Ülkü et al., 2012), software upgrades, such as in the case of ODCFs "have not been examined thus far" (Wiegand & Imschloss, 2021, p. 2). In distinction to related phenomena such as external product upgrades through add-on features, product versioning, product upgrading, and over-the-air updates, "little marketing research has examined how consumers respond to having to pay for activating deliberately restricted features in a physical product" (Garbas et al., 2022, n. p.).

Schaefers et al. (2022) underscore that consumers' fairness perceptions - defined as judgments of outcome/process reasonability (Xia et al., 2004) - impact purchase decisions. Unfairness perceptions reduce purchase intentions and increase complaints, mistrust, and switching behaviors (Cziehso et al., 2019; Namkung & Jang, 2009; Nguyen & others, 2013; Blodgett et al., 1997). In exploring ODCFs, the authors focus on tangibility and pricing. Tangibility involves software-based intangibles vs. hardware-based tangibles. Consumer reactions vary; software features (e.g., intelligent voice assistant) are accepted more, whereas hardware features (e.g., seat heating) are approached with caution, affecting purchase intentions (Atasoy & Morewedge, 2018; Schaefers et al., 2022). In pricing, flat rates (similar to Netflix or Spotify) are preferred and viewed as fairer than pay-per-use due to simplicity. Participants showed higher purchase intent for flat rates, emphasizing its role in ODCF acceptance (Schaefers et al., 2022). Lastly, while tangibility and pricing are vital, ODCFs' design should consider core (e.g., car driving assistance) vs peripheral features (e.g., phone integration), prompting future research on diverse ODCF types, such as safety vs entertainment (Schaefers et al., 2022).

Garbas et al. (2022) investigated consumer reactions to internal versus external product upgrades, emphasizing normative expectations and psychological ownership. They theorized adverse reactions to internal upgrades, viewed as trust breaches when charging for perceived inherent features. Comparably, Wiegand & Imschloss (2021) distinguished between software and hardware upgrades, assessing consumer valuation differences.

Garbas et al. (2022) highlighted behavioral repercussions from internal product upgrades, notably increased perceived feature ownership leading to feelings of betrayal and negative consumer responses. Strategies suggested for these effects' mitigation involved three factors: upgrading responsibility, feature tangibility, and product-identity-relevance. Internal upgrades for intangible features (e.g., driving performance software), received less backlash, arguably due to weaker feature ownership feelings than tangible features (e.g., rear-view cameras). The tangible upgrades intensified feelings of betrayal, whereas external upgrades were less contentious (Garbas et al., 2022). This research adds dimension to Schaefers et al. (2022), emphasizing monthly internal product upgrade subscriptions.

Garbas et al. (2022) pinpointed mediators and moderators influencing ODCF end-user acceptance: perceived betrayal, a mediator, signifying a firm's intentional norm violation in consumer relations (Grégoire & Fisher, 2008), affects behavioral intentions like purchase and loyalty. Another mediator, perceived feature ownership, suggesting personal attachment to an object or part thereof (Pierce et al., 2003), creates feelings of betrayal from internal upgrades, diminishing consumer sentiments. As for moderators, feature tangibility (the balance between tangible and intangible feature elements) impacts consumer reactions based on upgrade type. Lastly, product-identity-relevance, i.e., how a product reflects a user's identity (Kwon et al., 2017), moderates reactions: individuals with high product-identity relevance respond negatively to tangible versus intangible upgrades, a response mellowed in those with lower product identity relevance (Garbas et al., 2022).
Wiegand & Imschloss (2021) executed four studies with relevant findings in each.

Firstly, upgradeability increases vehicle value, with hardware upgradeability preferred over software, improving consumer evaluations regarding attitude and purchase intention.

Secondly, consumers differentiate software and hardware upgrades, each having distinct value across product qualities. Superior hardware quality does not enhance perceived software upgrade effectiveness.

Thirdly, they probed mechanisms linking software vs hardware upgradeability to consumer attitudes, finding mediation via expected product quality and upgrade effort. Bundling software upgrades increased perceived product quality.

Fourthly, they explored modular software upgrades, focusing on unlocking pre-installed functions and continuous innovation. Upgrades based on a subscription model, like temporary functionality access, were discussed. Unlocking product features could be perceived as unfair, mirroring insights from Garbas et al. (2022) and Schaefers et al. (2022). The utility of withheld functions versus continuous innovation merits further study, as withholding might devalue consumer evaluations (Wiegand & Imschloss, 2021).

Taking the results together, two mediating determinants can be identified for the context of ODCFs: First, expected upgrade effort describes the consumer input, such as time and decision-making, required for upgrade implementation. Minimizing perceived effort by underscoring ease of integration could benefit firms. Second, expected product quality relates to the upgrade's enhancement of product performance and durability. Their results show that consumers perceive software upgrades as indicative of diminished product quality relative to hardware upgrades. This finding resonates with earlier studies emphasizing a consumer inclination towards tangible products, attributing them with superior characteristics (Atasoy & Morewedge, 2018; Peck & Shu, 2009). Moreover, the mediation through product quality significantly outweighs upgrade efforts (Wiegand & Imschloss, 2021). This supports Christensen's (2011) assertion that performance metrics take precedence over usability facets in the context of product innovation adoption (Christensen, 2011).

From the results of studies related to the specific context of ODCFs, in total, nine factors have been identified, i.e. fairness perception (Schaefers et al., 2022), feature tangibility (Garbas et al., 2022; Schaefers et al., 2022), pricing structure (Schaefers et al., 2022), types of features (Schaefers et al., 2022), perceived betrayal (Garbas et al., 2022), product-identity-relevance (Garbas), expected upgrade effort (Wiegand & Imschloss, 2021), and expected product quality (Wiegand & Imschloss, 2021).

## 4.5 Integrated acceptance model of ODCFs

The acceptance model for ODCFs has been developed by building on two already established acceptance models (i.e., the state-of-the-art UTAUT and CTAM) and following the structural guidelines of a multi-level framework whereby relevant factors derived from both acceptance research in related contexts and studies in the actual context of ODCFs, have been integrated as factor classes on meso- and micro-level (see Figure 2). In accordance with the methodology advocated by Nordhoff et al. (2019), the individual variance factors situated at the micro-level exert both direct and indirect influences on the factors at the meso-level, often mediated or moderated by intervening mechanisms. Furthermore, the model posits interconnections among the components comprising the domain-specific, symbolic-affective, and moral-normative facets (Nordhoff et al., 2019).

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Several studies identified prior similar experience as a relevant determinant towards acceptance of related contexts towards ODCFs. For instance, Kim et al. (2016) investigated user resistance toward acceptance of invehicle infotainment (IVI) systems. Contrary to their expectations, the prior similar experience triggered negative perceptions toward IVI systems and is a direct and powerful antecedent for resistance. This outcome could potentially be attributed to the relatively inferior quality of telematics systems that were accessible prior to the current iteration of IVI systems in the market (Kim et al., 2016).

Nordhoff et al. (2020) showed that experience with specific advanced driver assistance systems could positively impact individuals' behavioral intention in the context of conditionally automated cars. For instance, experience with adaptive cruise control was found to have a small positive effect on behavioral intention. However, experience with parking assistance had a small negative impact, possibly due to driver difficulties with using such systems. The findings suggest that the effect of prior experience depends on the specific feature and whether the prior experience with the feature has been positive or negative (Nordhoff et al., 2020). Hence, the feature type could be a relevant moderating factor for investigating the relationship between prior similar experiences and behavioral intention to accept ODCFs.

Razak et al. (2022) investigated the comprehension of in-vehicle applications and identified a positive impact on trust, social influence, and system characteristics. These factors, in turn, contribute to cultivating a positive attitude and greater intention to utilize the application within their driving context. The authors contend that users are more likely to make well-informed decisions when knowledgeable about the applications' merits and

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limitations (Razak et al., 2022). Stiegemeier et al. (2022) evaluated knowledge as drivers who do not know how their system works would need to learn it. In line with the argumentation of Razak et al. (2022) but in other words, they conclude that users will not adopt a technology due to a lack of knowledge about the system (Stiegemeier et al., 2022). Hence, a higher level of knowledge about ODCFs (i.e., benefits, and limitations) would increase the behavioral intention to accept ODCFs.

#### 4.5.1 Domain-specific system evaluation

Numerous studies identify performance expectancy or perceived usefulness as influential in behavioral intention towards ODCFs. Hanesch et al. (2022) observed that performance expectancy significantly impacts behavioral intention for connected car services (Hanesch et al., 2022). Similarly, in the IoV services context, performance expectancy positively affected usage intentions (Liang et al., 2020). This effect was mirrored in the context of autonomous cars (Nordhoff et al., 2020), vehicular services (Walter & Abendroth, 2020), telematics (N. H. Chen, 2019), and other related domains (Razak et al., 2022; Yu & Jin, 2021; Yoon & Cho, 2016). Hence, it can be expected that performance expectancy would positively influence the driver's behavioral intention to acceptance of ODCFs.

Effort expectancy (or "perceived ease of use") showed a positive link to the behavioral intention of autonomous driving acceptance (Garidis et al., 2020), consistent with Leicht et al. (2018). Contrarily, no significant relationship was observed in studies by Cho et al. (2017), Liang et al. (2020), and Nordhoff et al. (2020). Yet, PEOU revealed positive associations with outcomes like attitude or perceived usefulness in other research (N. H. Chen, 2019; Yu & Jin, 2021). Thus, drivers who find ODCFs easier to use tend to have more positive attitudes and a greater willingness to accept them. In contrast, drivers who find ODCFs time-consuming will more likely have negative attitudes.

Regarding facilitation conditions, Park et al. (2013) identified a positive correlation between facilitation conditions and smartphone-car connectivity (Park et al., 2013). Although Liang et al. (2020) found no direct effect on behavioral intention in the context of IoV services, they highlighted its role in conjunction with other conditions (Liang et al., 2020). Nordhoff et al. (2020) did not find facilitation conditions directly influencing behavioral intention for automated cars, but observed significant relationships between effort expectancy and hedonic motivation (Nordhoff et al., 2020). Regarding ODCFs, it would not be expected to find a strong positive influence directly on the behavioral intention to accept. Still, facilitation conditions can positively influence other factors, such as hedonic motivation, directly influencing the driver's acceptance of ODCFs.

Safety is crucial in technology acceptance within vehicles. Osswald et al. (2012) stress the risky nature of limited technology interaction in cars and underscore the influence of perceived safety on drivers' acceptance of in-car information systems (Osswald et al., 2012). Numerous studies have noted safety's impact on the intention to use autonomous driving technologies (Cho et al., 2017; Garidis et al., 2020; Nordhoff et al., 2020). Specifically, Garidis et al. (2020) identified safety as a paramount determinant for autonomous vehicle adoption (Garidis et al., 2020). Stiegemeier et al. (2022) investigated in-vehicle technology acceptance and determined that perceived safety, viewed as potential driving distractions, consistently influences technology adoption in vehicles (Hewitt et al., 2019; Osswald et al., 2012; Trübswetter & Bengler, 2013). They suggest including safety concerns in acceptance models for future investigations (Stiegemeier et al., 2022). Considering the findings of these studies in related contexts of ODCFs, it can be expected that safety will positively influence drivers' acceptance of ODCFs. Razak et al. (2022) showed system characteristics influence perceived usefulness and ease of use in in-vehicle applications, directly affecting usage intentions (Razak et al., 2022). Chen et al. (2019) integrated TAM with TTF, assessing technology's fit with user tasks in automobile telematics. Telematics products, being relatively new, may make users unfamiliar with benefits, leading to technology characteristics having a more pronounced impact than task characteristics (N. H. Chen, 2019). Thus, system and technology specifics likely influence performance and effort expectancy in ODCFs.

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Several factors can directly influence or explain behavioral intention to accept ODCFs in the domain-specific system evaluation. Hampton-Sosa (2019) studied music product usage in streaming platforms, focusing on the access economy model (Hampton-Sosa, 2019). While not directly addressing vehicle functions, the study centers on the access economy business model, prioritizing user access over product ownership. This aligns with ODCFs, wherein features are pre-installed in the vehicle but require an additional activation fee. The study introduced variables like perceived product format usefulness and ease of product modification. Modern trends allow for easier digital content modification, enhancing consumer engagement (Hampton-Sosa, 2019). Such adaptability in ODCFs can enable users to activate built-in car features, supporting continuous product customization. Hampton-Sosa emphasizes that easier product modification enhances the user-perceived utility and provides more enjoyment opportunities (Hampton-Sosa, 2019). This idea stems from customizable products requiring minimal effort (Hampton-Sosa, 2019; Pavlou & Fygenson, 2006). Concerning product trials, pre-purchase product assessments are crucial (Rogers, 2010). Hampton-Sosa defined this as effortless product evaluation before the acquisition (Hampton-Sosa, 2019). In the context of ODCF, this variable could be relevant since studies found negative perceptions of consumers towards internal product upgrades, which short-term trials could alleviate. Also, trials could contribute to knowledge about a function or system, which in the study of Stiegemeier et al. (2022) was found to be a relevant category: "Many drivers develop an understanding [...] mainly through trial and error and experiences with the system" (Stiegemeier et al., 2022, p. 77). Hampton-Sosa's results indicated significant positive correlations between perceived ease of product modification and usefulness and enjoyment. They also found significant influences of product trial ease on usefulness and enjoyment (Hampton-Sosa, 2019). Given this, ease of product modification and trial can likely affect drivers' acceptance of ODCFs.

Other potential endogenous or exogenous mechanisms toward driver's acceptance of ODCFs are security (Garidis et al., 2020), complexity (J. Kim et al., 2016), accessibility (N. Kim et al., 2019), uniqueness (Vafaei-Zadeh et al., 2021), visual attractiveness (Yoon & Cho, 2016), and immediacy (Noraga et al., 2021).

## 4.5.2 Symbolic-affective system evaluation

Nastjuk et al. (2020) explored autonomous driving acceptance using a TAM-based design, highlighting enjoyment as a key determinant with a positive correlation to perceived ease of use (Nastjuk et al., 2020). Similarly, Chen et al. (2019) emphasized perceived enjoyment as an intrinsic motivator affecting perceived ease of use (N. H. Chen, 2019; Venkatesh, 2000). This suggests that in ODCFs, enjoyment may influence effort expectancy and, thus, driver acceptance.

Subjective norm, defined as one's perception of others' expectations regarding behavior (Fishbein & Ajzen, 1975), was significantly linked to perceived usefulness in autonomous driving by Nastjuk et al. (2020) and as an antecedent for resistance in in-vehicle infotainment systems by Kim et al. (2016). A similar concept of social influence was identified in several studies as significantly impacting acceptance. Notably, Nordhoff et al. (2020) ranked social influence as a primary predictor for using automated cars (Nordhoff et al., 2020). Multiple studies confirm this trend across various in-vehicle technologies, underscoring the importance of social influence in tech acceptance (Adell, 2010; Buckley et al., 2018; Kaye et al., 2020; Panagiotopoulos & Dimitrakopoulos, 2018; Yu & Jin, 2021). For IVIS usage, drivers cited social influences during purchasing but rarely discussed in-drive safety (Oviedo-Trespalacios et al., 2019). Stiegemeier et al. (2022) propose that familial or peer influences may impact vehicle purchase decisions but not the choice to utilize advanced driver assistance systems or IVIS during drives (Stiegemeier et al., 2022). Razak et al. (2022) and Zadeh et al. (2021) also observed significant links between social influence and user attitudes towards in-vehicle applications and dashcams respectively (Razak et al., 2022; Vafaei-Zadeh et al., 2021). Walter & Abendroth (2020) found social norms impacted intentions concerning connected vehicular services (Walter & Abendroth, 2020). Given its frequent identification across studies, social influence appears pivotal in ODCFs acceptance.

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#### 4.5.3 Moral-normative system evaluation

Walter & Abendroth (2020) examined informational privacy in connected vehicles and developed an acceptance model. Their results highlight the significance of privacy considerations in shaping attitudes towards system use, directly influencing user intentions. Notably, the study emphasized the importance of privacy concerns, privacy risk, and perceived information control in vehicular app acceptance, suggesting measures that enhance personal information control (Walter & Abendroth, 2020). Similarly, Noraga et al. (2021) observed that perceived privacy influenced consumer acceptance of on-demand services due to concerns over personal information exchange (Noraga et al., 2021). Integrating informational privacy variables such as privacy concerns, privacy risk, and perceived information control should lead to relevant findings in the context of ODCF acceptance.

Yu & Cai (2022) investigated factors affecting attitudes towards in-vehicle infotainment data services, incorporating variables like data breach anxiety and various perceived risks. The research identified significant relationships between these variables and users' attitudes, with the most substantial link between data breach anxiety and perceived privacy risk. The findings stress the implications of perceived risks on user attitudes for intelligent connected vehicle data services and emphasize the consequences of data breaches (Yu & Cai, 2022). These insights align with Walter & Abendroth (2020), underscoring the need to consider differentiated risk factors (security, privacy, performance) as predictors e.g., trust, attitude, and behavioral intention in ODCFs.

#### 4.5.4 Socio-demographics

Razak et al. (2022) found that users with limited self-reported capabilities firmly intended to use in-vehicle applications. Urban or suburban residents, gender, and driving experience also influenced intentions, but age had inconclusive effects (Razak et al., 2022). Nordhoff et al. (2020) identified age and gender as having minor effects on the intention to use automated cars (Nordhoff et al., 2020). Factors like household structure and residential location affected support for autonomous vehicles, with urban residents showing higher support (Hudson et al., 2019). Positive associations were identified between having children, higher income levels, higher education, and acceptance of vehicle automation, but negative associations were observed among the unemployed or retired (Bansal et al., 2016; Nazari et al., 2018; Kyriakidis et al., 2015; Liu et al., 2019; Hudson et al., 2019). These insights suggest that factors like self-reported capabilities and residential location could directly, indirectly, or moderating influence the acceptance of ODCFs by drivers.

#### 4.5.5 Travel behavior

Users involved in road accidents show a greater intention to use in-vehicle applications (Razak et al., 2022). Nordhoff et al. (2019) confirmed the relevance of travel behavior for automated vehicle acceptance (Nordhoff et al., 2019). Licensed drivers were less likely to use shared autonomous vehicles (Bansal et al., 2016). A positive link exists between driving extent and willingness to pay for autonomous vehicles (Kyriakidis et al., 2015). However, driving distance or experience doesn't notably influence in-vehicle app acceptance (Razak et al., 2022). Individuals with more accident experiences tended to embrace automated vehicles (Bansal et al., 2016). Commuting modes correlate with self-driving vehicle use preferences; private car drivers were more reluctant than public transport users or pedestrians (Zmud & Sener, 2017). Ride-sourcing users and carsharing subscribers favored demand-responsive travel modes over traditional driving (Winter et al., 2017). Given the insights derived from the acceptance of autonomous vehicles, it is plausible to anticipate that various factors linked to travel behavior may exhibit moderating effects on the associations between variables elucidating the acceptance of ODCFs.

#### **4.5.6** Personality

Trust is a key determinant in user acceptance of ODCFs (Chan & Lee, 2021; Cho et al., 2017; Liang et al., 2020; Nastjuk et al., 2020; Razak et al., 2022; Stiegemeier et al., 2022; Vafaei-Zadeh et al., 2021). Initial trust affects the intent to accept IoV-based services (Liang et al., 2020). Trust's significance was emphasized in dashcam adoption and the influence of user perceptions about its safety and usefulness (Razak et al., 2022). Proper trust

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calibration can increase acceptance (Stiegemeier et al., 2022). Hence, trust is expected to be an essential determinant regarding drivers' acceptance of ODCFs, and higher levels of trust increase the behavioral intention to accept.

High technographic, indicating technological inclination, lead to increased adoption of car connectivity services (Park et al., 2013). Such drivers likely have positive beliefs regarding in-vehicle infotainment systems (J. Kim et al., 2016). Thus, the same is expected for the context of ODCF acceptance because it is an innovative concept that, as expected, is also initially accepted by drivers with an affinity for innovation.

Desire for control negatively influences intentions toward autonomous vehicles (Garidis et al., 2020). In parking assists, some drivers prioritize personal control (Stiegemeier et al., 2022). This factor, alongside "preference for own action," can influence ODCF acceptance.

Personalization significantly impacts the adoption intention of on-demand services (Yeap et al., 2017). Thus, ODCFs that allow for personalization are expected to be well-received.

Resistance affects the intention to use in-vehicle infotainment systems influenced by perceived usefulness, complexity, and risk (J. Kim et al., 2016). Hence, drivers with higher resistance towards ODCFs are expected to be less likely to accept and use ODCFs.

Risk tolerance for online activities is a significant moderator for connected car service adoption (Hanesch et al., 2022), implying higher risk-tolerant drivers might be more accepting of ODCFs.

## 4.5.7 Technology

This group class pertains to the class of IT artifacts utilized by individual users in their task execution (Burton-Jones & Straub Jr, 2006; Goodhue & Thompson, 1995). Technological attributes encompass collective functionality, distinctive features across various technologies within the same class, and other attributes like usability (Venkatesh et al., 2016). The target technologies, such as enterprise information systems (Neufeld et al., 2007), e-government technologies (Carter & Schaupp, 2008; McLeod et al., 2009; Schaupp et al., 2010), or online collaboration technology (Brown et al., 2010) served as the stimuli for UTAUT extensions in several studies (Venkatesh et al., 2016).

In this present paper, the technology class includes different types of on-demand car functions (i.e., features) as well as the critical characteristics of ODCFs, namely their tangibility and pricing structure (Garbas et al., 2022; Schaefers et al., 2022). Blut et al. (2022) extended technology types by integrating transaction/non-transaction, offline/online dimensions (Meuter et al., 2000) and introducing mobile/non-mobile based on Balasubraman et al. (2002). They emphasized differential behavioral intentions towards transactional technologies due to potential financial risks and associated expectations (Blut et al., 2022). In the context of ODCFs, the differentiation could be relevant depending on the monetization model and whether a free trial is offered. For example, ODCFs can be offered temporarily or unlimited for a fee (transactional), but there is the option for a free trial beforehand (non-transactional). Authors also question these options: "Could free short-term trials backfire or alleviate the negative impact of internal product upgrades?" (Garbas et al., 2022, n. p.). Hence, this factor is closely related to the pricing structure, which already showed relevant effects in studies on ODCFs, e.g., Schaefers et al. (2022).

Different user expectations are proposed for internet versus non-internet technologies (Meuter et al., 2000). The impact of effort expectancy, facilitating conditions, and social influence on behavioral intention and usage will exhibit greater strength for Internet technologies than non-Internet technologies (Blut et al., 2022). In the context of ODCFs, the individual functions differentiate in terms of their software and hardware share (feature tangibility) (Garbas et al., 2022; Schaefers et al., 2022). Thus, on the one side, pure software functions can require a

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permanent internet connection (i.e., internet, for instance, real-time traffic information). On the other side, pure hardware functions (e.g., heated seats) do not require a permanent internet connection once activated (non-internet). Hence, the factor is related to feature tangibility and type of feature, and different effects of factors such as effort expectancy on behavioral intention to accept ODCFs can be expected for internet versus non-internet technologies.

Regarding mobile and non-mobile technologies, Blut et al. (2022) suggest that while mobile technologies offer increased flexibility (Balasubraman et al., 2002), users' reliance on them due to limited alternatives may strengthen the effects of performance expectancy, effort expectancy, and facilitating conditions on behavioral intention and use, particularly for mobile technologies compared to non-mobile ones. This technology dimension could be related to the different technologies that drivers can use to unlock ODCFs, for instance on a website (non-mobile), on their smartphone (mobile) (Garbas et al., 2022), or directly in the on-board system of the car (mobile) (Petry & Moormann, 2020). Since all these technologies have individual specifics regarding how the user can interact, it can be assumed that drivers' perceptions and behavioral intention to accept ODCF will differentiate depending on the non-mobile versus mobile technology to unlock ODCFs.

Schaefers et al. (2022) found that exposure to intangible ODCFs, like intelligent voice assistants, led to higher purchase intent than tangible ODCFs, such as seat heating. Fairness perceptions affected purchase intentions, favoring intangible ODCFs. These results support feature-dependent consumer responses, favoring software-based intangible features over hardware-based tangible ones (Schaefers et al., 2022). Besides differentiating the types of features based on the tangibility, also other criteria can be used to distinguish types of features from each other:

For instance, the value proposition encompasses the additional value provided to customers, which can address existing problems or fulfill existing needs (Bosler et al., 2018). The value proposition is crucial to customer purchase decisions (Osterwalder & Pigneur, 2010). Consequently, monetising a connected car service becomes unfeasible if customers fail to perceive its benefits (Chanias & Hess, 2016; Piccinini et al., 2015). Sterk et al. (2022) conducted a study that classified the value propositions of connected car services for individual drivers into five broad categories: safety, convenience, cost reduction, traffic efficiency, and infotainment (Sterk et al., 2022). Similar value propositions, tailored to the driver's perspective, have been identified in other studies (Coppola & Morisio, 2016). Additionally, environmental benefit, such as reducing environmental impact, is considered a value proposition or customer benefit in the context of connected vehicle services (Tian et al., 2018). Another dimension to classify connected car services is based on the application's target object type. This classification results from an extensive literature survey by Tian et al. (2018). It adds another dimension with three categories, i.e., vehicle-centric, infrastructure-centric, and traveler-centric (Tian et al., 2018).

Lastly, as part of the IoV architecture, the application layer provides various services and supports novel services and business operating models. The application layer can be classified into closed services (particularly services highly correlated with vehicles aiming to increase driving safety) and open services (mainly provided by third parties to users) (Yang et al., 2017).

These additional three criteria (i.e., value proposition, type of object targeted, and closed/open services) can be used individually or in combination to differentiate the types of features of ODCFs. Existing studies have already achieved different results when types of features are differentiated by feature tangibility (Garbas et al., 2022; Schaefers et al., 2022), so it can be assumed that this also applies to the additional criteria mentioned.

#### 5. Discussion

This study presents an integrated model for driver's acceptance of ODCFs. It is based on a critical literature of studies on ODCFs and acceptance research in related contexts, revealing 74 relevant acceptance factors for the model. The factors are located at two levels, whereby the meso-level merges domain-specific, symbolic-affective, moral-normative factors, and relevant factors retrieved from existing acceptance models. It is influenced by factors at the micro-level, representing individual difference factors (see Figure 2).

This model can be implemented in two distinct ways. Firstly, when the research objective involves understanding the acceptance of ODCFs, the complete model can be employed and tailored to the specific research context. Secondly, when the research objective focuses on explanation or prediction, a partial model can be developed by incorporating relevant individual factors from both levels to align with the individual context. This procedure is also suggested by Venkatesh et al. (2016), who recommend theorizing cross-level influences and conducting multi-level research to examine the impacts of contextual factors empirically. Furthermore, they recommend considering new conceptualizations of technology acceptance and use (Venkatesh et al., 2016), i.e., the usage behavior in the presented model.

Some studies in the context of ODCFs incorporate different consumer responses such as willingness-to-pay (Garbas et al., 2022), loyalty intentions (Garbas et al., 2022), or purchase intentions (Garbas et al., 2022; Schaefers et al., 2022; Wiegand & Imschloss, 2021). Based on the recommendations of Venkatesh et al. (2016) and the different consumer responses in the context of ODCFs, a simple multi-level model that reflects the recommendations discussed before can be derived (see Figure 3).

It conceptualizes that fairness perception and expected product quality positively influence behavioural intention to accept ODCFs, while perceived betrayal and expected upgrade efforts negatively impact driver's acceptance. The feature's tangibility moderates these relationships. Finally, the behavioral intention to accept has a positive effect on the driver's purchase intention of ODCFs.

This exemplary partial model (Figure 3) is deduced from the comprehensive model (Figure 2) following crosslevel theorizing and offering new conceptions of relevant factors. Both models have been originally conceptionalized within this study, drawing upon corresponding literature and potential acceptance criteria pertaining to driver's acceptance of ODCFs.

In forthcoming research endeavors, the respective acceptance critera can serve as foundation for developing appropriate constucts and formulating hypotheses. The novelty of these figures lies in their collective establishment of an inclusive, multi-dimensional model, synthesizing established theories and empirical findings and encompassing diverse factors within a structured framework. Practically, this innovative approach provides a roadmap for researchers and practitioners, facilitating nuanced understanding and enhanced decision-making concerning the acceptance and implementation of ODCFs.

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Figure 3. Impact of ODCF factors on acceptance and purchase intentions moderated by feature tangibility Source: Own elaboration

Prior studies have predominantly employed linear regression analyses to assess the associations between acceptance factors and the acceptance construct. Multivariate analysis methods like regression or structural equation modeling can quantify mathematical relationships among model factors. Qualitative approaches like focus groups and interviews can complement the model by identifying new factors. The model also elucidates causal relationships among factors. Thus, future research should adopt longitudinal and experimental designs to explore causal relationships (Nordhoff et al., 2019).

The strength of the integrated acceptance model for ODCFs is its profound ground in empirical research; however, the current state of the research on the specific topic of ODCFs is limited. More specifically, no research is available on drivers' acceptance of ODCFs. Due to that, mainly acceptance research in contexts related to ODCFs has been used to develop the model. This is associated with uncertainty about the extent to which the results of the studies in other contexts can be applied to ODCFs. ODCFs are primarily about a new business model or service concept and only secondarily about the actual function of the connected vehicle. The few existing studies in the ODCF context have already identified individual factors (e.g., fairness perception, perceived betrayal) that take this distinction into account and focus on the main aspect of ODCFs, which is the service offering concept.

In contrast, the studies from the related contexts are predominantly concerned with the content or the actual functions and not about how to access the functions. In a sense, they start at a later point in the value chain and assume that the function is available to the driver without any further action, which means that the function content is the primary decision criterion for the driver's acceptance. In addition, there are challenges within this content research; for example, in the context of autonomous driving functions, the authors mention that respondents lack knowledge of experience with autonomous vehicles, which may threaten the validity of results (Fraedrich & Lenz, 2014). This can be transferred to the ODCFs context, which as a service innovation is still in an early stage of adoption where respondents lack experience with the concept and how this technology can form a part of their lives in the short- and middle-run.

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Therefore, further studies should focus on identifying specific driver acceptance criteria about the activation and offering model of vehicle functions and to differentiate the activation from usage more clearly using a process. This can be approached by considering industries such as music-/video-streaming, or car-sharing, where the ondemand concept is more established. The literature review identifies various factors associated with ODCFs, warranting further validation or extension via empirical research. Due to the inclusion of multiple factors, the model's complexity may hinder its application, even though streamlined factors often provide significant explanatory power (Nordhoff et al., 2019). Yet, the model permits factor extraction for empirical methods, e.g., hierarchical linear models (Venkatesh et al., 2016). It predominantly addresses micro- and meso-levels, neglecting macro aspects like environment or organization, necessitating a broader focus in future research (Nordhoff et al., 2019; Venkatesh et al., 2016). Additionally, factor weightage is absent, but as Ajzen and Fishbein (2005) suggest, this could vary based on the behavior and audience studied (Ajzen & Fishbein, 2005; Nordhoff et al., 2019).

#### 6. Conclusions

This study introduces an integrated multi-level model to predict drivers' acceptance of on-demand car functions (ODCFs). Rooted in the UTAUT and CTAM frameworks, this model amalgamates pertinent acceptance factors derived from extensive research concerning ODCFs and related domains. A comprehensive set of seventy-four acceptance factors is delineated across micro and meso levels. The meso-level encapsulates factors encompassing the baseline model, antecedents to domain-specific, symbolic-affective, and moral-normative elements, and user exposure to preceding ODCFs. Meanwhile, the micro-level involves individual difference factors such as socio-demographics, travel behavior, personality, and technology affinity, influencing the meso-level factors. The model serves to enrich both researchers and practitioners engaged in ODCF implementation. To fortify the model's robustness and utility, future endeavors should encompass empirical validation, potential model adaptations, in-depth exploration of factor nuances and interconnections, and potentially employ longitudinal or experimental studies to accomplish these goals.

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Tom GRAESNER, M. Sc. is a Ph.D. Candidate at Universidad Católica San Antonio de Murcia (UCAM). He started his career 2013 with Mercedes-Benz taking different position in the retail organization, corporate start-ups, research and development and IT in Sales & Marketing. Since 2022, he is responsible for a software engineering unit in a Mercedes-Benz subsidiary in Lisbon [Portugal]. Tom Graesner holds a bachelor's degree in international management and a master's degree in sales management.

ORCID ID: https://orcid.org/0009-0007-5313-5311

Roland VOGT, Ph.D. is a Professor at the FOM University of Applied Sciences in München [Germany] and conducts research as Head of KCFM Competence Center for Future Mobility at FOM University of Applied Sciences in Essen [Germany].

ORCID ID: https://orcid.org/0009-0001-7312-7956

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# IMPACT OF LEADERSHIP STYLE ON THE USE OF ACCOUNTING INFORMATION FOR DECISION MAKING\*

Amélia Ferreira da Silva 1\*, Belen Fernandez-Feijoo 2, Susana Gago-Rodriguez 3

<sup>1</sup> Porto Accounting and Business School, Polytechnic Institute of Porto, CEOS.PP, Rua Roberto Frias, n°712, 4200-465 Porto, Portugal <sup>2</sup>University of Vigo, Lagoas Marcosende s/n, 36310 Vigo (Spain); <sup>3</sup>Economics and Business Administration School,

University of Vigo, Lagoas Marcosenae s/n, 30310 Vigo (Spain); "Economics and Business Administration Schoo Comillas Pontifical University – ICADE – Madrid, Spain

*E-mails*<sup>1\*</sup> <u>acfs@iscap.ipp.pt</u> (Corresponding autor); <sup>2</sup><u>belen@uvigo.es</u>; <sup>3</sup><u>sjgago@icade.comillas.edu</u>

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**Abstract.** The article explores the effect of different leadership styles on behavioural outcomes and the use of accounting tools. Literature on clinicians' behaviours regarding the use of accounting tools is sparse, limited in scale, centred on nurses and lacking generalizability, especially in non-Anglo-Saxon countries. The article fills this gap. The analysis focuses on how middle doctors-manager (associates) respond to their senior doctors-manager (leader) leadership styles and the influence of these trade-offs on associates' use of accounting tools for decision-making and decision control. The study is conducted in two large public Portuguese hospitals. Data collection using questionnaires and partial least squares (PLS) was the statistical technique applied. The results show that the relationship between leadership styles and behavioural outcomes is not straightforward, and doctors' professionalism plays an important role that needs attention. As highly-educated professionals, doctors have their own criteria and do not always consider managerial ones.

Keywords: Accounting tools; behavioural outcomes; decision control; decision management; leadership style; Portugal; public hospitals

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## 1. Introduction

Healthcare organizations have confronted successive waves of reforms during the last decades. To successfully lead these reforms in public hospitals, the first choice for politicians was to shift managerial power from healthcare professionals to managers, commanded to conceal clinical quality efficiently. However, practice indicated that it was frequently easier for doctors to gain organizational skills and knowledge than managers who

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learned medicine (Giacomelli et al., 2019). Consequently, governments stimulated the emergence of hybrid professionals (Kurunmäki, 2004), i.e., doctors-managers, in hospitals. These 'hybrid roles, framed by both professionalism and managerial logics, diffused across healthcare systems globally' (McGivern et al., 2015, p.412) in such a way that there are voices that claim for 'formal management training in the medical curriculum' (Myers and Pronovost, 2017, p.5821; Piccinetti et al., 2023).

As soon as governments understood that engaging clinicians in hospital management was crucial for the success of public reforms, new accounting information tools (AIT) were implemented. Previous research recognizes the different reactions of the public and the private sector when facing changes: staff within the former sector is less inclined to enforce transformations than within the latter (Rodrigues Quesada et al., 2014). Interestingly, doctor managers have become users (decision-making) and objects (decision control) of these AIT. Nevertheless, the literature suggests that senior doctors often need to gain knowledge and skills to lead these health enterprises (Grigsby, 2015). This may be because, previously, they did not receive training in or were not socialized within a (bureaucratic) management control system (Myers and Pronovost, 2017). However, effective leadership is core for senior doctors to face hospitals' complex challenges to achieve efficiency (Ferreira-da-Silva et al., 2019). Leadership styles' influence on managers' commitment to organizational goals is commonplace in the management literature (Robescu et al., 2021). The role of transformational and transactional leadership, proposed by Bass and Avolio (1994), has been widely accepted as an effective way to enhance organization performance. Martin and Learmonth (2012) suggest that leadership is an instrument to align healthcare stakeholders' objectives with policy intentions.

On the other hand, prior investigation reinforces the role of accounting as guardian of the aimed efficiency in healthcare reforms, and doctors' response is a crucial issue to this aim (Gebreiter, 2016). For instance, Ferreira-da-Silva ate al. (2019) show that transformational leadership encourages doctors to use AIT. Nevertheless, most accounting studies that analyze the achievement of efficiency at hospitals focus on senior managers' leadership style but ignore the implications of doctors' behaviour (e.g. Abernethy et al., 2010; Snieska et al., 2020).

Yet, literature about clinicians' behaviours regarding the use of AIT needs to be more extensive, limited in scale, lacking generalizability, and mainly focused on Anglo-Saxon countries. This paper explores the effect of different leadership styles on behavioural outcomes and the use of AIT. We contribute to the knowledge on the involvement of doctors in managerial processes. We extend Fryer et al. (2018)' conversation highlighting the importance of middle manager affective commitment for successfully implementing improvement programs. Specifically, we analyze the way middle doctors-manager respond to different leadership styles of their senior doctors-manager ('affective commitment') and the influence on formers' use of accounting tools for decision-making and decision control ('improvement programs') following Andersen's (2019) concepts. We conducted our study in two large public teaching hospitals in Portugal, contributing to overcoming the lack of non-Anglo-Saxon countries' research in the field. We anticipate that behavioural outcomes were higher under the most proactive leadership style, namely transformational style; that satisfaction is an antecedent of the other two outcomes, namely effectiveness and extra effort; and that using AIT for decision control is an antecedent for decision-making.

This paper is split into four additional sections. In the next section, we described our theoretical framework and our hypotheses. We then present our methodology, followed by our results and discussion. The concluding section summarizes our contributions and explains the implications for further research.

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## 2. Leadership Style: Previous Literature and Development of Hypotheses

Prior literature has reported leadership's key role in organizations' success (Llach et al., 2017). Bass and Avolio (2004) proposed a continuum typology of leadership styles: transformational, transactional, and passive/avoidant. A transformational leadership style requires not merely that a leader recognizes their associates' needs but also that they actively work to develop those needs from lower to higher levels of maturity. Transformational leaders raise their associates' awareness of the importance of achieving valued outcomes and the strategies to reach them. These leaders encourage associates to transcend their self-interest for the team, organization, or more extensive policy. The relationship between transformational leader and their associates is based on qualitative aspects and interpersonal bonds (Noeverman, 2007).

Transactional leadership focuses on the forces of a leader to motivate their associates to perform at their full potential over time, either for the leader's sound or a larger collective. In its more constructive form, transactional leadership can be reinforced by working with individuals or teams, setting up and defining agreements or contracts to achieve specific work objectives, discovering individuals' capabilities, and specifying the compensation and rewards that can be expected upon successful task completion (Witges and Scanlan, 2014). In its corrective form, transactional leadership is similar to monitoring for mistakes. Whichever form it takes, this style focuses on identifying errors (Bass and Avolio, 2004). Transactional leaders base their relationship with their associates on quantitative evaluation of performance and deviations from objectives. They reward or punish their subordinates when they achieve or do not reach their targets (Noeverman, 2007).

Passive/avoidant leadership (i.e., *laissez-faire* style) is neither constructive nor active. *Laissez-faire* leaders follow a strategy of alienation. They avoid getting involved in problems or taking important decisions. More remarkably, as Toor and Ofori (2009) concluded, there is a negative association between ethical behaviour and *laissez-faire* leadership.

Prior literature identifies three different behavioural outcomes: effectiveness of the style, satisfaction with the kind and extra effort it induces (Bass and Avolio, 1994, 2004). Effectiveness reflects the leader's capacity to guide an effective group and meet their associates' needs (Bass, 1999). Satisfaction captures the degree to which associates are satisfied with the leader's behaviour and their job (Bass, 1999). Extra effort refers to the leader's capacity to increase associates' desire to succeed and encourage them to excel (Bass, 1999). The effect of each leadership style on associates' behaviour is different. Bass and Avolio (2004) indicated that the highest levels of all three outcomes are achieved for those leaders that follow a transformational style, whilst the lowest levels correspond to a *laissez-faire* style (Asiri et al., 2023).

#### 2.1 Leadership styles and behavioural outcomes in hospitals

Earlier studies found that each leadership style distinctly influences associates' satisfaction, effectiveness and extra effort (Kim et al., 2015). Nevertheless, the research on this topic in the healthcare sector has mainly approached hospitals in Anglo-Saxon countries at a nurse level (e.g. Casida and Parker, 2011; Chen and Chen, 2018). Yet, further analysis is needed.

Some researchers found that the effect of transformational leadership on the three outcomes was more substantial and positive in clinical staff than in other styles (Xirasagar et al., 2006). For instance, Salas-Vallina et al. (2022) analyze how to restore satisfaction and enthusiasm among physicians after the deep psychological damage that COVID-19 left behind within these professionals. They conclude about the importance of shared leadership for the searched physician re-engagement that may be framed in the transformational style. Similar results are reported for different environments (Alwali and Alwali, 2022; Øygarden et al., 2020). These studies also identified a more substantial effect of transactional leadership on associates' outcomes than of *laissez-faire* style.

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However, they recognized that hospitals are complex organizations and factors, such as the structural distance among groups, moderate the favourable relationship between transformational leadership and the three perceived outcomes (Avolio et al., 2004).

Another stream of literature contradicts these findings in some way. Hospitals seem to belong to the negative zone of organizational receptivity to transformational leadership when professionals (nurses, physicians, etc.) are weakly committed to the organization (Bass, 1999; García-Sierra et al., 2023). As mentioned, most research that analyzes this relationship (leadership style and outcomes) focuses on nurses in Anglo-Saxon countries. The role that nurses perform in the hospital power structure, which is highly hierarchical, may explain these results. Therefore, they may not necessarily extend to doctors because, contrarily to nurses, doctors occupy an upper level in the organization's hierarchy. Additionally, doctors are professionals who are more educated and motivated to be considered self-leaders (Ugurluoglu et al., 2015; Zhang et al., 2023). Therefore, we expect to see higher behavioural outcomes for those doctors who perceive that they are following a transformational leader who considers associates' needs and converts them into leaders, whilst the lowest levels may correspond to a *laissez-faire* style.

Based on our analysis, the first hypothesis is stated as follows:

**H1:** A perceived transformational leadership style has a more positive effect on the behavioural outcomes of doctors than a transactional style, whilst *laissez-faire* (i.e., no style) has a negative impact.

## 2.2 Behavioral outcomes and the use of AIT for managerial decisions

The growing demand for healthcare services and quality improvement has put a lot of pressure on doctors to manage and control costs. Doctor managers are expected to become regular users of AIT to support decision-making and control their subordinates. The underlying rationale is that doctors' decisions about patient treatment and care commit hospitals to costs and must be conscious of the economic implications of their clinical decision-making. Therefore, the information provided by AIT will be used for decision control of doctor managers. Medical motives for accepting managerial responsibility may be primarily defensive. Once doctors are responsible for most managerial decisions that commit hospital resources, the political strategy of co-opting them into the management aims to ensure that clinical professionals become directly involved in the administrative process (Xirasagar et al., 2005).

As Abernethy and Vagnoni (2004) noted, the users of accounting information, i.e. physicians, should be considered when designing AIT in hospitals. Furthermore, Ferreira-da-Silva et al. (2019) showed that the presence of a transformational style of leadership in hospitals produces a positive perception of AIT by doctors. We progress in this idea by hypothesizing that the behavioural outcomes of each leadership style mediate the use of AIT. When the style is positively perceived and has positive consequences on the three behavioural outcomes, i.e., effectiveness, satisfaction and extra effort, doctors feel more committed to the hospital. They are more inclined to use AIT. Effectiveness enhances the use of AIT because it is recognized as essential to any process that requires organizational changes, mainly when the change involves highly-qualified professionals, such as doctors, and highly politicized institutions, such as hospitals (Abernethy and Vagnoni, 2004). Organizational changes that imply the introduction of AIT also need extra effort to overcome challenges. It might also be expected that satisfaction with the leader promotes the involvement and commitment of doctors with economic and financial objectives.

Doctors are an educated workforce willing to develop their abilities, seek personal enrichment, and understand and assume their organizational mission (Hater and Bass, 1988). If their senior doctor develops an adequate leadership style, its behavioural outcomes will likely facilitate the use of AIT. We expect that behavioural outcomes encourage the use of AIT, which is perceived as an organizational goal (Engin and Gürses, 2019), an objective of implementing organizational changes that involve professionals in the managerial process (Jansen,

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2011). Positive behavioural outcomes are suitable for guaranteeing organizational commitment when organizational changes that deal with AIT are implemented, mainly when the change involves doctors and hospitals (Abernethy and Vagnoni, 2004; Ferreira-da-Silva et al., 2019). Our second hypothesis is, therefore: **H2:** Positive behavioural outcomes from a leadership style positively influence using AIT information for decision-making and decision-control.

## 2.3 Behavioral outcomes inter-relationship

The three behavioural outcomes: effectiveness, satisfaction and extra effort, are not balanced. Previous research has reported causal precedence of satisfaction over organizational commitment, leading to extra effort to achieve organizational goals (Yun et al., 2007). In the healthcare sector, subordinates' satisfaction is positively related to patient satisfaction, increasing effectiveness. Satisfaction is also a facilitator of trust and loyalty to leaders, generating effectiveness and extra effort (Myrden and Kelloway, 2015).

As it is above mentioned, the healthcare literature on our study topics is mainly focused is staged by the nursery body. The relationship between satisfaction and other leadership outcomes is not an exception. Trofino (2003) reports that as satisfaction increased, effectiveness and extra effort increased for nurse staff. Kammerlind et al. (2004) identify the facilitator effect between satisfaction and the other outcomes, for the healthcare sector, by improving patient satisfaction and care. They find that healthcare organizations that are customer and process focused have satisfied employees improving organizational results and more satisfied patients.

The effect of satisfaction on effectiveness and extra effort among highly-qualified physicians needs to be explored more. To this aim, we formulate our third hypothesis as follows:

H3: In hospitals, associates' satisfaction with the leader's behaviour promotes effectiveness and extra effort.

## 2.4 Effect of the use of AIT for decision control on decision management

Academics generally agree that AIT information supports management and control decisions. The AIT information facilitates organizational members to make both management and control decisions, which should be consistent with the organization's objectives (Iveroth et al., 2013). The increasing importance of healthcare costs requires using AIT for decision management and control. Using accounting information for management decisions reduces ex-ante uncertainty to make better-informed and educated decisions. AIT provides ex-post information for decision control to evaluate associates' performance and closeness to organizational objectives (Bouwens and Abernethy, 2000).

Abernethy and Vagnoni (2004) assessed these two roles of AIT in their decisions through the organizational use of budgetary information at a subunit level. The first is the decision management role, i.e., doctor managers use AIT (budget information) in their decisions. The second is the decision control role which refers to the use, by their senior managers, of accounting information to control the doctors' behaviour (i.e., their clinical decisions). Using AIT information for decision management reinforces formal authority (Abernethy and Vagnoni, 2004). The use of AIT for decision control positively influences its use in doctors' decision-making process (Ferreira-da-Silva et al., 2019).

Our hypothesis is based on the following rationale. If senior managers monitor (control) subordinates using AIT information, it is plausible to assume that doctors will want to use the same information structure for their decision-making. In that way, doctors will feel more confident about the information supporting their decisions, as they will be controlled by it. This hypothesis is built on 'strategic coherence' (Lusiani and Langley, 2019), meaning that senior doctor managers will transmit consistent messages throughout the managerial hierarchy. Therefore, we propose our fourth hypothesis as follows:

**H4:** The use of AIT for management control by senior doctor-managers positively influences associate managersdoctors to use AIT for decision-making.

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#### 3. Methodology

We conduct this study in two large public Portuguese hospitals. They had similar characteristics and faced a similar political, economic and regulatory environment. They are both located in the same district in the north of Portugal. Both hospitals were public, university and central, had the same funding arrangements and were organized into similar internal formal structures. We chose this setting because the Portuguese government introduced 2003 a structural reform of healthcare, primarily aimed at public hospital management. The intention was to introduce disruptive changes with irreversible effects.

Consequently, hospitals in the public sector faced administrative and structural changes, which may have considerably impacted their management. These changes included decentralization of authority to give hospitals more autonomy and to make them act more like businesses to attract consumers and resources. Hospitals in Portugal have become autonomous units, much like the hospital trusts created by the 2003 reform of the National Health Service in the United Kingdom (National Health Service and Community Care Act 1990). This means that

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each hospital prepares a business plan and budget proposal, which, after being approved, serve as a basis for performance evaluation and budget control. These hospitals are semi-independent autonomous governmental health units within the civil service. This change in their status will eventually give them much more authority in dealing with personnel, budgets, and capital. Since then, AIT has experienced substantial changes and increased importance in managerial decision-making. Additionally, most significant changes in internal hospital management are directed towards doctors. These significant structural changes may lead to substantial changes in hospital authority and important changes in AIT's role in decision-making.

This paper is part of a comprehensive long-range research project initiated in 2009 in collaboration with the Otorhinolaryngology Service. Despite facing a temporary 3-year pause due to the pandemic, we steadfastly continue our research alongside the same medical service. The data for this study were collected using questionnaires. We issued 93 of them but only 72 doctors-managers (77.42 per cent) decided to collaborate with us. Of the 72, 43 came from the first hospital and 29 from the second. The confidentiality agreement reached with the second hospital limited our disclosure of information on the sample, so we can only report details about the first hospital. The average seniority of clinical service directors in their current positions for the whole sample was 9.87 years (SD = 5.03); 28 of them had PhDs (40.58 percent). The sample from the first hospital was 62.5 per cent male, the average age was 56.43 years, and the average seniority as doctors was 31.28 years. All of the interviewees in both hospitals worked as heads of services, but 20 (27.78 per cent) were graduate assistants, with lower administrative classification than the other 52 (72.22 per cent), who were, and worked as, heads of service. To test how each proposed factor behaved in this sample, we retained the original data and did not exclude any participant from the sample.

For interviewees about the use of AIT for decision management and decision control in hospitals, we use the questionnaire earlier used by Ferreira-da-Silva et al. (2019), Abernethy and Vagnoni (2004), and Swieringa and Moncur's (1975). To assess the perceptions of the interviewees on the three leadership styles (transformational, transactional and *laissez-faire*) and their behavioural outputs (satisfaction, effectiveness and extra effort), we use Bass and Avolio's Multifactor Leadership Questionnaire (Bass and Avolio, 2004). We translated this questionnaire from English to Portuguese and performed a pre-test of the questionnaire with experts in research into hospitals. This confirmed its adequacy. All respondents were responsible for managing one clinical service/unit in one of the hospitals.

We applied the partial least squares (PLS) technique to test our hypotheses. In doing this, we first represent the relationship between the observed variables (answers from the questionnaire) and the latent constructs (transformational style, transactional style and *laissez-faire* styles, satisfaction, effectiveness, extra effort, decision management, and decision control) using the measurement model, assessing its reliability and validity. We defined reflective links as observed variables that are believed to reflect the latent constructs (Chapman and Kihn, 2009). PLS is appropriate for predictive analysis with multiple dependent variables for a relatively small sample size, such as the one we have.

## 4. Results and Discussion

Reliability and validity assess reflective measurement models. To fulfil reliability for exploratory research (Chapman and Kihn, 2009), we dropped six out of twenty items of Transformational Style and two out of twelve of Transactional Style. Additionally, when we examined the loadings of manifest variables, we observed that three items of the construct Transactional style, referred to as passive management, had negative signs, and, consequently, we removed them. All the latent variables shown in Table 1 have high composite reliability (i.e., from 0.8354 to 1.0000).

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Variables	AVE	Composite Reliability	Cronbach's Alpha	$\mathbb{R}^2$
Laissez-faire style	0.7383	0.9712	0.9673	
Transactional style	0.6496	0.9169	0.8907	
Transformational style	1.0000	1.0000	1.0000	
Satisfaction	0.7784	0.8751	0.7235	0.7803
Effectiveness	0.7396	0.9185	0.8802	0.8863
Extra effort	0.9092	0.9678	0.9500	0.8889
Decision control	0.7061	0.9053	0.8592	0.0702
Decision management	0.7175	0.8354	0.6076	0.5785

Table 1. AVE, composite reliability, Cronbach's Alpha and R<sup>2</sup>

Source: Own elaboration

Standardized  $\beta$ -statistics and their p-values assess the adequacy of the structural model and R<sup>2</sup> assesses model fitness. We calculated. The R<sup>2</sup> values for the dependent (endogenous) constructs were very high for the outputs of the three models of leadership while satisfactory for Decision management (R<sup>2</sup>=0.58) and low for Decision control (R<sup>2</sup>=0.07) (Table 1). The PLS results in Table 2 indicate a negative association between *Laissez-faire* style and Satisfaction (-0.2408; p-value < 0.001). Regarding the Transformational style, there was a significant positive association between this style and the three behavioural outcomes: Satisfaction (0.6174; p-value < 0.05), effectiveness (0.3093; p-value < 0.05), and Extra effort (0.5434; p-value < 0.001). We found a marginal significant positive relationship between Transactional style and effectiveness (0.2364, p-value < 0.10). Our results are comparable to those reported for Anglo-Saxon environments (e.g. Xirasagar et al. (2006) for doctors and Casida and Parker (2011), and Witges and Scanlan (2014) for nurses). These results provide support for Hypothesis 1.

Table 2. Results from Plant	LS analysis	(path coefficient	s; n=72)

Paths	Original sample	
Laissez-Faire -> Satisfaction	-0.2408****	
Laissez-Faire -> Effectiveness	-0.0097	
Laissez-Faire -> Extra Effort	0.0377	
Transactional -> Satisfaction	0.1637	
Transactional -> Effectiveness	0.2364*	
Transactional -> Extra Effort	0.1163	
Transformational -> Effectiveness	0.3093**	
Transformational -> Extra Effort	0.5434****	
Transformational -> Satisfaction	0.6174***	
Satisfaction -> Decision Control	-0.5384***	
Satisfaction -> Decision Management	-0.4766*	
Effectiveness -> Decision Control	0.3131	
Effectiveness -> Decision Management	0.0294	
Extra effort -> Decision Control	0.3121	
Extra effort -> Decision Management	0.2555	
Satisfaction -> Effectiveness	0.4350****	
Satisfaction -> Extra Effort	0.3356***	
Decision Control -> Decision Management	0.6849****	

 $p^* < 0.10$  (one-tail test);  $p^* < 0.05$ ;  $p^* < 0.01$ ;  $p^* < 0.001$ .

#### Source: Own elaboration

Regarding Hypothesis 2, the effect of Satisfaction, Effectiveness and Extra effort on the use of AIT for Decision control and Decision management, we only found a significant relationship for satisfaction on both control and management (-0.5384, p-value <0.01; -0.4766, p-value<0.10). Surprisingly enough, the relationship is negative, meaning that doctors-mangers who are more satisfied at work with the leadership style of their superior are those

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who are negatively inclined towards using AIT information for decision-making and control. This result might be explained by the fact that doctors are highly-qualified professionals, committed not only to their organization's goals but mainly to their patient care and safety (Shoemaker et al., 2010). Doctors' satisfaction based on patients' care, more vital than satisfaction generated by their leader, might drive a specific denial to manage the economic figures involved in their daily decisions. We must then reject hypothesis 2. This negative effect contradicts some previous studies (Abernethy and Bouwens, 2005), although others on the topic do not refer to this relationship (e.g., Chenhall, 2003).

Satisfaction is positively related to Effectiveness (0.4350; p-value < 0.001), and Extra effort (0.3356; p-value < 0.01). These results support Hypothesis 3. Those physicians who are more satisfied with their leader are prone to invest additional effort and perceive that their leader is effective. We confirm that satisfaction is an antecedent of the other two outcomes, Effectiveness and Extra effort.

We also found a strong and significant association between Decision control and Decision management (0.6849; p-value < 0.001), which leads us to accept Hypothesis 4. This result indicates that those doctor managers whose leaders use AIT information to exert decision control are prompted to use AIT for decision-making. These doctor-managers like their superiors to use AIT information to control their performance like to use AIT information for their decision-making. Previously, Abernethy and Vagnoni (2004) addressed the importance of decision control and decision management to doctors appointed to manage the day-to-day activities of clinical units by examining how superiors use budget information to control doctor-managers' behaviour. They considered both roles as simultaneous consequences. Here, we found that using AIT for decision control is an antecedent of clinician-managers' favourable use for decision-making.

## 5. Conclusions and Future Research

The healthcare sector faces significant challenges, which may be overcome by, among other options, the involvement of doctors in managerial processes. These challenges imply substantial changes in the hospitals. Doctors playing a middle administrative role are becoming regular users of AIT. How these doctor-managers use accounting information depends on their senior doctors' leadership style and behavioural outcomes. This paper focuses on how these doctor-managers behave in response to their perceptions of the leadership style of their senior doctor and the effect that this behavioural response exerts on their use of AIT for decision-making. We also examined how this use of AIT influences their views of the decision controls used by their senior doctors.

Our results provide evidence that a transformational leadership style stimulates positive behavioural outcomes, i.e. satisfaction, effectiveness and extra effort, in doctor managers, whilst a *laissez-faire* style results in adverse outcomes in satisfaction. The transactional style is more neutral, with a marginal effect on effectiveness. In sum, transformational leadership achieves the best behavioural outputs. This result has already been reported by previous research in Anglo-Saxon environments. Our contribution is the confirmation of this hypothesis in other settings and, for doctors, become this approach a noteworthy novelty. We also find that satisfaction is solely the behavioural outcome affecting the use of the AIT information for decision-making and decision-control by doctor-managers.

Contrary to our expectations, it results in lower use of the AIT. These doctor-managers feel satisfied with their leader and their work. Satisfaction driven by their professionalism and commitment to patient care and safety is vital enough to overcome satisfaction driven by their leader and commitment to organizational goals. In sum, they do not perceive the AIT information as a valuable tool for their decision-making.

Remarkably, satisfaction is the key outcome, negatively affected by the *laissez-faire* style, neutral for transactional and positively affected by the transformational style. It is a behavioural outcome that indicates

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whether a leader generates a positive and satisfactory working environment for their followers. Its primary role might be explained by the two objects of our research setting: doctors are highly-qualified professionals, and hospitals are highly politicized and hierarchical institutions. Satisfaction is crucial for these two objects. This finding may interest both researchers and practitioners. The desired satisfaction is achieved using the transformational style and not by introducing an accounting logic of performance.

Our contribution to literature is threefold. First, we explore the effect of different leadership styles on behavioural outcomes. We found that the relationship among these constructs could be more complex, and doctors' professionalism plays an important role that needs attention. These results have practical implications for regulators when implementing reforms of the AIT in hospitals. There are also implications for academics because further research is needed to clarify these complex relationships. Second, we contribute to the knowledge of the involvement of doctors in managerial processes. As highly-educated professionals, we have learned that doctors look for their criteria (e.g., the Hippocratic oath leads to patients' care and safety) and only sometimes consider managerial ones. This contribution hints at hospital top managers when designing practical procedures that combine medical and administrative criteria. Again, professionalism in the healthcare setting needs further attention from academics. Finally, we contribute to the topic's literature by researching doctors' issues in a non-Anglo-Saxon country. Prior literature has mainly focused on nurses and Anglo-Saxon countries. Both facts might influence contradictory results with previous literature due to the different research settings. Country culture influences institutions such as hospitals and medical professions. Hence, an international research setting could help determine the specific relationship between leadership styles, behavioural outcomes, and the use of accounting information for decision management and control.

As with all exploratory research, the study has some potential limitations. First, we examined a relatively simple model. Second, the sample size could also be considered a limitation, even though it was internally consistent. Our sample was only 72 managers. Although we use statistical procedures applicable for short samples, this could have biased against finding any statistically significant differences. A third limitation is that we used a sample of Portuguese managers. Cultural, economic, psychological and social factors could have biased their answers. Future research should be based on a more extensive sample, adding information from other countries and incorporating cultural country parameters as another exciting element to explain the effect of leadership style in the use of AIT for decision-making and decision control.

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Amélia Ferreira da SILVA is a Coordinating Professor at Porto Accounting and Business School, Polytechnic of Porto. She has a Phd in Accounting, from University of Vigo, Spain. She was head of CEOS.PP - Centre for Organizational and Social Studies of Porto Polytechnic, by FCT – Fundação para Ciência e Tecnologia, the Portuguese entity for science. Her research interests are accounting for decision making, digital transformation in accounting, and business failure prediction. ORCID ID: https://orcid.org/0000-0002-8366-9863

Belen FERNANDEZ-FELJOO worked in the public sector and in private companies for 12 years. She developed her academic career in University of Vigo. She was hired as an assistant professor in 1992, received her Ph.D. in 1994, became associate professor in 1997, and full professor in 2020. Her research interests are in the areas of hospital management, corporate social responsibility, and cooperative enterprises. She has published in journals such as Corporate Social Responsibility and the Environment, Journal of Business Ethics, and Australian Accounting Review. ORCID ID: https://orcid.org/0 0000-0003-3642-2136

Susana GAGO-RODRÍGUEZ is a lecturer in the Department of Financial Management at the Universidad Pontificia Comillas. She holds a PhD in Economics and Business Administration. She leads the Financial Reporting and ESG research group at ICADE and is a member of the CETIS PhD committee and the AACSB support committee. She is currently associate editor of the International Journal of Disclosure and Governance. Her research focus on critical and behavioural accounting and auditing, management control and ethics, areas where she supervises doctoral theses. ORCID ID: https://orcid.org/0000-0002-6225-9822

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Clarivate Analytics

## INFORMATION TECHNOLOGY FOR INTELLECTUAL ANALYSIS OF ITEM DESCRIPTIONS IN E-COMMERCE\*

Olga Cherednichenko<sup>1</sup>, Oksana Ivashchenko<sup>2</sup>, Marcel Lincenyi<sup>3</sup>, Marián Kováč<sup>4</sup>

1.2,3,4 Bratislava University of Economics and Management, Furdekova 16, 851 04 Bratislava, Slovakia

*E-mails:* <sup>1</sup> <u>olga.cherednichenko@vsemba.sk;</u> <sup>2</sup> <u>oksana.ivashchenko@vsemba.sk;</u> <sup>3</sup> <u>marcel.lincenyi@vsemba.sk;</u> <sup>4</sup> <u>marian.kovac@vsemba.sk</u>

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Abstract. E-commerce is experiencing a robust surge, propelled by the worldwide digital transformation and the mutual advantages accrued by both consumers and merchants. The integration of information technologies has markedly augmented the efficacy of digital enterprise, ushering in novel prospects and shaping innovative business paradigms. Nonetheless, adopting information technology is concomitant with risks, notably concerning safeguarding personal data. This substantiates the significance of research within the domain of artificial intelligence for e-commerce, with particular emphasis on the realm of recommender systems. This paper is dedicated to the discourse surrounding the construction of information technology tailored for processing textual descriptions pertaining to commodities within the e-commerce landscape. Through a qualitative analysis, we elucidate factors that mitigate the risks inherent in unauthorized data access. The cardinal insight discerned is that the apt utilization of product matching technologies empowers the formulation of recommendations devoid of entailing customers' personal data or vendors' proprietary information. A meticulously devised structural model of this information technology is proffered, delineating the principal functional components essential for processing textual data found within electronic trading platforms. Central to our exposition is the exploration of the product comparison predicated on textual depictions. The resolution of this challenge stands to enhance the efficiency of product searches and facilitate product juxtaposition and categorization. The prospective implementation of the propounded information technology, either in its entirety or through its constituent elements, augurs well for sellers, enabling them to improve a pricing strategy and heightened responsiveness to market sales trends. Concurrently, it streamlines the procurement journey for buyers by expediting the identification of requisite goods within the intricate milieu of e-commerce platforms.

Keywords: Information Technology; e-Commerce; Product Matching; Text Processing; Model; Artificial Intelligence

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## 1. Introduction

The concept of business digital transformation signifies a pivotal shift wherein digital technologies assume a central role in shaping business operations and broader societal changes (Vaska et al., 2021). Among these transformative technologies, the Internet of Things (IoT) and Artificial Intelligence (AI) stand out as game-changers, wielding a profound impact on the trajectory of business development (Caputo, 2021). Our research is particularly attuned to enhancing product matching processes within the e-commerce sector, recognizing its far-reaching implications for customers and sellers. As underscored by calculations provided by Statista Market Insights in 2023, the compound annual growth rate (CAGR) of retail e-commerce sales is anticipated to maintain an impressive trajectory, projected at a robust 11.16 percent from 2023 to 2027. This surge in e-commerce growth is emblematic of the broader digital transformation sweeping across industries, further emphasizing the significance of optimizing processes like product matching to meet the evolving demands of the digital age.

The rapid growth of the e-commerce sector has ushered in a steep surge in competition, compelling sellers to embrace information technologies and innovations within their business processes. According to recent statistics (Digital Transformation - Statistics & Facts, 2023), three pivotal technologies are steering the course of digital transformation across various economic industries: big data (64%), the cloud (50%), and artificial intelligence (AI) (44%). In recent works (Kumar & Rn, 2019; Bharadiya, 2023), noteworthy trends have emerged regarding utilizing information technologies in e-commerce and the broader business landscape. Chatbots and virtual assistants have emerged as instrumental tools, streamlining customer communication, answering common queries, disseminating seller information, and facilitating smoother transactions. Furthermore, integrating applications offering augmented reality and virtual reality (AR and VR) during the product purchasing process has proven to be a strategic approach to maintaining competitiveness in e-commerce (Magnolia Market, 2023). Additionally, web scraping bots and web scraping APIs have empowered businesses to extract valuable data from websites (Bright Data, 2023; Oxylabs, 2023; Smartproxy, 2023).

Machine learning and AI techniques have emerged as invaluable assets, automating tasks related to data analysis, transformation, and feature extraction, thereby enhancing the decision-making processes and overall business operations. These technologies have been harnessed to collect and interpret customer preferences, transaction data, reviews, and estimations, paving the way for personalized customer support and targeted marketing and advertising campaigns. Notably, Amazon's recommender systems have a rich history (Smith & Linden, 2017; Amazon Science, 2019), with a substantial 35% of customer purchases attributed to their influence, as reported by McKinsey and Company in 2013. Furthermore, contemporary advancements in this field have led to intriguing developments, such as Amazon's Personalization team opting to base learning on a product-level buying history, yielding superior results compared to consumer-level histories. In this intensely competitive e-commerce landscape, integrating these technologies and strategies is pivotal for sellers aiming to thrive and excel in a rapidly evolving digital marketplace.

The challenge of processing product descriptions has been a longstanding concern, with effective solutions contingent upon the quality and variety of available text data. This paper seeks to develop an adaptable and versatile information technology framework for product matching by processing item descriptions. Our approach entails the construction of this information technology as a series of flexible pipelines designed to facilitate product searching, categorization, and matching.

#### 2. Theoretical background

Researchers, as noted by (Chatterjee, 2015), define e-commerce as a mode of business where parties engage in transactions over the Internet utilizing various means and technologies. However, the digitalization of business, including e-commerce, brings with it a set of advantages and disadvantages. One notable disadvantage of e-commerce, as highlighted by (Taher, 2021), revolves around security and privacy concerns. Recently, even reputable companies have fallen prey to scam attacks, losing valuable customer data. This issue is further underscored in the work of (Jamra et al., 2020), where the most prevalent security issues in e-commerce encompass credit card fraud, cyberattacks, and threats to sensitive information. The e-commerce transaction process, as elucidated by (Chatterjee, 2015), comprises several intricate steps, each necessitating security and privacy measures.

Additionally, these steps often require the collection of personal customer information. Without robust safety measures, the risks of data breaches and unauthorized use of personal information loom large. Therefore, detecting and managing risks associated with security and privacy are integral components of effective online platform management, yielding benefits for both customers and sellers.

Beyond the sphere of safety and privacy, (Guru et al., 2020), drawing from a review of research papers, identifies three primary categories of perceived risks in e-commerce: performance risk, financial risk, and time-loss risk. Perceived risk characterizes the uncertainty customers experience when making purchasing decisions. Performance risk pertains to whether products meet customers' expectations in terms of functionality. Financial risk relates to whether the quality of online services justifies the monetary investment made by customers. On the other hand, a time-loss risk emerges when customers are dissatisfied with the vast array of products returned in response to their queries, often due to poor product matching, delivery issues, or complicated return procedures. Consequently, time-loss risk can be defined as the time required to purchase, return, or exchange items when customers find them unsatisfactory.

Our suite of information technology solutions assumes a consequential role in mitigating these risks and preserving the integrity of customer data. We propose an information technology for the intelligent analysis of item descriptions, with the primary objective of addressing the inherent temporal inefficiencies in e-commerce operations. Our system components are intentionally designed to refrain from storing or processing personal customer data, thus mitigating the susceptibility to data breaches. In the context of mitigating time-loss risk, our technology excels at matching product features to search queries and recommending products that align with customer preferences. These matching results undergo meticulous calibration to optimize precision and relevance, expediting the shopping process and generating substantial time and cost savings for users. This functionality fosters elevated trust among customers in their engagements with online platforms.

The subject of item matching has been a subject of previous investigation by researchers (Appel et al., 2022; Peeters et al., 2020; Zuo et al., 2020; Strauß et al., 2019; Akritidis et al., 2019; Akritidis & Bozanis, 2018; Mudgal et al., 2018; Kannan et al., 2011; Köpcke et al., 2012; Gopalakrishnan et al., 2012; Zheng, & Sun, 2022). Typically, this involves categorizing attributes through utilizing specific similarity functions designed to process these attributes (Strauß et al., 2019; Łukasik, 2021). An alternative approach for matching unstructured product offerings involves semantic processing of item descriptions (Shah et al., 2018; Ristoski et al., 2018, Nigam et al., 2019; Singh & Shashi, 2019). The central task in this context is addressed as a binary classification problem, where pairs of product offers are assessed to determine whether they describe the same or similar products (Ristoski, 2018, Strauß et al., 2019; Akritidis et al., 2019; Łukasik et al., 2019; Lukasik et al., 2019; Lukasik et al., 2019; Lukasik et al., 2019; Lukasik et al., 2019; Akritidis et al., 2019; Lukasik et al., 2019; Luka

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A diverse range of techniques is employed to tackle the challenge of product matching, spanning natural language processing and machine learning methodologies. There has been a discernible shift in the development of tools and algorithms in recent years. There is a notable transition from traditional statistical and machine learning methods toward adopting deep learning techniques, particularly those rooted in transformer architectures and language models (Peeters et al., 2020; Li, 2020; Ye, 2022). This paradigm shift has resulted in a substantial body of research focused on the implementation of end-to-end entity resolution tasks (Konda, 2018; Konda et al., 2016; Mudgal et al., 2018; Dou et al., 2023; Wang et al., 2021; Peeters et al., 2020, Primpeli & Bizer, 2021). The entire process is consolidated into a single integrated model in this context. Additionally, considerable research efforts have been directed toward the creation and refinement of benchmark datasets tailored for evaluating the efficacy of various product matching approaches (Bizer et al., 2019, Crescenzi et al., 2021; Foxcroft et al., 2021, Peeters et al., 2023, Primpeli et al., 2019; Primpeli & Bizer 2020; Wang et al., 2022). These benchmarked datasets are fundamental for model training and evaluation, facilitating robust comparisons and methodological analyses.

Our research addresses the intricate challenge of item matching within the context of e-commerce platforms. We observe the proliferation of identical physical items offered across multiple e-commerce platforms in the contemporary landscape. Moreover, the same physical item may be presented with disparate descriptions and associated conditions even within a single platform. Consequently, locating a specific item has become a time-intensive undertaking for both customers and sellers. In response, we propose an innovative information technology solution for product matching. This solution amalgamates state-of-the-art approaches in entity resolution, natural language processing, and constructing a flexible data analysis pipeline.

## **3.** Research objective and methodology

Text mining is concerned with extracting structured information from unstructured text collections. The methodologies employed in text mining necessitate task-specific text analysis processes, often comprising multiple interdependent steps. Typically, these processes are implemented through the creation of text analysis pipelines. A significant challenge arises from the fact that these pipelines are predominantly constructed manually, demanding expertise in their design. In addressing the problem of product matching, methods for processing item descriptions can be categorized into distinct stages, encompassing preliminary data processing, tokenization, and the application of specialized processing steps such as clustering and classification. These processing steps collectively constitute the pipeline.

Conceptually, a text analysis pipeline can be represented as a tuple comprising a set of text analysis algorithms and a schedule that dictates the sequence in which these algorithms are applied (Wachsmuth et al., 2013). Each algorithm within the set is responsible for a specific text analysis task, generating information of predefined types as output. To operate effectively, each algorithm relies on the input text and information of specific types, which preceding algorithms must produce within the pipeline. Consequently, the schedule must ensure the fulfilment of input requirements for all algorithms.

The primary objective of text analysis pipelines is to process input texts, transforming them into structured information relevant to specific needs. Consequently, a pipeline's core text analysis task can be summarized as follows: Given a collection or stream of input texts, process them to deduce structured information. The nature of the input texts can range from a confined set of texts in a specific domain to an ongoing stream of open-domain texts from the web. Notably, the composition of text analysis algorithms is inherently task-specific. Thus, when confronted with a text analysis task, a text pipeline is predefined by selecting and scheduling a suitable subset of available text analysis algorithms.

Our approach presents a systematic sequence of steps for processing product text descriptions to identify similar or identical products through machine learning algorithms (see Fig. 1). The initial input data for this process

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encompasses product titles and product text descriptions. In the first step, we focus on the preprocessing, vectorizing, and clustering of the product text descriptions. At this stage, the user has the flexibility to select the most suitable vectorization and clustering models, considering the research objectives and the inherent characteristics of the data. This step serves the dual purpose of reducing the dataset size and generating groups of text descriptions that correspond to similar products. These text description groups serve as the input for the subsequent step.

Moving to the next stage, the second step, we create core tags for each of these groups. These core tags comprise sets of words that encapsulate essential information about a given group of similar products, providing a succinct yet informative description of the group. This step encompasses several substeps, including preprocessing to generate core tags for each similar product group, cleansing to eliminate duplicates and creating core tags through utilizing a word2vec model in terms of a similarity metric. In the final phase, we generate a reference description for similar products by implementing a model based on a reinforcement learning approach. This reference description is a consolidated representation of the identified similar products, streamlining the understanding and communication of their collective attributes and characteristics.



Figure 1. General pipeline for processing product text descriptions

Source: Own work

To establish a functional pipeline, it is imperative to understand its definition, components, and the procedures required for effective deployment. Within the realm of computing systems, a pipeline signifies a structured sequence of operations through which instructions for sequential data processing are systematically passed. It constitutes a methodical framework for the orderly storage, placement, and consecutive data transmission (Wachsmuth, 2015). A distinguishing characteristic of a pipeline lies in the fact that the output generated by the processing of one function serves as the input for the subsequent function in a seamless and interconnected manner.

We implement a data processing pipeline, encompassing critical stages such as data preprocessing, filtering, tokenization, vectorization, and clustering. In this endeavor, we are considering various clustering methods, including well-established techniques such as K-means and SVM (Ahmed et al., 2020; Winters-Hilt & Merat, 2007; Yao et al., 2013; Korovkinas et al., 2019), owing to their widespread applicability in tasks of this nature. Vectorization, a pivotal component of our pipeline, involves converting textual data into numeric representations that encode their underlying meaning. While several vectorization approaches are available, we have opted for the Word Embeddings method, leveraging the Word2Vec model due to its demonstrable superiority in terms of accuracy (Mikolov, Chen et al., 2013; Mikolov et al., 2013).

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We have chosen the WDC Product Data Corpus for experimentation and validation, accessible at <u>http://webdatacommons.org</u>, as our dataset. We are harnessing publicly available Python libraries, including spaCy, gensim, and scikit-learn to facilitate the implementation process. Our software implementation adheres to a structured Python library format comprising modules that can be seamlessly integrated into other applications. This software solution is designed to serve as an adaptable component, suitable for internal and external deployment within various systems. At its core, it features a pipeline controller responsible for orchestrating interactions with preprocessing processors, a token processor that interfaces with the vector model, and a main processor dedicated to data clustering and classification. This design separates processing into distinct modules, ensuring a flexible and versatile framework for data processing.

The main goal of information technology development is to continually enhance and innovate the capabilities, efficiency, and utility of digital tools and systems to meet evolving technological, business, and societal needs. The main objective of our research is to optimize the analysis and understanding of textual product descriptions, enabling accurate identification, categorization, and matching of products while enhancing user experiences in e-commerce and related applications. To achieve this goal, we establish the information technology tailored for processing textual descriptions pertaining to commodities within the e-commerce landscape.

In the context of product description processing within information technology development, there are the following research questions:

RQ1. How can machine learning algorithms, such as Word Embeddings or Word2Vec, be utilized to generate informative vector representations of product descriptions?

RQ2. What techniques and models are most effective in improving product categorization and matching?

RQ3. How can natural language processing techniques be leveraged to improve the accuracy and efficiency of product matching based on textual descriptions?

## 4. Results and discussion

The primary objective is to enhance the generality and flexibility of product description processing. Given that we primarily utilize textual representations for product descriptions, applying natural language processing techniques is a promising avenue. It's essential to acknowledge that product descriptions exhibit distinct characteristics. For instance, product names often incorporate terms that may not directly pertain to the product itself (e.g., "new," "incredible," "innovative," etc.). Additionally, product descriptions may undergo automatic translation into English, enabling the detection of non-English words within titles and descriptions.

Moreover, descriptions of product offerings on e-commerce platforms frequently contain abbreviations, size indicators, brand names, model references, product codes, and more. These peculiarities lead to two significant observations: firstly, text description processing necessitates a specialized preprocessing phase, and secondly, traditional natural language processing methods may not yield the desired outcomes. This type of text resembles more of a raw collection of keywords rather than a semantic representation describing a specific product.

Furthermore, it's worth noting that in many instances, product attributes could be more present, complete, or riddled with errors. Extracting and organizing these attributes can significantly enhance the effectiveness of addressing the product-matching challenge. Therefore, natural language processing techniques can be effectively employed to preprocess and cleanse text descriptions, extract values associated with product attributes, and generate a comprehensive set of keywords that encapsulate product descriptions.
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Given that we process data in textual format, the utilization of embedding methods emerges as a logical choice. We have identified two key tasks for vectorizing text data based on our prior expertise (Cherednichenko et al., 2023) and a wealth of conducted experiments. Firstly, we aim to represent all product descriptions as a collection of keywords that collectively encapsulate the consumer attributes of the product. We assert that keywords associated with a single product should exhibit semantic proximity. To accomplish this, we endorse the approach proposed by (Cherednichenko et al., 2023), which involves tokenizing and cleansing each text description, followed by representing each token (keyword) as a vector. For this purpose, we employ a pre-trained Word2Vec model for the English language from spaCy library. However, it's essential to address the issue of encountering words in the descriptions the model does not recognize. To resolve this, one potential approach is to independently train the model, albeit this entails significant additional resources. Alternatively, if the number of unrecognized words is minimal, they can be eliminated during the preprocessing stage.

The second vectorization task revolves around representing a comprehensive product description in vector format. In this scenario, we posit that two identical products offered by different sellers should yield vector representations that are proximate within the defined vector space. To achieve this, we leverage the available Doc2Vec model from the gensim library. The vector representations of descriptions enable the application of clustering techniques for categorising and grouping similar products or those sharing analogous descriptions.

Given our approach of transforming each textual product representation from an e-commerce platform into a collection of keywords that closely correspond to the product's description, we posit that a cluster of similar products can similarly be represented by a shared set of keywords that collectively characterize the group. We refer to this set as a "tag core," defined as a collection of keywords that semantically depict a group of identical or highly similar products. The threshold for inclusion in the tag core is determined empirically for each cluster of similar products, employing the cosine similarity measure. Thus, we employ a flexible and customizable pipeline (Cherednichenko et al., 2023) for processing descriptions of such product clusters, culminating in the construction of a tag core. The input for this task comprises sets of keywords derived from each product description within the group of similar products, while the output is the resultant tag core.

In summary, building upon the findings in (Cherednichenko, 2023), we propose an information technology framework for processing textual descriptions of products (see Figure 2). This framework streamlines the automation of the entire process, commencing with data collection and preliminary preprocessing of product information sourced from e-commerce platforms and culminating in resolving challenges related to product grouping, categorization, and comparison. The reusability of models and software solutions will enable the construction of customized processing workflows for product descriptions, accounting for the distinct characteristics of product categories and processing objectives. This approach minimizes the labor-intensive research, modeling, design, and approach validation aspects for product comparison tasks. In an extension of our work as presented in (Cherednichenko et al., 2023), we suggest incorporating a crowdsourcing feature to gather data from potential e-commerce customers. Additionally, we emphasize the functions of product matching and the creation of reference descriptions, as illustrated in Figure 2.

The proposed information technology encompasses a suite of functions designed to process textual descriptions of e-commerce products. This technology relies on a family of models encompassing tasks such as data cleansing, tokenization, vectorization, clustering, and classification of texts. These functions are realized through software implementation in the form of flexible custom pipelines, effectively furnishing a mechanism to address the challenges associated with processing textual descriptions. The chosen functions are pivotal in streamlining the preparatory phase of work, which typically demands substantial effort and labor. This phase encompasses activities such as collecting textual descriptions, cleansing them, grouping them, and generating tag cores, ultimately resulting in standardized descriptions for product categories that interest users. This standardization

process structures vast datasets and significantly reduces the time required for subsequent product search and matching.



Figure 2. Functional Model of Information technology

Answering the research questions, we can draw the following conclusions. Addressing the first research question, it is evident that machine learning algorithms, such as Word Embeddings or Word2Vec, prove highly effective in representing keywords within a semantic vector space. These algorithms enable the construction of tag cores for groups of similar products and facilitate clustering of textual descriptions, leading to the formation of product groups. In response to the second research question, we have concluded that to achieve effective categorization and comparison of goods, it is essential to construct a reference description. This reference description serves as the basis for comparison and relies on the cosine similarity measure within the semantic space of product description tags. Regarding the third research question, our findings suggest that while natural language processing technologies may not be ideal for addressing the direct problem of product comparison, techniques such as preprocessing, stop word removal, tokenization, and vectorization have proven to be valuable and can be seamlessly integrated into the overarching information technology.

# 5. Conclusions

E-commerce, as a mode of business, operates in a realm untethered from physical presence, eschewing the traditional brick-and-mortar establishments and direct face-to-face interactions between sellers and customers (Andonov et al., 2021). In the digital epoch, online platforms are steadily evolving into fiercely competitive arenas, harnessing a diverse array of technologies and innovations. The strategic integration of cutting-edge technologies rooted in artificial intelligence (AI) and machine learning has empowered online retailers to revolutionize their service offerings. The deployment of chatbots, virtual assistants, and recommender systems caters to a more personalized customer experience, delivering both cost-efficient and time-saving services.

Source: Own work

Sellers, too, reap the rewards of information technologies. These technologies are invaluable assets for analyzing vast troves of big data, facilitating precise predictions, streamlining decision-making processes, and automating routine business operations and customer interactions. In essence, information technologies have become indispensable allies in the realm of e-commerce, propelling it into the future of business.

The proposed information technology is crucial in safeguarding customer data integrity and streamlining ecommerce efficiency. We offer an intelligent item description analysis solution designed to combat time-related inefficiencies. Our system prioritizes data security by abstaining from personal customer data storage, reducing the risk of breaches. In terms of time efficiency, our technology excels at matching products to search queries based on customer preferences, leading to precise and expedited shopping experiences. This functionality not only saves users time and money but also enhances trust in online platforms

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**Dr. Olga CHEREDNICHENKO, DSc** is an Postdoctorant at the Department of Management and Marketing of Bratislava University of Economics and Management (Slovakia), Professor at the Department of Software Engineering and Management Intelligent Technologies of National Technical University "Kharkiv Polytechnic Institute" (Ukraine). Research interests: the mathematical models of intelligent systems with focus on the multi-agents systems. E-mail: olga.cherednichenko@khpi.edu.ua

Bratislava University of Economics and Management, Furdekova 3240/16, 851 04 Bratislava, Slovakia. National Technical University "Kharkiv Polytechnic Institute", 2, Kyrpychova str., 61002, Kharkiv, Ukraine **ORCID ID**: https://orcid.org/0000-0002-9391-5220

**Oksana IVASHCHENKO** is an PhD student at the Department of Management and Marketing of Bratislava University of Economics and Management (Slovakia). Senoir lector is at the Department of Software Engineering and Management Intelligent Technologies of National Technical University "Kharkiv Polytechnic Institute" (Ukraine). Research interests: data mining, artificial intelligence and machine learning. E-mail: Oksana.Ivashchenko@vsemba.sk Bratislava University of Economics and Management, Furdekova 3240/16, 851 04 Bratislava, Slovakia. **ORCID ID**: https://orcid.org 0000-0003-3636-3914

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**doc. PhDr. PaedDr. Marcel LINCENYI, PhD** is the vice-rector for doctoral and postgraduate studies of Bratislava University of Economics and management (BUEM), an associate professor and Head of the Department of Management and Marketing of BUEM (Slovakia). Research interests: marketing management, marketing of services, marketing communications E-mail: marcel.lincenyi@vsemba.sk

Bratislava University of Economics and Management, Furdekova 3240/16, 851 04 Bratislava, Slovakia. **ORCID ID**: <u>https://orcid.org/ 0000-0002-9076-026X</u>

**Ing. Marián KOVÁČ, PhD,** is an associate professor of the Department of Management and Marketing of BUEM (Slovakia). Research interests: crisis management, risk management E-mail: marcel.lincenyi@vsemba.sk Bratislava University of Economics and Management, Furdekova 3240/16, 851 04 Bratislava, Slovakia. **ORCID ID**: <u>https://orcid.org/0000-0003-4701-7830</u>

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# THE USEFULNESS OF FINANCIAL INSTRUMENTS IN ASSESSING THE BANKRUPTCY RISK OF COMPANIES\*

Analytics

# Agnieszka Lisowska <sup>1</sup>, Tadeusz Waściński <sup>2</sup>, Jevgenijs Kurovs <sup>3</sup>, Marcin Szpernalowski <sup>4</sup>, Małgorzata Waszkiewicz <sup>5</sup>

<sup>1,2,4,5</sup> Faculty of Management, Warsaw University of Technology, Narbutta 85 Street, 02-524 Warsaw, Poland
 <sup>3</sup> Riga International School of Economics and Business Administration, Meža iela 3, Zemgales priekšpilsēta, LV-1048, Rīga, Latvia

*E-mails:* <sup>1</sup> <u>agnieszka.lisowska@pw.edu.pl;</u> <sup>2</sup> <u>tadeusz.wascinski@pw.edu.pl;</u> <sup>3</sup> <u>jevgenijs.kurovs@riseba.lv;</u> <sup>4</sup> <u>mszpernalowski@gmail.com;</u> <sup>5</sup> <u>malgorzata.waszkiewicz@pw.edu.pl</u>

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Abstract. The research problem relates to modern enterprises' central dilemmas, which use existing financial instruments to assess the company's situation. Issues raised in this study involve identifying matters in the financial analysis of chosen companies listed on a stock exchange, the recognition of which may improve and heal the current economic situation. For this purpose, the document analysis and analysis methods were used. Documents contain financial statements of the researched enterprises, balance sheets and income statements included therein, and the conducted source analysis of contemporary subject literature of economics, finance and statistical studies. Studies on assessing the financial situation of the researched companies were carried out according to the following structure: preliminary analysis of financial statements, preliminary analysis of balance sheet, preliminary analysis of income statement, preliminary analysis of cash flow statement, ratio analysis of financial statements, working capital and financial liquidity ratios, efficiency ratios, debt and debt sustainability ratios, capital market ratios. The article ends with the financial condition improvement recommendations. This study may be used in similar scientific publications and teaching materials, or enterprises can use it to recognize ineffective areas. It also can be used to assess the effectiveness of the early warning model.

Keywords: stock exchange; economic analysis; financial analysis; early warning models

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JEL Classifications: G17, G33, L61

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## **1. Introduction and review of literature**

In current economic realities, the international business environment is constantly affected by an increasing number of insolvent companies (Grosu et al., 2023, p. 41). A lot of scientific research is held in organizational bankruptcy risk assessment (Štefko et al. 2020; Baboyan, 2023; Cho, Shin, 2023; Jones, 2023; Ullah, et al., 2023).

Financial analysis is, therefore, one of the components without which it is difficult to imagine a proper and effective management of 21<sup>st</sup>-century enterprise. Its usefulness refers to information capable of helping a decision-making process by having confirmatory value, predictive value or both (Frendy, Semba, 2017). The business volume and asset structure matter (e.g., Harris, Raviv, 1988). Corporate control contests and capital structure.

Financial stability analysis allows us to understand cause-and-effect sequences, creating a more complete overview of the situation inside a given enterprise. There is a relationship between the capital structure and the company viability (Baha et al., 2023).

Seňová, Čulková, Taušová and Teplická (2023, p. 65) claim that the more tangible assets the company have, the higher its indebtedness. A financial analysis carried out correctly provides a lot of data affecting the bottom line and allows the development of an effective plan for improving the economic situation.

The financial information and the Management Control Information (MCI) may determine a company's success (Monteiro et al. 2021, p. 497).

The priority direction of the financial diagnosis of an enterprise is its liquidity, which directly determines its economic and financial condition. As the analysis of many early warning systems based on multivariate analysis models shows, it constitutes the most common variable from which discriminant functions are built (Antonovich et al. 2021, p. 66).

There are many financial analysis methods; and they all have a common goal. A firm is called bankrupt when its liabilities exceed the going concern value of its assets (Altman, 2019, p. 8). The financial statements can deliver signals of an increasing probability of bankruptcy (Mucko, Adamczyk, 2023). Bankruptcy risk assessment is crucial for investors who consider investing in stocks or bonds, as well as for managers taking responsibility for activities taken in the area of financing, investment and distribution (Bărbuță-Mişu, Madaleno, 2020).

Anyway, it is important to note, that information about the bankruptcy risk can still be concealed, what may result in bad decisions (Lukason, 2019, p. 1). In our paper we tackle this gap by focussing on the essential information, which is necessary for assessment of the company's situation, and making of pertinent economic decisions.

The study aims to identify issues in the economic and financial analysis of selected companies listed on a stock exchange, which recognition may improve and heal the current and predictive financial situation. From the main research problem, the research hypothesis was derived:

Are the selected enterprises in a proper financial situation and which areas in the financial structure require additional recognition in the process of bankruptcy risk assessment?

## 2. Methodology

The work uses the following research methods: deductive methods of logic and geometry, inductive methods of statistical inference, source analysis of literature on the subject, and analysis of source documents (Apanovich, 2003). This assessment is carried out primarily based on quantitative data, the primary source of which is accounting (Zaleska, 2012, p. 9), in the form of preliminary analysis of financial statements, preliminary analysis of balance sheets, preliminary analysis of income statements, preliminary analysis of cash flow statements, ratio analysis of financial statements, working capital and financial liquidity ratios, efficiency ratios, debt and debt sustainability ratios, capital market ratios. A comparative analysis of two enterprises currently active in the metallurgic sector across Poland and Europe was done. The selected systems were described following the scientific literature. The accuracy of the forecasts obtained from the systems used was evaluated based on observations of the mentioned companies (Gąsiorkiewicz, 2011, p. 82).

## 3. Characteristics of Y Holding S.A.

Y Holding S.A. is an enterprise established in 1946, which is currently one of the largest companies in the metal products sector in Poland and Central and Eastern Europe. Today, the company that went public on the Warsaw Stock Exchange in 2005 specializes in designing, manufacturing and maintaining over 2000 products. Table 1 presents selected financial data of Y Holding S.A. from the previous years correlated with the analyzed period.

Selected financial data	Year					
	2016	2017	2018	2019	2020	
Net revenues from sales of products, goods and materials	377137	568251	617482	702823	675759	
Gross profit (loss)	37932	55247	48891	62557	60120	
Net profit (loss)	33490	45007	41078	56777	50537	
Total assets	538601	621799	693396	722851	733049	
Long-term liabilities	86442	97815	114233	142630	150619	
Short-term liabilities	86466	114598	161042	175323	163654	
Equity	365693	409386	418121	404898	418776	
Share capital	1335	1335	1335	1335	1335	
Number of shares	6676854	6676854	6676854	6676854	6676854	

**Table 1.** Selected financial data of Y Holding S.A. from the previous years

Source: own elaboration based on financial statements of Y Holding S.A.

The above table shows that the company was recording an upward trend in the previous years when it comes to net revenues from sales of products, goods and materials.

It was not until 2020 that there was a fall in this value recorded in comparison to the previous year. The value of assets owned by the company was growing year by year. Long-term liabilities held by the company showed the same tendency.

To conduct a preliminary analysis of the balance sheet of Y Holding S.A. it was converted into its analytical form, presented below in Table 2.

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Contents	Settlement period						
	31.12.2	2019	31.12	.2020	Deviation		
	Value [in thousands of PLN]	Structure value [%]	Value [in thousands of PLN]	Structure value [%]	Value [in thousands of PLN]	I.Dynamics value [%]	
A. Capital assets	444 768	61.53%	477 584	65.5%	32 816	7.38%	
I. Intangible assets	78 418	10.85%	71 636	9.77%	-6 782	-8.65%	
II. Tangible non-current assets	342 691	47.41%	316 159	43.13%	-26 532	-7.74%	
III. Long-term assets	2 892	0.40%		0.00%	-2 892	-100.00%	
IV. Long-term investments	12 123	1.68%	81 034	11.05%	68 911	568.43%	
V. Long-term prepaid expenses	8 644	1.20%	8 755	1.19%	111	1.28%	
B. Current assets	278 083	38.47%	255 465	34.85%	-22 618	-8.13%	
I. Inventories	115 657	16.00%	109 845	14.98%	-5 812	-5.03%	
II. Current receivables	122 121	16.89%	102 352	13.96%	-19 769	-16.19%	
III. Short-term investments	40 305	5.58%	43 268	5.90%	2 963	7.35%	
Total assets	722 851	100.00%	733 049	100.00%	10 198	1.41%	

#### Table 2. Analytical form of balance sheet assets of Y Holding S.A.

Source: own elaboration based on financial statements

For Y Holding S.A. a growing trend in the proportion of capital assets in the structure of assets can be noticed, which is shown by its increase from 61.53% in the base year to 61.15% at the end of 2020.

These are minor deviations resulting from the influence of many variables, one of which is a decrease in the value of property, plant and equipment. It was caused by the sale of machinery and equipment, means of transport, and purchase of land and properties in 2020.

While analyzing the categories of property, plant and equipment in further detail, it is noticed that the increase in gross value of this property compared to the base year was 1%. In contrast, a dominant effect that impacted the decrease in property, plant, and equipment was accumulated amortization and write-downs, characterized by an increase of 22% compared to the base year.

Another category that can be distinguished regarding changes in capital assets is right-of-use assets. They concern mainly all goods held under leasing and reclassification of rights of perpetual usufruct of land.

The obtained results in terms of a ratio of capital assets to total assets depend mainly on the type of industry in which the company operates.

Production companies can reach a rate of 90%, and with the increase in value, there is also an increased risk. The dynamics value is 1.07 (nominal increase in capital assets compared to base year equals 7.38% - Figure 1). This value may be interpreted as indicator of small efforts of the company to investment activity.

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**Figure 1.** Structure of capital assets of Y Holding S.A. *Source:* own elaboration based on financial statements

Simultaneously with increasing capital assets, current assets also decrease. In the base rate, the percentage of current assets in relation to the balance sheet total is 38.47%, 34.85% in the following year, which happens because of small dynamics of 0.92. The dominant position in current assets is occupied by inventories, which constitute 41.59% of the total current assets in the base year and 43% in 2019, suggesting a minimal increase in their value. Maintaining inventory influences the necessity to ensure rhythm and regularity of production. The relation of inventory dynamics to general dynamics of sale has a decreasing tendency, which means that the cause of an increase in current assets lies in the growth of production with a tendency to have a larger share of current assets in sales. During the analyzed period, there is a decrease in inventories of 5.03%, which relates mainly to a decline in materials and goods. Figure 2 presents the structure of current assets.



Figure 2. Structure of current assets of Y Holding S.A. *Source:* own elaboration based on financial statements

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Finances and their equivalents in both years are around 5% of total assets (13.4% of current assets in the base year and 15% in 2019). The percentage ratio of receivables to liabilities in the base year is approximately 45%, while in the following year, it is 50%, which suggests the emergence of problems with financial liquidity and lack of effective fundraising.

One of the main changes in the analyzed period is a tenfold increase in derivative financial instruments, which amounted to 0.03% of total assets in the base year (0.01% of current assets) and 0.36% in 2019 (1% of total assets)—the increase results from the activities taken to reduce the adverse changes caused by foreign exchange transactions.

The analysis of the profit and loss account of Y Holding S.A. shows that the origin of revenues from sales of products amounted to as much as 93% in the base year and 94% in the following year Table 3). However, the remaining revenues are from sales of materials and goods (5% of total assets in 2019 and 2020) and sales of services (2% in 2019 and 1% in 2020). Thus, a downward trend is observed. Sales dynamics reached high values (0.96), meaning sales did not collapse.

Specification	Settlement period							
_	31.12.2	2019	31.12	.2020	Devi	ation		
	Value [in thousands of PLN]	Structure value [%]	Value [in thousands of PLN]	Structure value [%]	Value [in thousands of PLN]	Deviation [%]		
A. Net revenues from sales of products, goods and materials	702823	100.00%	675759	100.00%	-27064	-3.85%		
B. Costs of sold products, goods and materials	547039	77.83%	522210	77.28%	-24829	-4.54%		
C. Gross profit (loss) on sales	155784	22.17%	153549	22.72%	-2235	-1.43%		
D. Sales charges	36670	5.22%	35715	5.29%	-955	-2.60%		
E. General administrative	49844	7.09%	50561	7.48%	717	1.44%		
expenses								
F. Profit (loss) on sales	69270	9.86%	67273	9.96%	-1997	-2.88%		
G. Other operating income	5655	0.80%	5106	0.76%	-549	-9.71%		
H. Other operating costs	11644	1.66%	7861	1.16%	-3783	-32.49%		
I. Profit (loss) from operating activities	63281	9.00%	64518	9.55%	1237	1.95%		
J. Financial income	3051	0.43%	735	0.11%	-2316	-75.91%		
K. Financial costs	3775	0.54%	5133	0.76%	1358	35.97%		
L. Profit (loss) from business	62557	8.90%	60120	8.90%	-2437	-3.90%		
activity								
M. Result on extraordinary events	0	0.00%	0	0.00%	0			
N. Gross profit (loss)	62557	8.90%	60120	8.90%	-2437	-3.90%		
O. Income tax	5780	0.82%	9583	1.42%	3803	65.80%		
P. Other mandatory profit reductions	0	0.00%	0	0.00%	0			
R. Net income (loss)	56777	8.08%	50537	7.48%	-6240	-10.99%		

Table 3.	Profit and	loss account	of Y	Holding S.A.
	1 rome and	1000 account		rioranng on n

Source: own elaboration based on financial statements

The costs of sale in the analyzed period, built by the costs of selling products, goods and materials, amounted to more than 77% of revenues from their sale. In both discussed categories, value gradually decreased, and total proceeds from sales incomes decreased by 3.85%. The most significant impact on them was caused by the revenues from sales of services, which are characterized by a decrease of almost 31% compared to the base year

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and related mainly to a reduction in services in industrial automation. The decline in own selling costs by 3.49% - compared to 2019 - can also be noticed. A dominant part of total sales is the costs of products sold, showing similar values in 2019 and 2020. However, the lowest percentage corresponds to the costs of sold services, showing a decrease from 1.43% of revenues from sales in 2019 to 0.63% in 2020 (a drop of over 58%). A positive phenomenon may be coverage of sales costs with sales revenues, which allowed to generate profit on operations from basic sales.

Loss in sales in the analyzed years does not reach a high value (22.17% in 2019 and 22.72% in 2020), which induces a modest increase in total revenue share.

Operating profit is characterized by a gradual increase of 1.95%, and its percentage increased to 9.55% concerning revenues. The most significant share in capital distribution is general and administrative expenses, amounting to 7.09% in 2020. The most significant change of 32.5% relates to a reduction of other operational costs, with a value of 11 644 thousand PLN in the first year (1.66% of revenues) and 7 861 thousand PLN in the following year (1.16% of revenues). Operating profit is characterized by a positive balance.

Profit resulting from financial activity in both years is about 8.90% of total revenues, and it has not lost its value in relation to sales despite a decrease of 3.90%.

Net profit showed a downward trend in 2020 (from 8.08% in 2019 to 7.48% in 2020). Both incomes and charges slightly contribute to revenue share, ranging below 1% of their sum. The presented company generates a profit before tax on financial activities due to the coverage of financial costs, proceeds and previously generated profit.

The fact that income dynamics is superior to cost dynamics benefits the company's operations. In terms of both categories, almost all components correspond to total revenues and costs. It is different with revenues from the sale of foods and materials, showing the dynamics higher than the revenue by 5%.

Higher dynamics of revenues characterize the ratio of the dynamics of proceeds and operational burdens; however, the most beneficial dynamics is illustrated by revenues (the value of 0.24) and financial costs (the value of 1.36%).

The above preliminary analysis shows significantly higher revenues from primary operating activity. The other operating costs and financial costs from revenues generated from proper activities are higher. Finally, the company generated net profit in both reporting periods. The interiority of net profit dynamics in relation to sales dynamics suggests generating profit from the current activity.

# 4. Characteristics of X S.A.

X S.A. is a company established in 1993. Its main activity is production and trade in tubing, supplied for the gas sector needs in Poland and Central and Eastern Europe. The company is also producing anti-corrosion coatings and is among the European leaders of this industry. Table 4 presents selected financial data of X S.A.

Selected financial data	Year					
	2016	2017	2018	2019	2020	
Net revenues from sales of products, goods	210 061	379 878	563 996	808 128	717129	
and materials						
Gross profit (loss)	3 102	8 766	11 412	18 013	14 488	
Net profit (loss)	2 456	7 093	9 136	14 473	11 900	
Total assets	268 686	365 471	456 261	533 156	489 988	
Long-term liabilities	25 748	33 607	31 610	31 885	35 792	
Short-term liabilities	79 469	161 337	247 301	312 406	257 731	
Equity	163 469	170 527	177 350	188 865	196 465	
Number of shares	32 744	32 744	32 744	32 744	32 744	
	000	000	000	000	000	

Table 4. Selected financial data of X S.A. from the previous year

Source: own elaboration based on financial statements

As in the case of X S.A., net revenues from sales tended to increase until 2019 and decreased in the analyzed period. It is the same with the profit made by the enterprise. Value of assets owned by the company was also growing, and the first decline in several years was noted in the analyzed period. Table 5 presents the analytical form of the balance sheet assets of X S.A.

Contents	Settlement period						
	31.12.2	2019	31.12	.2020	Deviation		
	Value [in thousands of PLN]	Structure value [%]	Value [in thousands of PLN]	Structure value [%]	Value [in thousands of PLN]	I.Dynamics value [%]	
A. Capital assets	172359	30.54%	187322	35.21%	14963	8.68%	
I. Intangible assets	1590	0.28%	1445	0.27%	-145	-9.12%	
II. Tangible non-current assets	166049	29.43%	180522	33.93%	14473	8.72%	
III. Long-term assets	0	0.00%	0	0.00%	0	0.00%	
IV. Long-term investments	0	0.00%	0	0.00%	0	0.00%	
V. Long-term prepaid expenses	4720	0.84%	5355	1.01%	635	13.45%	
B. Current assets	391922	69.46%	344750	64.79%	-47172	-12.04%	
I. Inventories	215562	38.20%	227050	42.67%	11488	5.33%	
II. Current receivables	173952	30.83%	112493	21.14%	-61459	-35.33%	
III. Short-term investments	2408	0.43%	5207	0.98%	2799	116.24%	
Total assets	564281	100.00%	532072	100.00%	-32209	-5.71%	

Table 5. Analytical form of the balance sheet assets of X S.A.

Source: own elaboration based on financial statements

While analyzing the structure of non-current assets in X S.A. for the years 2019-2000 (Figure 3), it can be noticed that there is a significant share of property, plant and equipment in assets, amounting to 29% of total assets in 2018 and 34% in the following year. Items such as intangible assets and non-current prepayments remain at less than 1% of capital assets. The values reached a similar level in both 2019 and 2020. There is an upward trend, except for other non-material assets. Capital assets constitute almost 31% of the balance sheet total in the base year and a little over 35% in the next year. There is an incremental rise in the percentage of capital assets in the total value of the assets.

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**Figure 3.** Structure of capital assets of X S.A. *Source:* own elaboration based on financial statements

Current assets reached 69% of total assets in 2019 and 65% the following year (Figure 4). The dominant components of current assets include inventories, short-term expenditures on deliveries and services, and short-term investments. During the analyzed period, the inventories increased by 5%. Current receivables and prepaid expenses have values of 31% in 2019 and 21% in 2020. The lowest value of current assets is represented by short-term investments, which generated 0.43% of current assets in 2018 and 0.98% in 2020. The short-term investment levels have increased by 116% over the analyzed period.





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The ratio of capital and current assets in 2019 reached 44% and increased in 2020 to 53%. In the first year, the capital invested in current assets exceeds the capital assets twice. In the following year, property, plant and equipment were increased, and current receivables were reduced, which was the reason for the decline in the coverage of capital assets with current assets. Table 6 shows the liabilities of a balance sheet for X S.A. company.

Tat	<b>ble 6.</b> The habilities of a balance sheet for X S.A.							
Content			Settlem	ent period				
	31.12.2	2019	31.12	.2020	Devi	ation		
	Value [in thousands of PLN]	Structure value [%]	Value [in thousands of PLN]	Structure value [%]	Value [in thousands of PLN]	Deviation [%]		
A. Equity (fund)	190271	33.72%	19\$996	37.00%	3725	4.59%		
I. Registered capital (fund)	65488	11.6196	65488	12.18%	0	0.00%		
IV. Supplementary capital (fund)	108897	19.30%	120489	22.40%	11592	10.64%		
VII. Profit (loss) from previous	15886	2.82%	13019	2.42%	-2867	-18.05%		
years								
VIII. Net profit (loss)	15886	2.82%	13019	2.42%	-2867	-18.05%		
B. Long-term outside capital	37317	6.61%	50140	9.32%	12323	34.36%		
II. Long-term liabilities	15339	2.72%	29092	5.41%	13753	89.66%		
III. Non-current prepayments	21978	3.89%	21048	3.91%	-930	-4.23%		
C. Short-term outside capital	336693	59.67%	283717	53.68%	-47976	-14.25%		
I. Provisions for short-term liabilities	2311	0.41%	4990	0.93%	2679	115.92%		
II. Short-term liabilities	134410	23.82%	113183	21.04%	-21227	-15.79%		
III. Short-term inter-period settlements	199972	35.44%	170544	31.71%	-29428	-14.72%		
Total liabilities	564281	100.00%	537353	100.00%	-26423	-4.68%		

Source: own elaboration based on financial statements

The assessment of internal funds of X S.A. shows similar results in 2019 and 2020. The core noticeable change occurs in supplementary capital (19.3% of all funding sources in 2019 and 22.40% in 2020). There has been a decrease in the profit from the previous years over time – by 18% in 2020 in relation to 2019. The company generated a profit from earlier years and the current period.

A noteworthy fact is an increase in the percentage of equity in total liabilities. Internal funds reaching the value of 190 271 thousand PLN in the base year amounted to 34% of all; however, in the following year, 198 996 thousand PLN reached 37% of the total balance sheet.

A percentage of internal funds in an overall view of the company's source of financing indicates unfavourable creditworthiness. The most essential components of short-term liabilities are short-term liabilities, inter-period settlements, and short-term bank credits and loans.

Table 7 presents the profit and loss of X S.A. company.

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	Table 7. Profit and loss of A S.A.							
Specification			Settlem	ent period				
	31.12.2	2019	31.12	.2020	Deviation			
	Value [in thousands of PLN]	Structure value [%]	Value [in thousands of PLN]	Structure value [%]	Value [in thousands of PLN]	Deviation [%]		
A. Net revenues from sales of	866 337	100,00%	770 331	100.00%	-96006,00	-11.08%		
B. Costs of sold products, goods and materials	801 465	92.51%	716 034	92.95%	-85431.00	-10.66%		
C. Gross profit (loss) on sales	64 872	7.49%	54 297	7.05%	-10575.00	-16.30%		
D. Sales charges	23 926	2.76%	13 087	1.70%	-10839.00	-45.30%		
E. General administrative	22 571	2.61%	23 015	2.99%	444,00	1.97%		
expenses								
F. Profit (loss) on sales	18 375	2.12%	18 195	2.36%	-180,00	-0.98%		
G. Other operating income	1 181	0.14%	2 407	0.31%	1226.00	103.81%		
H. Other operating costs	1 581	0.18%	4 526	0.59%	2945.00	186.27%		
I. Profit (loss) from operating activities	17 975	2.07%	16 076	2.09%	-1899.00	-10.56%		
J. Financial income	3 840	0.44%	2 658	0.35%	-1182.00	-30.78%		
K. Financial costs	2 020	0.23%	2 773	0.36%	753.00	37.28%		
L. Profit (loss) from business activity	19 795	2.28%	15 961	2.07%	-3834.00	-19.37%		
M. Result on extraordinary events	-15	0.00%	-49	-0.01%	-34.00	226.67%		
N. Gross profit (loss)	19 780	2.28%	15912	2.07%	-3868.00	-19.56%		
O. Income tax	3909	0.45%	2930	0.38%	-979.00	-25.04%		
P. Other mandatory profit reductions	-18	0.00%	-61	-0.01%	-43.00	238.89%		
R. Net income (loss)	15 853	1.83%	12 921	1.68%	-2932.00	-18.49%		

CVC

Source: own elaboration based on financial statements

The company is characterized by the values illustrated above in terms of revenues and costs of sales with a visible downward trend. Also, net revenues from the sales of products, goods and materials, as well as the costs of products, services, goods and materials sold in the analyzed period, have decreased by around 11% compared to 2019. The results on sales were positive in the studied reporting periods, and sales revenues were higher than the costs of sold products and services. The dynamics of the sale results within 2020/2019 indicate a decrease of 16.30%. In the case of dynamics of costs and revenues in 2020/2019, its value fluctuates around 0.89, suggesting regular reduction of costs and sales revenues in the company.

The charges resulting from the sale amounted to 23 926 thousand in 2019, to decrease in the following year, reaching 13 015 thousand PLN. Sales profit both in 2019 and 2020 shows similar values.

Revenues in 2018 amounted to 0.44% and in 2019 to 0.35% of sales receivables, and they did not have a significant impact on the financial result, similar to financial costs equal to 0.23% in 2018 and 0.36% in 2020 of sales revenues. The financial income exceeded financial costs by 90% at the beginning of the analyzed period. The increase in financial expenses was caused by increasing costs, accruing on interests on credit, liabilities, borrowings, leasing and budget liabilities. The generated profit decreased by 19% in the following year, which amounted to 15 961 thousand PLN on 31 December 2019.

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The result of extraordinary events refers to a difference between, among others, total revenues and losses incurred due to random events. In the base year, there was a loss of 15 thousand PLN, which has increased almost three times in 2019, reaching 49 thousand PLN.

In the analyzed range of years, the gross profit amounted to just over 2% of the share in net sales revenues. There is a visible decrease of 19.56% in comparison to 2019. According to the vertical analysis of the profit and loss account, the company's net profit in 2018 was 1.83% and 1.68% of net revenues from selling products, services, goods and materials in 2019. There is a decrease of 18.49% in relation to the analyzed years.

# 5. Assessment of the financial situation of the analyzed companies

The essential aspects affecting the market in the metal industry include energy prices and customs issues between countries. A capital group of Y Holding S.A. has reached sales revenues of 676 million PLN. At the same time, the company achieved an EBITDA result of 96 million PLN in 2020, the highest result in the Group's history. The net result was fluctuating around 51 million PLN. Despite the significant economic slowdown, especially in the last quarter of 2019, the obtained net profit and EBITDA were consistent with the Management Board's forecast. The economic factors played a significant role in reducing the generated revenues from the operating activity, which were slightly different from the expectations of the Management Board.

In 2020, the X S.A. company presented record-high profits from operational activities based directly on the cash flow of 98 million PLN. As a result, the company was fine with covering capital spending of 40 million and dividend payments of approximately 31 million PLN. The company's net indebtedness remained at 44%, and the equity ratio in funding assets amounted to 56-57%. According to the analysis of three financial liquidity ratios of the company, which had values within the required ranges, the company would be able to cover all short-term liabilities in the case of need. Still, it would be necessary to liquidate some of the capital assets. Despite the relatively high cycle of receivables, liabilities and inventories, the company aims to reduce these rates yearly. The data gathered in this way proves an excellent financial situation and stable cash position on 31 December 2020. The net financial result of X S.A. company was positive in the following two years, and the dynamics in 2019/2020 showed that the company's net profit decreased by 18.49%. On 31 December 2020 the company reported sales revenues of 770 million PLN. The dynamics of revenues and the dynamics of costs from sales show a regular decrease in relation to previous years.

The analyzed liquidity ratio in the studied years remains relatively equal; however, it does not fit into the optimal value of this ratio, which may indicate an excessive freezing of capital in current assets. Although the company does not show problems with maintaining financial liquidity and additionally, an increasing value of ratios may suggest that the company's financial condition continues to improve, the company must liquidate capital assets to cover all liabilities.

The attention is attracted to sales profit, which does not show any improvement, but in the case of this company, it has to look mainly at the net profit. It is connected with exchange rate hedges on imported pipes and the euro exchange rate fluctuations in relation to the Polish zloty influence it. With the sales revenues obtained in the amount of 770 million PLN, the company achieved a net profit of 13 million PLN. This shows that X S.A. company reports a high sales profit and, at the same time, a relatively low net profit.

The company generated negative cash flows from operating activities. The direction of changes in the cash flow statement suggests that the company cannot generate actual cash as part of its core business. Return on assets is slow. Such values are characteristic of the industrial sector. Higher values characterize return on equity.

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The debt ratios are at a similar level over the analyzed period. Total debt fluctuates between 63-65%. It shows how much of the company's assets are financed by loans and indicates its ability to meet its debt obligations. The index obtained by the X S.A., which is above 0.6, is generally considered low as there is a risk that the company will not generate enough cash flow to service its debt. When this result is maintained for an extended period, the company may have difficulty borrowing money. The debt-to-equity ratio compares a company's debt to total equity. It is 197% and 170%, which means that the company's financing comes from creditors, not from its financial sources, which may be a dangerous tendency.

# 6. The study on the risk of bankruptcy of analyzed companies

The risk of bankruptcy appears due to objective factors – usually changes in financial markets – or is caused by subjective factors coming from the financial decisions of the managers (Nguyen, Kien, 2022, p. 23). The more advanced bankruptcy-prediction models have the highest accuracy in large modern datasets they bring (Kanapickiene et al. 2023). Early recognition of bankruptcy risk is essential for immediate corrective actions. Some companies use anti-crisis management tools for deteriorating financial ratios (Garškaitė-Milvydienė, 2014). Early warning systems (EWS) increase the timeframe for efforts to reduce economic damage (Alfieri et al. 2012; Nygård et al. 2018). The carried-out verification of bankruptcy prediction aims to check whether the presented companies can be classified into a group of companies characterized by high efficiency and liquidity, as shown by the authors of the financial statements. To assess the risk of bankruptcy, models from three Polish early warning systems were examined.

The first model was created by Hadasik (1998). Taking into account the author's concept, enterprises can be divided into two groups. The first of them is under threat of bankruptcy. The second group of enterprises involves companies not at risk of bankruptcy despite financial difficulties. The ratios' values in Hadasik's model for Y Holding S.A. are presented in Table 8.

Ratio	Value of the
	ratio
X1 = total liabilities/balance sheet total	0.395
X2= reciveables*365/sales revenue	55.284
X3 = inventories*365/sales revenues	59.331
X4 = net financial result/inventories	0.460

Table 8.	The value	of ratios f	or Y I	Holding	S.A. by	Hadasik's	s model
Lable Of	The tarae	of factor i		ioiams	5.1 <b>i</b> . 0 j	i i u u u u u u	model

Source: own elaboration based on financial statements of the Y Holding S.A.

The value of discriminant function of D. Hadasik's model for Y Holding S.A. is:  $Z1 = -2.50761 \times 0.395 + 0.00141147 \times 55.284 - 0.00925162 \times 59.331 + 0.0233545 \times 0.460 + 2.60839 = 1,158$ Table 9 shows the ratios of the early warning system for X S.A. company.

Table 9.	The v	alue o	f the	ratios	for X	S.A.	by	Hadasik's m	ıodel
							-		

Ratio	Value of the
	ratio
X1 = total liabilities/balance sheet total	0.630
X2= reciveables*365/sales revenues	53.302
X3 = inventories*365/sales revenues	107.581
X4= net financial result/inventories	0.057

Source: own elaboration based on financial statements of the X S.A.

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The value of discriminant function of D. Hadasik's model for X S.A. is:

 $Z1=-2.50761 \ge 0.630 \pm 0.00141147 \ge 53.302 \pm 0.00925162 \ge 107.581 \pm 0.0233545 \ge 0.057 \pm 2.60839 = 0.11$ In this model the critical point was 0. When the value of discriminant function for the analyzed company reaches a value lower that critical point, interpretation may suggest existing rationales for financial bankruptcy of the company. According to applied discriminant analysis appropriate for Hadasik's model X S.A company has reached the value of 0.11 in both analyzed years. The results obtained in this way indicate that the company is not at risk of immediate bankruptcy, but this value is very close to the critical point.

The value of the discriminant function of the model used for Y Holding S.A. was 1.158. The author of the above model did not foresee the creation of grey areas, the range of numbers that correctly characterizes values. Based on the only criterion, with the critical point equal to 0, it can be concluded that both companies are not at risk of bankruptcy.

The second early warning model created by D. Appenzeller and K. Szarzec (2004) classified both companies as having good financial condition. The borderline point of the described early warning system is 0. Table 10 presents indicators of the early warning system for Y Holding S.A.

Ratio	Value of the
	ratio
X1 = current assets / short-term liabilities	1.828
X2= (current assets - inventories - short-term receivables) / short-term liabilities	0.320
X3= gross financial result/sales revenues	0.089
X4 = net financial result/average value of assets	0.069
X5 = average value of inventories * 365 / sales revenues	59.331
X6 = (liabilities+ provisions for liabilities )/(operating results	0.405
+deprecation)*(12/period)	

 Table 10. The value of the ratios for Y Holding S.A. by Appenzeller and Szarzec's model

Source: own elaboration based on financial statements of the Y Holding S.A.

The value of discriminant function for Y Holding S.A. is: Z1 =  $1.28644 \times 1.828 - 1.30528 \times 0.320 - 0.22633 \times 0.089 + 3.01528 \times 0.069 - 0.00538 \times 59.331 - 0.00943 \times 0.405 - 0.661 = 1.138$ 

Ratios of the next early warning system for X S.A. company are presented in Table 11.

**Table 11.** The value of the ratios for X S.A. by Appenzeller and Szarzec's model

Ratio	Value of the
	ratio
X1 = current assets / short-term liabilities	1.194
X2= (current assets - inventories - short-term receivables) / short-term liabilities	0.046
X3= gross financial result/sales revenues	0.021
X4 = net financial result/average value of assets	0.024
X5 = average value of inventories * 365/sales revenues	107.581
X6 = (liabilities+ provisions for liabilities )/(operating results	0.270
+deprecation)*(12/period)	

Source: own elaboration based on financial statements of the X S.A.

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The value of discriminant function in the applied model for X S.A. is:  $Z1 = 1,28644 \times 1,194 - 1,30528 \times 0,046 - 0,22633 \times 0,021 + 3,01528 \times 0,024 - 0,00538 \times 107,581 - 0,00943 \times 0,270 - 0,661 = 0,301$ 

The value for X S.A. fluctuated around 0. It was similar with Y Holding S.A., which obtained values above the critical point. The value of the discriminant function was 1.138. The values of discriminant functions above the critical point are caused by assigning the highest importance to the inventory turnover ratio in both enterprises. The last model provided assessing financial threat is based on logit analysis, which, compared to previous discriminant analysis models, does not aim at meeting predetermined points assuming normality of variables distribution. It means that the effect of this function is the probability of bankruptcy of the analyzed companies or the likelihood of its non-occurrence. This method was developed by P. Stępień and T. Strąk (2004). The form of this function is drawn upon four relations based on a company's liquidity. Table 12 presents the ratios of the early warning system for Y Holding S.A.

Ratio	Value of the
	ratio
X1 = outsider capital/total assets	0.429
X2 = (total current assets - inventories) /	1.042
short-term liabilities	
X3= net financial result/total assets	0.067
X4 = net sales revenues/operating expenses	1.294

Table 12. The value of the ratios for Y Holding S.A. by Stępień nd Strąk's model

The value of discriminant function in the applied model for Y Holding S.A. is:  $Z1=-11 \ge 0.429 + 6 \ge 1.042 + 40 \ge 0.067 + 19 \ge 1.94 - 19 = 9.799$ Table 13 presents values of indicators of the same early warning system, this time for X S.A. company.

Table 13. The value of the ratios for X S.A. by Stępień nd Strąk's model

Ratio	Value of the
	ratio
X1 = outsider capital / total assets	0.637
X2 = (total current assets - inventories) /	1.040
short-term liabilities	
X3= net financial result / total assets	0.024
X4 = net sales revenues / operating expenses	1.076

Source: own elaboration based on financial statements of the X S.A.

The value of discriminant function of this model for X S.A. is:

Z1 = -11 x 0.637 + 6 x 1.040 + 40 x 0.024 + 19 x 1.076 - 19 = 1.637

Comparing the obtained discriminant function values to the adopted criteria of their interpretation it can be found that both companies (Y Holding S.A and X S.A.) are not at risk of bankruptcy within one year.

Both companies Y Holding S.A. and X S.A. recorded a decrease in sales in the analyzed period and should focus on searching for a trade area and expanding it as soon as possible. They should not limit themselves only to their key customers. The solution is to strive to meet the demand of smaller contractors, especially those close to the

Source: own elaboration based on financial statements of the Y Holding S.A.

analyzed companies' logistics centres. An excellent way to increase sales revenue in both companies would be a greater focus on sales and producing products with the highest margin.

In the analyzed period, X S.A. company recorded an inventory turnover ratio significantly different from the benchmark, registering an increase. The high values of this ratio were mainly caused by increasing amounts of inventories that the company accumulated and the decline in sales revenues. The problem of excessive quantity of inventories could be solved by limiting the products which are less popular on the market in favor of those which are sold on an ongoing basis. These solutions would contribute to an increase in the current ratio, close to the desired value at the beginning and end of the analyzed period.

## Conclusions

Some authors believe that document analysis is not typically used for bankruptcy prediction; on the other hand, they also point out the usefulness of correctly setting up a model for this approach (Stankova, Hampel, 2023). The conducted research has shown that the situation of X S.A. company is slightly worse than Y Holding S.A. in the studied period. The dynamics of financial results showed that net profit decreased almost by 20% over the assessed time. The financial liquidity of X S.A. remains at the same level; however, the profitability ratios are not optimal. This fact indicates that there are too many frozen assets in the company's current assets. The company's debt is much higher than that of Y Holding S.A. The X S.A. company finances over 60% of its debts by loans, and outsider capital and debt ratios show that it may not generate such high cash flows to service the incurred debt. Maintaining the debt ratio at this level for a longer time may cause severe problems in the future relating to borrowing money.

Early warning models used to analyze and assess the financial condition of the studied companies showed that both companies have reached the value just above the critical point. Therefore, the financial situation of the companies is good.

The research suggests how to improve the examined companies' financial condition. It also shows EWS model implementation that companies from other sectors can easily follow. The conducted financial analysis should help investors and managers make proper financial decisions.

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Agnieszka LISOWSKA is an Assistant Professor at the Faculty of Management, Warsaw University of Technology. Research interests: economy, finance, management. ORCID ID: 0000-0003-0143-1905

**Tadeusz WAŚCIŃSKI** is a Professor at the Faculty of Management, Warsaw University of Technology. Research interests: economy, finance, forecasting, management. **ORCID ID**: 0000-0002-4848-314x

Jevgenijs KUROVS is a PhD student at the Business Faculty of the RISEBA University of Applied Sciences. Research interests: economy, finance, management. ORCID ID: 0000-0002-7082-9469

Marcin SZPERNALOWSKI is a PhD student at the Faculty of Management, Warsaw University of Technology. Research interests: economy, finance, management. ORCID ID: -

**Małgorzata WASZKIEWICZ** is an Assistant Professor at the Faculty of Management, Warsaw University of Technology. Research interests: economy, project management, real-estate management. **ORCID ID:** 0000-0002-6758-7104

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> Clarivate Analytics

# DISCOVERY OF TAX EVASION IN THE FIELD OF CONSUMPTION TAXES\*

Agneša Víghová

University of Economics and Management in Bratislava, Department of Small and Medium Business, Furdekova 16, 851 04 Bratislava 5, Slovakia

E-mail: agnesa.vighova@vsemba.sk

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**Abstract:** The state budget is the main instrument of state management. The most important source of income for the state budget is taxes, not only in Slovakia but also within the European Union. For the reason mentioned above, the tax area is the focal point of tax collection and recovery of tax arrears. An essential task of the state is to ensure efficient financial administration (tax and customs offices that carry out administration, control and enforcement proceedings), including a stable legislative system that effectively detects tax evasion. Tax evasion occurs most often in indirect taxes, i.e., in the case of VAT and consumption taxes. The article aims to point out typical illegal tax evasion in the consumption tax field and the fight against tax evasion. Analysis and comparison methods were used in the research. The analysis was carried out based on the data of the Financial Administration of the Slovak Republic, where the results of the control activities of the customs authorities were analyzed with a focus on consumption taxes. I drew attention to the most frequently occurring tax evasions in individual excise taxes as well as to the results of the investigation of the Criminal Office of the Financial Administration of the Slovak Republic in the detection of customs tax evasions and VAT on imports.

**Keywords**: excise taxes; Financial Administration of the Slovak Republic; customs authorities; legal tax evasion; illegal tax evasion; collection of excise taxes; international cooperation in the field of excise taxes

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#### 1. Introduction

Detecting tax evasion is a primary goal in the Slovak Republic and the European Union. The biggest tax evasion arises from indirect taxes, which are value-added and consumption taxes. Detecting tax evasion is a continuous and challenging process; while it is not possible to eliminate it, it is possible to reduce the incidence of tax evasion. The Financial Directorate of the Slovak Republic plays an essential role in this process, as it performs tax inspections focused on consumption taxes through the customs offices. It ensures enforcement and additional collection of excise taxes through tax inspections. Tax authorities participate in detecting VAT tax evasions of

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direct taxes defined by law; they also provide the recovery and additional collection of taxes. The employees of the Criminal Office of the Financial Administration investigate tax crimes in the area of tax evasion.

# 2. Literature review

The category of indirect taxes in the Slovak Republic consists of VAT and consumption taxes. The biggest tax evasions occur in the field of indirect taxes. The Financial Administration of the Slovak Republic ensures institutional collection and administration of taxes through tax and customs offices. Customs offices carry out administrative security and tax control of excise duties. Tax authorities safeguard the performance of tax control in the area of VAT as well as direct taxes determined by law. The authors present these and other findings in their publications: Babčák, 2012; Beličková, 2010; Majchrák & Zemaník, 2013; Víghová, 2022; Stieranka et al., 2016; Schultzová et al., 2018; Kačaljak, 2017; Babčák, 2019; Cachia, 2017; Pavic, 2020, Skare, Kukurin, 2020.

In the effective detection of tax evasion of indirect taxes, an important role is played by the stable legislation valid in the Slovak Republic and international cooperation by individual financial administrations within the European Union (European Commission, 2021). The EMCS electronic global information system dramatically contributes to the detection of tax evasion. This system ensures that goods are sent and received only by tax entities authorized to do so; thus, the employees of the customs offices can identify the occurrence of tax evasion faster and more efficiently. The authors provide information about these facts: Burák, 2016; Silva et al., 2021; Balko et al., 2009; Hellmann, 2021; Frintrup, 2020; Wijekoon et al., 2021; Natalizi, 2020.

Tax evasion can have the nature of legal or illegal tax evasion. Evasion of tax results in a reduction of tax liability, which impacts the violation of law and may have the character of a crime of tax reduction. In the Slovak Republic, the Criminal Office of the Financial Administration provides tasks in detecting offences related to violations of tax regulations in VAT on imports and excise duties. The authors of the following publications wrote about it: Babčák, 2018; Tawiah & Gyapong, 2021; Henrique et al., 2020; Lombardi et al., 2020; Miah et al., 2021; Roca, 2021; Stewart et al. 2021; Sacer, 2020.

# 3. Basic characteristics of excise taxes in the Slovak Republic

Consumption taxes belong to indirect taxes; they are selective taxes because they apply to selected types of products (wine, beer, alcohol, tobacco products, mineral oils, electricity, coal, and natural gas). They are chosen once, i.e. at one stage. The final users of the products pay these taxes, i.e. residents through purchase. Consumption taxes represent a stable and significant income for the state budget of the Slovak Republic; they belong to the oldest category of taxes in the Slovak Republic. In the Slovak Republic, they are regulated by the following laws:

- Act No. 530/2011 Coll. on excise duty on alcoholic beverages, as amended,
- Act No. 106/2004 Coll. on excise duty on tobacco products, as amended,
- Act No. 105/2004 Coll. on alcohol excise duty and amendments to Act no. 467/2002 Coll. on the production and placing of alcohol on the market as amended by Act 211/2003 Coll.
- Act No. 98/2004 Coll. on excise duty on mineral oil, as amended,
- Act No. 609/2007 Coll. on excise duty on electricity, coal and natural gas and on amendments to Act no. 98/2004 Coll. on excise duty on mineral oil as amended (Stieranka et al., 2016).

The aforementioned laws define basic terms for individual types of consumption taxes, such as definition of taxpayer, subject of tax, tax base, tax calculation (Burák, 2016).

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With the accession of the Slovak Republic to the European Union, the process of harmonizing tax legislation began. It is possible to state that in the field of consumption taxes, the legislation of the Slovak Republic is most harmonized with the legislation of the European Union (Schultzová, 2018). The problem areas were excise duty rates, which were not set according to EU Directives. For the mentioned reason, the Slovak Republic applied for an exception or postponement of the introduction of rates that the EU regulates. The European Union granted the request to the Slovak Republic. Therefore, in the Slovak Republic, the minimum excise tax rates are determined by individual laws and may differ from the rates determined by the EU directive (Kačaljak, 2017).

Table 1 contains the minimum rates of consumption taxes according to the EU directive.

Minimum rates of consumption taxes set by EU directives				
Ethanol/pure alcohol	550 € /1 000			
Wine	Nonsparkling	0 € /hl		
	Sparkling	0 € /hl		
Intermediate product	45 €/hl			
Beer	0,748 €/hl/ °Plató			
	1,87 €/hl/alcohol level			
Cigarettes	60 % weighted average retail price, but must not be lower	than €90/1.000 pcs (from 1.1.2014)		
Cigars and cigarettes	5% of the retail price including all taxes or €12 per 1,000 p	bcs or 1 kg		
Tobacco	Fine-cut tobacco	46% of the weighted retail price or		
		54% of 1 kg (from 1.1.2015)		
	Other tobacco	25% of the retail price including all		
		taxes or €22 / 1 kg		
Gasoline	Leaded	421€ / 1000 1		
	Lead-free	359 €/ 1000 1		
Diesel/ gas oil	As fuel	330 €/ 1000 1		
	Other use	21 €/ 1000 1		
Petroleum/ kerosene	e As fuel 330 €/ 1000 1			
	Commercial use	21 €/ 1000 1		
	For heating	0 €/ 1000 1		
LPG	As fuel	125 €/ 1 000 1		
	Commercial use	41 € /1 000 1		
	For heating	0 € /1 000 1		
Natural gas	As fuel	2,60 € on gigajoul		
	Other use	non-business purposes 0,30 € on		
		gigajoul		
		business purposes 0,15 € on gigajoul		
Coal and coke	For heating-business purposes	0,15 € on gigajoul		
	For heating – non-business purposes	0,30 € on gigajoul		
Electricity	For heating-business purposes	0,50 € on gigajoul		
	For heating – non-business purposes	1,00 € on gigajoul		

**Table 1.** Minimum excise tax rates set by EU directives

Source: Schultzová et al. (2018, p. 282)

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# 4. Legislative provision of tax control of excise taxes in the Slovak Republic

## 4.1 Institutional security of the Financial Administration

In the Slovak Republic, tax control of individual taxes is ensured by the Financial Administration. Financial report according to Act no. 35/2019 Coll. on financial management, as amended, consists of:

- a) Financial Directorate of the Slovak Republic,
- b) Customs offices (there are currently 9 customs offices, 57 customs office branches and 17 customs office stations on the territory of the Slovak Republic),
- c) Tax authorities (there are currently 8 tax authorities, 1 Office for selected economic subjects, 39 branches of tax authorities and 29 contact points of tax authorities in the territory of the Slovak Republic),
- d) Criminal Financial Administration Office (Balko et al., 2009).
  - a) **The Financial Directorate of the Slovak Republic** is a budgetary organization that exercises its powers throughout the territory of the Slovak Republic. The seat of the Financial Directorate of the Slovak Republic is Banská Bystrica. Customs offices, tax offices and the Criminal Office of Financial Administration are pre-tax organizations involved in the budget of the Financial Directorate of the Slovak Republic (Majchrák & Zemaník, 2013).
  - b) The customs authorities carry out the administration and control of excise taxes in the Slovak Republic. **Customs offices** perform tasks set by law, for example:
  - make decisions and perform actions in matters of customs supervision, excise tax control and excise tax administration,
  - decides on seizure of goods or things and on confiscation of goods,
  - decides on duty refunds or duty remissions and tax refunds for which he is the tax administrator,
  - allows deferment of duty payment, allows deferment of tax payment or payment of tax in installments,
  - clarifies and negotiates customs violations and misdemeanors,
  - recovers arrears of customs duties, arrears of fines and other payments assessed and imposed according to customs regulations and recovers tax arrears, monetary payments imposed by decision, enforcement costs and cash expenses in enforcement proceedings,
  - inspects the release of the goods,
  - informs tax subjects about their rights and obligations in matters of taxes,
  - performs tasks resulting from international agreements within the scope of the President's mandate,
  - performs other tasks established by law (Babčák, 2018)
  - c) Administration and control of VAT and selected direct taxes in the Slovak Republic is carried out exclusively by **tax authorities**. Their scope is defined in § 6 par. 1 of Act 35/2019 Coll. on financial administration as amended (Beličková, 2010).
  - d) **The Criminal Office of Financial Administration** exercises jurisdiction over the entire territory of the Slovak Republic. The seat of the Criminal Office of the Financial Administration is Bratislava, it fulfills, for example, the following tasks:
    - carries out customs supervision in agreement with the authorities of other countries by secret escort of the delivery or another secret method of monitoring, if there is a reasonable assumption that the shipment contains narcotic substances, psychotropic substances,
    - carries out cross-border surveillance and cross-border persecution to the extent and under the conditions established by an international treaty,

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- fulfills and ensures tasks in the area of detection of crimes committed in connection with violations of tax regulations in the area of value added tax and consumption taxes or customs regulations and detection of their perpetrators,
- fulfills the tasks of the central coordination unit and other tasks resulting from international agreements in the defined area.

# 4.2 Analysis of the detection of tax evasion in excise duties through the control activities of the customs authorities of the Slovak Republic

The main mission of the Financial Administration is to ensure the uniform collection of taxes and customs duties and the protection of the state's fiscal interests. When collecting taxes and duties, financial administration entities proceed according to the provisions of Act 563/2009 Coll. tax code as amended. The aforementioned legal standard contains the basic rights and obligations of tax subjects, tax auditors, the course of tax control, appeals, and enforcement proceedings.

In connection with ensuring the mission of the Financial Administration, individual customs offices in the Slovak Republic carried out the number of excise tax inspections listed in Table 2.

Customs office	The number of completed tax audits in the area of excise duties			
	YEAR 2019	YEAR 2020	YEAR 2021	YEAR 2022
Banská Bystrica	238	304	309	404
Bratislava	354	343	381	515
Košice	201	162	189	159
Michalovce	100	101	75	85
Nitra	176	161	147	197
Prešov	352	379	375	495
Trenčín	307	206	262	276
Trnava	191	189	198	170
Žilina	178	202	175	226
Spolu	2 097	2 047	2 111	2 527

**Table 2.** Number of completed tax audits in the area of excise duties

Source: Finančné Riaditeľstvo Slovenskej Republiky (20220

By comparing the years 2021 and 2022, it can be concluded that there was an overall increase in the number of completed tax audits, primarily related to the intensification of tax audits in interlales in accordance with the internal management act of the Financial Administration of the Slovak Republic. At those customs offices where a decrease in the number of completed tax audits was recorded, the reasons were mainly a more significant number of audited tax periods in one tax audit and the tactful introduction of the tax reliability index in 2019, resulting in a lower periodicity of tax audits.

When comparing the periods of 2019 and 2020, it can be concluded that a decrease in tax audits was recorded. The reasons for the reduction in the number of tax inspections in the area of consumption taxes were the following facts:

- within individual tax audits, audits of several tax periods were carried out (several calendar years, year, half-year),
- in connection with the return of consumption taxes, in some cases, tax inspections were replaced by local investigations,
- extraordinary measures connected with the spread of the contagious contagious human disease COVID-19.

Another task of the Financial Administration is closely related to the performed tax audits, which consist of detecting tax evasion, through which the revenue part of the state budget is secured.

Table 3 contains an overview of the collection of customs revenues from individual types of excise taxes for the period 2019 to 2022 (while the term individual types of excise taxes refers to the following types of taxes: excise tax on mineral oils, excise tax on alcohol, excise tax on beer, excise tax on wine, excise tax on tobacco products, excise tax on electricity, excise tax on coal, excise tax on natural gas).

Customs office	Overview of excise duty collection			Difference	
	YEAR 2019	YEAR 2020	YEAR 2021	YEAR 2022	2022-2021
Banská Bystrica	68,031	62,627	72,817	83,926	11,109
Bratislava	2 541,783	2 341,973	2 665,075	2 941,886	276,811
Michalovce	131,453	124,074	147,183	161,170	13,987
Košice	212,892	158,996	300,190	393,840	93,65
Nitra	526,021	489,939	659,726	758,741	99,015
Prešov	152,246	131,528	134,834	142,132	7,298
Trenčín	247,426	219,807	269,963	324,661	54,698
Trnava	606,122	601,686	786,694	949,987	163,293
Žilina	588,905	510,347	607,127	739,260	132,133
Unidentified	0,007	6,863	0,105	0,126	0,021
payments					
Together	5 074,886	4 647,840	5 643,712	6 495,729	852,017

Table 3. Overview of excise duty collection by individual customs offices in the period 2019 to 2022

data are in millions Eur

Source: Finančne	Riaditeľstvo	Slovenskej	Republiky	(2022)
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Table 3 contains the collection of excise taxes, which in practice means the payment of the tax due according to the tax return filed by the taxpayer and the collection of excise taxes after the tax audit. The search for tax evasion is ongoing as part of the tax audit. We divide tax evasion into legal and illegal tax evasion. Legal tax evasion is tax evasion in the line of valid legislation; it is characterized by avoiding tax liability by using the options the law offers. Illegal tax evasion will result in reduced tax liability, which has the effect of breaking the law.

Illegal tax evasion of excise duty on tobacco and tobacco products:

- illegal production (fakes of well-known brands are produced in illegal facilities),
- illegal importation smuggling through border crossings,
- fictitious exports and subsequent claims for tax refund,
- unauthorized termination of the transit regime and subsequent sale on the internal market,
- declaring a lower weight of tobacco products upon import.

Illegal tax evasion on excise duty on alcoholic beverages:

- illegal production of alcohol by registered persons and their subsequent placement on the market without being marked with stamps,
- abuse of the possibility of applying standardized losses in legal production plants for exemption from alcohol excise duty without actual losses, subsequent placement of such unofficial stocks on the market,
- illegal production of alcohol by unregistered persons and their subsequent placement on the market without being marked with stamps,

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- incorrectly declaring alcohol as tax-exempt in an attempt to circumvent legal obligations and its subsequent sale,
- violations during the transport of alcohol under tax suspension in the territory of the European Union,
- fictitious exports and subsequent sale of alcohol on the domestic market,
- unauthorized claims for the refund of alcohol excise duty in connection with fictitious exports. (Stieranka, 2016).

Illegal tax evasion on consumption tax on mineral oils:

- illegal way of acquiring mineral oil (for example, from Poland, and Lithuania) and selling it on the black market,
- illegal importation and its subsequent placement on the market without payment of excise duty, sometimes even by changing the purpose,
- application of a preferential rate of consumption tax on mineral oil, even though it is subject to a higher rate due to the actual volume,
- fictitious export with subsequent application of the right to refund excise duty.

During inspections, in addition to detecting tax evasion, the inspectors also detect other deficiencies in calculating tax liability in tax returns in the case of excise taxes. The most serious deficiencies detected during the performance of tax controls recorded by the customs authorities:

- illegal indication of the excise duty tax base
- claiming the right to refund excise taxes in the wrong amount,
- incorrect use of the tax rate,
- providing false information in the application for the production of distillates,
- registration of a tax subject after the statutory deadline.

Since consumption taxes are also related to foreign transactions to a considerable extent, the aspect of international cooperation with the financial administration of the European Union states is, therefore, important. International cooperation is implemented based on Article 3 of Council Regulation (EU) No. 389/2012 on administrative cooperation in the field of excise duties, is implemented by ensuring:

- exchange of information based on request,
- sending notifications about administrative decisions and measures required by member states according to Article 14 of Regulation no. 389/2012,
- compulsory exchange of information without prior request,
- voluntary spontaneous exchange of information,
- provision of statistical and other information.

As part of international cooperation, the EMCS information system has been introduced, which enables the monitoring of the transport of goods related to excise duties. The partial practical application of information EMCS ensures that goods are sent and received only by tax entities that are authorized to do so, which greatly reduces the risk of tax evasion. According to the data of the Financial Administration of the Slovak Republic, in 2022, 73,918 electronic accompanying documents were sent in the EMCS system, of which 26,137 were for transports within the tax territory and 47,781 for transports outside the tax territory. 70,801 electronic accompanying documents states.

**The Criminal Office of the Financial Administration** plays a special role in the detection of tax crimes; it has procedural subjectivity in proceedings according to the Administrative Code, it acts independently before the court within the scope of its competence according to the law. The director of the Criminal Office of Financial Administration or a member of the financial administration authorized by the director of the Criminal Office of

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Financial Administration or the president acts on behalf of the Criminal Office of Financial Administration before the court. It specializes in detecting crimes related to violations of tax regulations in VAT, excise duties, and import VAT. In addition, it provides tasks in combating the illegal import, export and transit of narcotic and psychotropic substances. In the years 2021 and 2022, he participated in the detection of tax evasion, pointing out the occurrence of damage to the state budget of the Slovak Republic.

**Table 4.** Overview of damage to the Slovak state budget from the position of investigating the criminal offense of reducing excise duties and VAT on imports in the period 2021 to 2022

Type of excise duty / VAT	The amount of damage to the state budget of the Slovak Republic	The amount of damage to the state budget of the Slovak Republic	
	year 2021	year 2022	
Tobacco and tobacco products	78.378.931,22 €	91.824.377,21€	
Alcohol	206.850,06 €	3.641,88€	
Mineral oil	1.148.022,44 €	1.341.913,13€	
Customs regulations	99.582.608,27 €	400.811.252,49 €	
VAT on import	233.412.421,71 €	232.777.431,76€	
Other (JIT)	429.991.991,40€	68.918,00€	
Products of the defense industry and dual-use	26.930,26€	565.430,26€	
goods			
Together	842.747.755,36 €	727.392.964,73 €	

Source: Finančné Riaditeľstvo Slovenskej Republiky (2022)

Table 4 shows, when comparing the years 2021 and 2022, a decrease of 115,354,790.60 Euros for the overall school compared to the state budget. When analyzing individual excise taxes, it is possible to note an increase in the occurrence of damage in the area of tobacco and tobacco products, in the area of customs regulations and in the area of defense industry products and dual-use goods.

# **Final evaluation and recommendations**

As part of the analysis, we discovered the following facts:

- not every initiated tax audit focused on the correct determination of the tax liability of excise duties ends with a finding, which in practice means that the effectiveness of tax audits is not 100%,
- a low number of inspectors and a high turnover of employees ensuring the inspection of excise taxes,
- frequent changes in tax laws in the field of consumption taxes,
- insufficient electronic communication between customs authorities and taxpayers,
- the functions of the EMCS information system are not used to 100%,
- there was an increase in damage to the state budget of the Slovak Republic compared to 2021 and 2022 in the area of tobacco and tobacco products, customs regulations and products of the defense industry and dual-use goods.

The following recommendations resulted from the above facts:

- increase the number of inspections carried out, with a focus on inspections that will be concluded with a finding (presumption of detection of violations of legislation in the field of excise taxes, which have an impact on the collection of additional tax liability),

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- To ensure the effective selection of tax subjects for the performance of tax audits, in practice it means to select for audit only such taxpayers who are expected to be found to have violated legal regulations and to collect additional tax,
- ensure effective recovery of tax arrears with an impact on the revenue part of the state budget. In practice, it means, during the tax audit, to issue a decision on a preliminary measure, according to the provisions of § 50 of Act no. 563/2009 Coll. on the administration of taxes (tax code), utilizing which the controller's decision prohibits dealing with the property of a potential tax debtor, until the tax arrears are paid,
- use the institute of local investigation (§ 37 of Act 563/2009 Coll. on Tax Administration (Tax Code)) for such tax subjects for which there is no assumption of additional excise duties. Since in that case, the tax audit is not initiated, but at the same time the auditors are sure of the correctness of the excise duty calculation),
- to make the job position of controller with a focus on consumption taxes more attractive,
- to ensure the stability of the legislation in the field of consumption taxes,
- improve the quality of the electronic services of the Financial Administration of the Slovak Republic,
- to ensure more effective international cooperation in the exchange of information on the transport of goods subject to excise duties,
- to provide the practical application of the EMCS system in full, in the interest of more effective detection of international tax evasion,
- to strengthen the competencies of the Criminal Office of Financial Administration in detecting tax crimes.

In conclusion, the stability of laws governing individual excise taxes is vital for auditors in detecting tax evasion. The legislative process regulating consumption taxes should be a functioning system within the Slovak Republic and the European Union, as consumption taxes are international in nature.

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**Agneša VÍGHOVÁ**, Assoc prof. PhD. is head of University of Economics and Management in Bratislava, Department of Small and Medium Business (Slovak Republic). Scientific field: Accounting, Taxation, Statutory audit **ORCID ID:** <u>https://orcid.org/0000-0001-8094-0067</u>

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Clarivate Analytics

# QUALITY CULTURE: A BEHAVIORAL INSPIRED WAY OF QUALITY IN SLOVAK SMALL AND MEDIUM ENTERPRISES\*

## Denisa Malá<sup>1</sup>, Ján Dobrovič<sup>2</sup>, Mariana Sedliačiková<sup>3</sup>, Anna Šatanová<sup>4</sup>, Mykola Palinchak<sup>5</sup>

<sup>1</sup> Department of Corporate Economics and Management, Faculty of Economics, Matej Bel University in Banská Bystrica, Banská Bystrica, Slovakia

<sup>2,4</sup> College of International Bussines ISM Slovakia in Prešov, Duchnovičovo námestie 1, 080 01 Prešov, Slovakia

<sup>3</sup> Department of Economics, Management and Business, Faculty of Wood Sciences and Technology, Technical University in Zvolen, Zvolen, Slovakia

<sup>5</sup> Uzhorod National University, Faculty of International Economic Relations, University Street 14, 880 00 Uzhorod, Ukraine

*E-mails:* <sup>1</sup> <u>denisa.mala@umb.sk;</u> <sup>2</sup> <u>dobrovic@ismpo.sk;</u> <sup>3</sup> <u>sedliacikova@tuzvo.sk</u>; <sup>4</sup> <u>satanova@ismpo.sk;</u> <sup>5</sup> <u>mykola.palinchak@uzhnu.edu.ua</u>

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**Abstract.** Corporate quality culture is perceived as a set of shared opinions, attitudes, ideas, interests and expectations in both the formal and informal relationships in quality management. An employee profile within the quality culture comprises three basic components: cognitive, affective and behavioral. The paper analyses the individual components of the employee profile within the Slovak small and medium enterprises and their impact on building a quality culture. The representativeness of the sample, based on the selected criteria (enterprise size and gender of respondents), was confirmed by Chi-square test. The research results were processed by the statistical programme IBM SPSS 19, using the methods of testing statistical hypotheses (Binomial test, Chi-square, Friedman, Wilcoxon, and Spearman tests), as well as the methods of descriptive statistics and data visualization. The paper'spaper's main contribution is the analysis of individual components of the employee profile and finding out their impact on building and maintaining a quality culture in the enterprise. The research results showed a strong dependence between the individual components of the employee profile.

Keywords: quality culture; employee profile; behavior; SMEs; quality management.

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## 1. Introduction

Achieving excellence leads to a corporate quality culture (Srinivasan & Kurey, 2014). Implementing a quality culture is a suitable alternative to normative approaches to quality management. It prioritizes fundamental changes, leaves room for creativity, and offers space to create new ways of achieving process quality (Loke et al. 2012). The concept of quality culture is very attractive to many entrepreneurs because it gives a human form to the ideas of employees associated with concepts such as control, assurance, and processes. Quality is usually associated with several values and may be understood as a subculture of the proper corporate culture. There is no generally accepted definition of a corporate quality culture. Brennan and Shah (2000) emphasize three dimensions generally agreed upon among scientists: "Culture includes values, attitudes and behaviors." Since attitudes and behaviors are based on values (Sundrum, 2004), it is essential to see quality values as a basis of quality culture.

Investigating the behavior of employees in the field of quality is important. A better understanding of employees' thinking and decision-making is essential because employees often make decisions inconsistent with a norm or an agreed rule. The analysis of the individual components of employee profile among Slovak small and medium enterprises (SMEs) enabled authors to pursue the main objective, defined as determining the level of quality culture and proposing simple recommendations for SMEs in Slovakia concerning implementing quality culture using the three main components of the employee profile.

## 2. Theoretical background

In the changing global scenario, making an enterprise more economically vibrant through quality assurance is a resilient concept and approach as the enterprise is emerging as an avenue for improvement, innovation and employment generation. Quality, the degree of excellence or superiority, is a combination of attributes, properties or characteristics that give each commodity value in terms of its intended use. That can be obtained by introducing a quality management culture within all the actors in the production and marketing or value chain (Hitka et al., 2022). One of the most critical priorities of the SMEs shall be to support the innovation processes through modern technologies, knowledge and information transfer to the owners, managers and employees (Svagzdiene et al., 2020). Therefore, a well-trained, flexible young workforce is necessary (Kapsdorferová et al., 2020).

Quality culture is an image of the employee approach to quality in the enterprise, expressed by the vision of quality, quality values and permanent support of continuous quality improvement by the corporate management (Wu, 2014; Harvet & Stensaker, 2008). A quality culture expresses what quality means for an enterprise, how quality goals are defined, how everyone in the enterprise participates in their fulfilment, how the group and individual performance is measured, and how those who have contributed to achieving quality goals are rewarded (Araújo et al., 2019). Corporate quality culture should be understood as a system of shared opinions, attitudes, ideas, interests and expectations in both the formal and informal relationships in the field of quality. Quality culture accompanies and influences human activity from the concept (stimulus) through the decision-making process, the implementation of decisions to learning from the impacts of implemented decisions and the subsequent (direct/indirect, conscious/unconscious) formation of a quality culture (Cronemyr et al., 2017).

Introducing a quality culture in the enterprise requires a gradual change in human thinking and behavior. Employees have to want, know and be able to. It is crucial to support people for changes or to force them to want to. Everyone can be involved in quality, but changing people's attitudes requires strong personalities. It is necessary to give people strong and lasting support and motivation from the management of the enterprise (Krot & Lewicka, 2020; Straková et al. 2021; Šimberová et al. 2021). Introducing a quality culture into the enterprise brings new habits, beliefs and feelings of employees (Mendez, 2018). This 3-dimensional learning process (performance, emotions and habits) creates talented and satisfied employees.

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Mendez (2018) lists three fundamental pillars of quality culture. The first pillar is a personal focus on quality, by which people improve themselves, the effort to create helpful habits in life, learn, teach people in our surroundings, the ability to turn information into knowledge in specific actions, proactivity, the ability to plan and manage activities over time, skills to maintain balance in life and thus achieve high individual performance. The second pillar is to build trust and mutual cooperation. Trust and open communication are the basis for quickly identifying real problems and their causes and for improvement (Wu, 2014). Immediate reactions and effective transfer of critical information within the group define the nature of the content of the second pillar. The third pillar presents solutions to problems across the enterprise, thus, a higher degree of teamwork. According to Mendez (2018), habits leading to quality can be characterized by three parts. The first is the trigger or so-called stimulus that has an activating meaning. The stimulus can be information, skill, or knowledge. The next part is the routine, automatic action. It is a behavioral aspect. And the last part is the reward, a kind of joy.

A strong correlation can arise between achieving quality in the enterprise and employee behavior; therefore, improving quality becomes an important factor in creating a corporate quality culture. Based on the research analysis of various authors (Pan et al., 2019; Avey et al., 2018; Mendez, 2018; Benčiková et al., 2019), three essential components of employee profiles have been defined within the framework of quality culture. The cognitive component refers to the employee's knowledge about his work in relation to quality in the enterprise, the affective component expresses the employee's relationship to himself and his self-esteem, and the behavioral component states the tendency to behave in a manner relevant to knowledge and self-evaluation: "I know, I have a feeling about it, I tried". The interplay of all three components leads the enterprise to a quality culture (Baird et al., 2011).

The cognitive component is focused on what the employee can do, knows, is aware of and how he can handle this knowledge and information. Cognitive functions include, for example, memory, speech, speed of thinking, aptitude to understand information, ability to assess and solve problems, planning, organizing, and self-control (Bandura, 2001). Cognitive reactions of employees concern their ways of disseminating information (Srinivasan & Kurey, 2014). The employee must know the corporate values, which are part of the documentation system of the enterprise.

The affective component represents employees' attitudes and feelings towards colleagues or a situation. It focuses on what the employee is willing to accept and tolerate, what he desires, is interested in, likes, prefers, etc. (Cristofaro, 2020). When this component is developed, the employee is satisfied with his work and is willing to take responsibility.

Behavioral component presents a tendency to act in the way the attitudes direct us (Park et al., 2014). The behavioral component builds on the employee's self-knowledge and self-evaluation, including self-presentation and self-monitoring. The essential element that affects the behavioral component is the overall personal belief in one's ability to deal with difficulties and challenges in the workplace. Behavioral reactions of employees relate to a mental desire to perform activities (behavioral intentions) and obvious and directly observable actions (actual behavior) (Srinivasan & Kurey, 2014). These are specific ways of solving problems, taking responsibility, and sharing best practices with colleagues. The behavioral component of the employee profile includes habit, routine, and automatic activity.

In connection with the profile of a quality employee, it is necessary to develop all its components, such as education and quality culture, interpersonal relationships, ability to cooperate, perception of social environmental factors, attitudes, ability to adapt, work performance, behavior, etc. Meaningful creation and use of human potential are prerequisites for building and developing a robust corporate quality culture (Vargas-Hernandéz et al.,

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2017). The fact that quality is supported in the enterprise is visible in the behavior and activities of employees, which is a manifestation of the quality culture.

## 3. Material and methods

The research was conducted in 2022. The study aimed to determine the level of three components of the employee profile in quality management and the relationship between them. The survey was executed by the interrogative method as a questionnaire. The identification consisted of questions about enterprises and their employees who participated in the survey. The size of the enterprise was based on the number of employees (micro-enterprise 1-9 employees, small enterprise 10-49 employees, medium enterprise 50-249 employees), the gender of respondents, how long they worked in the enterprise and their job position (owner, strategic manager, tactical manager, operational manager, administrative employee, and production employee). The technical part consisted of 36 statements describing individual components of the employee profile in the Slovak SMEs in quality management and building of quality culture (12 statements for each component). The statements were not arranged by components. The wording of the statements is shown in Tab. 4, 5 and 6. The respondents expressed the degree of their agreement with the statements using the Likert scale and had a choice: 1 - I can't express myself, 2 - strongly disagree, 3 - disagree, 4 - agree and 5 - strongly agree. Methods of testing statistical hypotheses (Chi-square, Friedman test, Wilcoxon test, correlation analysis), methods of descriptive statistics and data visualization (average, frequency tables) were used to evaluate the research results.

Based on theoretical background and empirical studies devoted to the researched issue (Benčiková et al., 2019; Araújo et al., 2019; Avey, 2018; Cristofaro, 2020; Cronemyr et al., 2017; Kotter & Cohen, 2002; Mendez, 2018; Pan et al., 2019; Srinivasan & Kurey, 2014), the following hypotheses were formulated:

 $H_1$ : the development of the cognitive and affective components influences the development of the behavioral component of the employee profile in the area of quality culture.

H<sub>2</sub>: the strongest component of the profile of Slovak employees in quality culture is the cognitive component.

 $H_3$ : the weakest component of the profile of Slovak employees in the area of quality culture is the behavioral component.

We tested the sample's representativeness, according to the selected characteristics - gender and size of the enterprise, by the Chi-square test. The Chi-square test statistics is defined by the sum of the amplified differences between the observed (O) and expected (E) frequencies, divided by the expected frequencies (E). (Kaščáková & Nedelová, 2010):

$$x^{2} = \sum_{i=1}^{N} \frac{(\text{O}i - \text{E}i)^{2}}{Ei}$$
(1)

Pearson's Pearson's Chi-square goodness of fit test is based on a frequency table and tests the statistical hypothesis that the frequencies in the individual categories are equal to the expected (theoretical) frequencies (Kaščáková & Nedelová, 2010).

The statistical program SPSS version 25 was used to evaluate the survey. A significance level of 0.10 was used to test the hypotheses. Hypothesis  $H_1$  was verified by the test of the significance of the Pearson correlation coefficient. Friedman test and Wilcoxon test were used to test hypotheses  $H_2$  and  $H_3$ .

## 4. Results and discussion

326 respondents participated in the research examining the components of the employee profile in quality management and building quality culture in Slovak SMEs. Three components of the employee profile (cognitive,

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affective and behavioral) in the area of quality culture were the objects of the research. The SMEs employees in Slovakia were the subjects. 179 men and 147 women were included in the study. Most respondents (38%) are business owners; 34% work in administration, 17% in production, 8% as strategic managers and 3 % as tactical managers. The employees working in the enterprise for more than 1 and less than 5 years (39%) represented the majority of our sample and were followed by those who have worked in the enterprise for more than 10 years (29%), more than 5 and less than 10 years (18%), and less than 1 year (14%). The research sample consisted of 5% of employees from medium enterprises, 10% from small enterprises and 85% from micro-enterprises.

The representativeness of the sample, according to selected characteristics - the size of the enterprise (which is determined by the number of employees) and the gender of the respondents, was tested by the Chi-square test at the significance level of 0.1. In both cases, the representativeness was confirmed (p-value<sub>size of enterprise</sub> = 0.789, p-value<sub>gender</sub> = 0.968).

The test of the significance of the Pearson's correlation coefficient was used in the research to determine the dependence between the individual components of the profile of SME employees in Slovakia in the area of building quality culture. The statements in the individual components of the employee profile were aggregated using the mean values. A strong direct linear correlation was found between the degree the SME employees agreed with statements related to the affective (A) and behavioral (B) components ( $r_{AB} = 0.744$ ) in the field of quality culture. If the employee's attitude towards quality is positive (meaning that he wants), it will positively affect the quality of his work because he tends to adapt to quality standards. If an employee sees that others act following quality standards, it also motivates his positive attitude towards quality. This means that when an employee becomes aware of his values and attitudes (which should align with the corporate values), he takes responsibility in practice, solves problems and shares practices with colleagues. Research conducted in companies in eight countries (Wu & Zhang, 2010) has also confirmed that a quality culture becomes more acceptable when integrated into employee value systems. Employees discover quality problems and solve them innovatively.

Similarly, for the affective (A) and cognitive (K) components, there is a solid direct linear correlation between the degree of agreement of SME employees ( $r_{AK} = 0.853$ ). This means that if the level of one of the compared components of the employee profile in the area of quality culture increases, the other component will also increase. The research results confirmed that by educating employees about quality, the enterprise can achieve a higher interest in quality and positively change their attitudes towards quality. At the same time, if employees have a positive attitude towards quality, their interest in education in this area also grows. Wu (2014) also claims that the corporate values and choice of the appropriate strategy for their dissemination among employees influence the employee attitudes towards quality, impacting the implementation of quality culture.

There was also a strong direct linear correlation between the degree of employee agreement ( $r_{BK} = 0.762$ ) between the statements in the area of quality management concerning the behavioral (B) and cognitive (K) components. If an employee is substantially informed about quality management in the enterprise and can work with this knowledge, he can apply it in practice for the benefit of the enterprise. If employees improve the quality of the enterprise with their ideas, this leads to learning and awareness of the benefits of implementing quality management with other employees. Similar results were obtained in the exploratory research by Loke et al. (2012), who conducted research in Malaysian manufacturing plants. They argue that effective analysis of information and choosing the right strategy for its dissemination among employees impacts their creative problem-solving and decision-making.

At the same time, we found out that the affective (A) and cognitive (K) components strongly influence the behavioral (B) component ( $r_{B,AK} = 0.786$ ). This means that the development of the affective and cognitive components of the employee profile strongly influences the development of his behavioral component. Based on these findings, hypothesis H<sub>1</sub> is valid. The results of the research indicate that if the enterprise takes the right steps

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in informing and educating employees in the field of quality, motivates them to be open to stakeholders' requirements and willing to improve processes, the enterprise will achieve favorable change in employee behavior towards quality and thus ensure the creating of quality culture. Also, according to Wu (2014), the knowledge and strategies that employees use, their attitudes, emotions, motivation and desire impact the quality of their performance in the area of quality. Implementing a quality culture is systemic work. If something from the chain fails, building a quality culture will cause a problem. Similarly, if we focus on developing only one component, it can cause failure in the adoption of a quality culture.

Based on evaluating the level of responses to statements in each of the three components of the employee profile (Tab. 1), it can be stated that the cognitive component is the strongest, followed by the affective and the behavioral component. This means that employees have enough knowledge and information about quality management in the enterprise, motivation, and will, and their attitudes in this area are weaker. Their work in connection with quality management is the weakest. Based on the results, the work of employees, i.e., how quality is manifested in their behavior, proved to be quite insufficient. Wu and Zhang (2010) achieved similar results in their exploratory research conducted in companies in eight countries (Austria, Finland, Germany, Italy, Japan, Korea, Sweden and the USA).

Table 1. Mean values in r	esponse to statements within each of	component of the employee profile
- abie in four ( aldeb in f	sponse to statements within each	component of the employee prome

	Mean	Frequency	Standard deviation
Mean cognitive component	4.22	326	0.40294
Mean affective component	3.99	326	0.43315
Mean behavioral component	3.88	326	0.41726

Source: own processing

The Friedman and Wilcoxon test also confirmed this order of importance of individual components. Using the Friedman test, it was confirmed that the employees did not express the same degree of agreement with the statements in the individual components of the profile (p-value = 0.0). Using the Wilcoxon signed-rank test, it was concluded that there was a statistically significant difference (p-value = 0.0) when the degree of agreement with the statements related to cognitive and affective components were compared. The highest degree of agreement was expressed by employees of SMEs in Slovakia with the statements concerning the cognitive component of the profile (meanaffective - meancognitive, Z = -6.491, p-value = 0.00 and meanbehavioral – meanaffective, Z = -2.740, p-value = 0.007). Z value is based on positive ranks. Based on these findings, we can confirm the validity of hypothesis H<sub>2</sub> and hypothesis H<sub>3</sub>.

In each component of the employee profile, the answers to 12 statements from the area of quality management in the enterprise were evaluated. Friedman test in all three components of the employee profile confirmed that the statements are not equally important for respondents concerning their degree of agreement (p-value in all three components was 0.000). By application of the Wilcoxon signed-rank test (Tab. 2, 3, 4), the order of statements was determined, and how they are not equally significant. The statements focused on the cognitive component and examined whether the employees of SMEs in Slovakia know and have information about quality management in the enterprise.

The highest agreement of employees was assigned to the statement that they know what they are responsible for in the enterprise (Tab. 2). Employees also agree with the statements that they know the customers and are aware of their contribution to meeting customer needs. They agree the least with the statement that they have enough information regarding quality improvement in the enterprise. It was interesting to find out that, on the one hand, employees claim to know their responsibilities, but on the other, they are not aware of their roles and competencies regarding quality culture. Employees expressed an equally low agreement with the statement that the enterprise has established ethical principles and values that employees must know. Employees shall be educated and informed to incorporate quality improvement into their daily work (Zelnik et al., 2012). There shall

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be open communication at all levels (Paipa-Galeano, 2020). At the same time, it was concluded that SMEs in Slovakia either have not established their ethical values and standards sufficiently or, even if they have them, they do not make employees aware of them. When implementing a quality culture, it is essential to have basic ethical principles and values related to quality so that employees know how to behave in certain situations (Snyder, Ingelsson, Backstorm, 2018). It is about establishing a convincing common vision of the required behavior, promoting employee involvement and consolidation, conducting training to maintain open and honest communication, supporting a confident climate, and incorporating ethics into the working environment (Bandura, 2001; Bartol & Srivastava, 2002).

	C7–C6	C11–C7	C8-C11	C12–C8	C1-C12	C9–C1
Testing statistics	-4.205b	-0.521b	0.000c	-2.787b	-0.570d	-1.808b
p-value	0.000	0.607	1.000	0.004	0.571	0.071
	C3–C9	C2–C3	C5–C2	C10–C5	C4–C10	
Testing statistics	-0.835b	-1.716b	-1.892b	-0.049d	-4.733b	
p-value	0.404	0.087	0.070	0.962	0.000	
Statements:						
C1 - Employees know the corporate goals set for continuous improvement.						
C2 - Employees know that part of evaluating the fulfillment of the set goals is the evaluation of quality.						
C3 - Employees are regularly informed about new information concerning their work.						
C4 - Employees are sufficiently informed about the quality improvements in the company.						
C5 - Employees know their roles, competencies and responsibilities regarding quality management.						
C6 - Employees know their responsibilities.						
C7 - Employees know well who are the customers of the company.						
C8 - Employees know their contribution to satisfy the needs of the company's company's customers.						
C9 - Employees understand the connection between their work and the fulfilment of quality goals.						
C10 - The company has clearly defined ethical principles and values that employees must know.						
C11 - Employees know documents related to the performance of their work.						
C12 - The employee has information about customers' opinions regarding the quality of the process for which he is						
responsible.						
Legend:						
a. Wilcoxon Signed Rank Test						
b. Based on positive ranks.						
c. The sum of negative ranks equals the sum of positive ranks.						
d. Based on negative ranks.						
Source: own processing						

Table 2. Wilcoxon signed rank test - Cognitive component of employee profile Wilcoxon signed rank test

Regarding the statements related to the affective component, we examined what the employees are willing, want, accept, and tolerate in quality management.

The analysis of the statements concerning the affective area (Tab. 3) showed that employees most agree that the enterprise supports them in expressing their opinion about the quality of the products and processes. They also strongly agree that the enterprise considers customer requirements when setting quality goals, and employees want to know how they help with their work to achieve quality goals in the enterprise.

The lowest degree of agreement was noted with the statement that they participate in making their development plan. It is essential to have the know-how to set up a development plan for the employees, from which it is possible not only to plan appropriate education and training but also the job classification and, thus, the responsibilities and competencies of the employee (Srinivasan and Kurey, 2014). SMEs in Slovakia must support the affective component of the employee profile, which will lead to more efficient communication between employees and affect their performance (Cristofaro, 2020; Avey et al., 2018).

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## **Table 3.** Wilcoxon signed rank test – Affective component of employee profile Wilcoxon signed rank test

Statements about the behavioral component of the employee profile were aimed at what employees do, can do, how they adapt to changes, or how they share the best practice in quality management (Tab. 4). Employees express the highest degree of agreement with the statement that their participation enables them to improve the enterprise processes. At the same time, they expressed a high degree of agreement, saying they could eliminate the problem through a correct procedure.

On the other hand, employees least agree with the statement that they use different tools and methods to solve problems in their work. Even though the employees do not have clearly defined procedures for solving problems, when a problem arises, they can eliminate it because they have enough knowledge and experience. This is also confirmed by the results of the research of Kumar and Sharma (2016), who found out that if the employee accepts quality among his enterprise values, he is more committed to solving problems promptly.

It was interesting to verify that, on the one hand, the enterprise does not have clearly defined ethical principles and values. However, on the other hand, employees still try to apply ethical principles and values in their work. It is crucial for the customer, as well as other stakeholders, to trust the employees of the enterprise.

It is also vital that employees in the enterprise trust each other. It is necessary to realize that morality and credibility are essential in promoting cooperation and improvement (Cassar, 2014). When employees are willing to invest their energy in progress, it directly impacts building a strong quality culture (Park et al., 2014).

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Table 4. Whotever signed tank lest – Benavioral component of employee prome whotever signed tank lest						
	B7-B12	B11-B7	B9-B11	B10-B9	B4-B10	B6-B4
Testing statistics	-2.512b	-3.369c	-1.818b	-2.993c	-2.254c	-0.172c
p-value	0.011	0.001	0.070	0.004	0.023	0.864
	B5-B6	B8-B5	B3-B8	B2-B3	B1-B2	
Testing statistics	-1.846b	-1.179c	-3.301b	-5.546c	-1.000c	
p-value	0.061	0.237	0.001	0.000	0.318	
p-value0.0610.2370.0010.0000.318Statements:B1 - The company I work in applies the basic principles of quality management.B2 - Employees use various tools and techniques to solve problems in their work.B3 - Employees use the conclusions from the internal audit to improve their work.B4 - The company solves problems as soon as they arise.B5 - The company adapts to innovation trends and changes.B6 - The company actively uses new tools and methods.B7 - If a problem arises during work performance, employees can choose the correct procedure to eliminate it.B8 - Performance standards in the company are set optimally.B9 - Employees can use the knowledge and information gained in the training to improve their work.B10 - The company uses its employees' talent and work experience to improve processes.B11 - Employees can improve processes in the company through their work.B12 - Employees can improve processes in the company through their work.B12 - Employees can improve processes in the company through their work.B12 - Employees can improve processes in the company through their work.B12 - Employees can improve processes in the company through their work.B12 - Employees can improve processes in the company through their work.B12 - Employees can improve processes in the company through their work.B12 - Employees can improve processes in the company through their work.B13 - Employees can improve processes in the company through their work.B14 - Employees can improve processes in the company through their work.B15 - Employees can improve processes in the company through their wo						
Source: own processing						

Table 4. Wilcoxon signed rank test – Behavioral component of employee profile Wilcoxon signed rank test

The research results confirmed the need to build a quality culture to ensure the sustainability of quality in the enterprise. Employees have satisfactory knowledge, information and abilities; however, there is still a wide gap in how they achieve quality objectives caused by an insufficient understanding of the social aspects of work. It is essential to interconnect all three components of the employee profile to build a quality culture.

The ability of the enterprise to adapt to changes has a direct effect on how successful it is in the market (Hitka et al., 2022). Although there is not one single predictor of long-term success, the everyday behavior that affects decision-making may be an appropriate indicator for the future of an enterprise (Benčiková et al., 2019; Mihalčová et al. 2021). Businesses with a strong quality culture spend \$ 350 million less per year on removing non-conformities than businesses with a weak quality culture (Srinivasan & Kurey, 2014). The definition of quality culture includes proactive approach, quality information flows, accepted values, development of commitment, support of immediate decision-making and acceptance of initiatives, support of risk acceptance and customer orientation (Cristofaro, 2020; Nenadál et al., 2018; Dobrovič et al. 2016; Paipa-Galeano, 2020; Avey et al., 2018; Snyder, Ingelsson, Backstorm, 2018; Korauš et al. 2021). The building of a quality culture requires a lot of adaptation. In an environment where customers' tolerance to quality problems is declining, employees who accept quality as their core value are a significant competitive advantage ((Srinivasan & Kurey, 2014). Therefore, for the quality culture to meet the corporate goals of increasing people satisfaction and business performance while remaining sustainable, we need to examine very carefully how we do things and ask ourselves why and what we do (Nenadál et al., 2018; Brecka & Koraus, 2016). It is important to create such a work environment in which employees not only follow standards, guidelines, and procedures but see and listen to others, take quality measures, solve problems, take responsibility, share best practices, talk about quality and feel the quality around them.

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## Conclusions

Ouality culture is based on employees who create quality in the enterprise by their behavior. By examining the behavioral component of the employee profile, we found that employees most agree with the statement that they can improve the enterprise's enterprise's processes by their work. The basic principle of achieving and maintaining quality is the continuous improvement of processes and, thus increasing their performance and employee performance. In the affective component, employees must agree that they are promoted to express their opinion about quality in the enterprise. If the processes in the enterprise do not improve, it is necessary to look for new information solutions, develop employees, emphasize the importance of improvement, and lead employees to changes. The enterprise needs to develop its employees to move them up to a higher level. In examining the cognitive component, employees expressed the greatest agreement with the statement that they know their responsibilities related to their work performance. The enterprise should provide the employees with the correct information (about customers, their responsibilities, benefits of their work), educate them in the direction of quality, and motivate them appropriately (express their opinion, solve problems independently, and accept changes) because only then employees will show interest in adhering to set standards and achieve quality properly. Based on the research results, we confirm that the cognitive component of the employee profile proves to be the strongest one and is followed by the affective and the behavioral components. Suppose an enterprise wants to introduce a quality culture. In that case, its employees must know (know the values of the enterprise) want (be engaged, have a positive attitude to quality) and act (behave so that they improve processes, products, themselves). The way to improve the quality culture leads through strengthening the connection between the values and the set goals of the quality of the enterprise in terms of how to implement and practice the values. Properly implemented quality culture takes into account the specifics of the enterprise and helps to find and understand its path to the sustainable success of the enterprise.

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**Denisa MALÁ** is the Associated Professor of Business Economic and Management at Economic Faculty of Matej Bel University in Banská Bystrica **ORCID ID**: https://orcid.org/0000-0002-5019-6625

Ján DOBROVIČ is the Associated Professor of Management at The College of International Business ISM Slovakia in Prešov

ORCID ID: https://orcid.org/0000-0002-0637-106X

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Mariana SEDLIAČIKOVÁ is the Professor of Business Economic and Management at The Faculty of Wood Sciences and Technology, Technical University in Zvolen ORCID ID: https://orcid.org/0000-0002-4460-2818

Anna ŠATANOVÁ is the Professor of Business Economic and Management at The College of International Business ISM Slovakia in Prešov ORCID ID: https://orcid.org/0000-0001-6770-7236

Mykola PALINCHAK is the Professor of Political Sciences at The Faculty of International Economic Relations of Uzhhorod National University

ORCID ID: https://orcid.org/0000-0002-9990-5314

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## INTEGRATED SECURITY STRATEGIES IN THE CONTEXT OF HYBRID THREATS IN THE SLOVAK REPUBLIC\*

Antonín Korauš<sup>1</sup>, Patrícia Krásná<sup>2</sup>, Stanislav Šišulák<sup>3</sup>, Stanislava Veselovská<sup>4</sup>

 <sup>1,2,3</sup> Police Academy in Bratislava, Sklabinská 1, 835 17 Bratislava, Slovakia
 <sup>4</sup> Pan-European University in Bratislava, Faculty of Economics and Entrepreneurship, Tematinská 10, 851 05 Bratislava, Slovakia

*E-mails:* <sup>1</sup>antonin.koraus@akademiapz.sk; <sup>2</sup>patricia.krasna@akademiapz.sk; <sup>3</sup>stanislav.sisulak@akademiapz.sk; <sup>4</sup>stanislava.veselovska@paneurouni.com

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**Abstract.** The presented study results from qualitative research conducted within the national project "Increasing Slovakia's resilience to hybrid threats by strengthening public administration capacities". Its content reflects the fulfilment of the main goal – identifying four pillars that need to be understood in connection with the concept of hybrid threats and a specific focus on the Police Force or members of the Police Force as well as experts from practice from the National Security Office. The authors also examine the definitions and conceptualisation of hybrid threats, which subsequently led them to identify the key features appropriate for the framework of the chosen research. When preparing this study, theoretical scholarly knowledge from the professional literature and the practical experience of experts from practice were processed. The authors also drew on facts they acquired during guided interviews conducted between May and July 2023 with members of the "first contact" point of the Police Force, general crime investigators, future Police Force members, students of the Police Force Academy in Bratislava and experts from practice, to gain insights and also to detect ambiguities in connection with the concept of hybrid threats.

Keywords: security; hybrid threat; Police Force; hybrid threat actors; hybrid threat tools; hybrid threat domains; hybrid threat phases; students

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## 1. Introduction

The presented study reflects on the need to ensure the building and maintenance of the security of the Slovak Republic through knowledge of the concept of hybrid threats by members of the Police Force. Over the past decade, several comprehensive strategies focused on reducing the risk of specific security threats, economic growth, improving social security and cyber security, and environmental protection have been formulated at the national level. However, the application and financing needed to carry out these strategies and concepts must be more synchronised and coordinated. No sufficiently effective system to help coordinate relevant actions and activities in the field of security and crisis management is present aside from those that are currently provided, managed and coordinated in a time of war or a state of war by the Government of the Slovak Republic and the Ministry of Defence of the Slovak Republic (Concept of the Security System of the Slovak Republic 2023).

The study reflects on the need to conduct ongoing research but also on facts that were studied in the research of the authors collective (Mazaraki, Kalyuzhna and Sarkisian 2021) based on results showing that a transformation of modern interstate conflicts is taking place in the direction of their acquiring hybrid features. These hybrid signs and manifestations are understood to be a process that employs different means of coercion, predominantly non-military. The authors also state that an urgent task for countering hybrid threats is to assess the probability of danger arising from the multi-application dimension of hybrid threats.

The above results from several changes that occurred and are still occurring within the security system of the Slovak Republic. Security as an essential feature of the existence of any state or community deserves direct and adequate attention because if we ignore building and sustaining it, presence in a society without security becomes impossible. During the processing of the study, our focus was on identifying four pillars that must be understood in connection with the concept of hybrid threats, with a specific focus on the Police Force and members of the Police Force. In the framework of the above-stated, emphasis of this study is also put on the definitions and conceptualisation of hybrid threats, which subsequently led to the identification of key attributes appropriate for the framework of the researched knowledge.

Knowledge of the concept of hybrid threats – dangers that are occurring more and more often in the perception of security not only in Slovakia but also in the global environment – needs to be studied scientifically to find the individual parallels it brings with it and to process them both on a theoretical and a practical level. It is essential that the results of the conducted research are presented at scholarly forums and thus support discussions linked with the effective building and maintaining of security in Slovakia, including thorough knowledge of hybrid threats by members of the Police Force. Suppose we want to investigate the effectiveness of any law or system. In that case, we must define the essential conditions (presuppositions) that allow us to consider whether investigating the system's effectiveness makes any sense. The first condition is the existence of minimally one system (Čentéš, Vojtuš 2020). In our case, this is precisely the security system and the securing of a state where the individual, institution or community will not feel threatened.

The police force is a critical element that plays a significant role in ensuring the state's security. "The Police Force is an armed security force that fulfils tasks in matters of internal order, security, the fight against crime, including its organised and international forms, and the tasks that arise for the Police Force from the international obligations of the Slovak Republic" (§ 1, par. 1 of Act No. 173/1993 Coll. on the Police Force, as amended). For these reasons, knowledge is explicitly focused on the perception of this problem by members of the Police Force themselves, i.e. students of the Police Academy in Bratislava and experts from applied practice.

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Suppose the concept of hybrid threats is known to the direct actors of security and law. In that case, there is an explicit assumption that security development will also be supported. It is also important to realise that the dangers present today and threaten the security of states need to be approached with scientific and practical knowledge. Every emerging problem, in theory, needs to be approached scientifically and practically because this is an effective means for ensuring the relevant core contexts that affect building a secure state. International cooperation made on a broad spectrum is essential. Still, the joint coordinated fight against these threats must be based on precise knowledge of hybrid threats and their dangers.

## 2. Theoretical background

Given the global effect of hybrid threats, coordinated international cooperation is necessary. The focus should, in particular, be on information exchange, cooperation and organising joint exercises with other countries to strengthen skills for a collective response to hybrid threats (Glänzel and Thijs 2017; Drelich-Skulska and Domiter 2020; Wadjdi, Tambayong, and Sianturi, 2023).

Hybrid threats are not new concepts; they are not even exclusive to the 21st century. The renowned Chinese general Sun Tzu referred to the strategy of using indirect warfare, deception and false information as early as the 6th century BC in his work *The Art of War*, where he stated that the best war is the one that never begins).

Given the ambiguity and lack of consensus in interpreting the essence of hybrid threats and their concept, it is crucial to interpret the primary attributes of hybrid threats and their related contexts clearly and unequivocally. In common understanding, a hybrid threat is perceived as a characteristic of a particular idea or situation that is unclear or has multiple meanings (Mumford and Carlucci 2023). Securing and defending a state against hybrid attacks is too complex to be divided into strict categories, so it is necessary to develop knowledge about the interoperability of law enforcement agencies in the context of hybrid threats (Birkemo 2013). This is due to the significant role that security forces play in building resilience against hybrid threats (Mattingsdal, Espevik, Johnsen and Hystad 2023).

The author summarises the achievements of the international conference titled "Interagency and International Cooperation in Countering Hybrid Threats" (Yanakiev 2019). The articles in this volume cover a broad range of issues related to NATO, the EU and national experiences in research and practical activities for countering hybrid warfare. The author presents an expert assessment of the institutional need for capabilities to combat hybrid threats and possible ways to contribute to their integration between different agencies.

In the context of the need for implementing systemic measures at the state level, it is crucial to focus on the area of public administration, which is purposefully understood in the broadest sense as the "process of transforming public policies into outcomes" (Kettl 2018). According to Giannopoulos et al. (2018), public administration exists to implement laws and rules. While this concept is theoretically clear, it can be challenging to apply it in practice. First, when interpreting the law to put it into practice, administration naturally contributes to policymaking by evaluating and formulating new policies. Based on the conceptual framework of Giannopoulos et al. (2018), the tools of state and non-state actors in hybrid threats for influencing, destabilising and disrupting the performance of public administration of weaknesses in public administration, promotion of corruption, exploitation of legal thresholds, exploitation of blind spots in the law, ambiguities, gaps and the creation of confusion. In terms of activities, this involves influencing, destabilising and disrupting the performance of public administration of blind spots in the law, ambiguities, gaps and the creation of confusion. In terms of activities, this involves influencing, destabilising and disrupting the performance of public administration of blind spots in the law, ambiguities, gaps and the creation of public administration (Korauš, Kurilovská and Šišulák 2022).

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The dataset is from the meta-analysis carried out in the article "Responses to digital disinformation as part of hybrid threats: a systematic review on the effects of disinformation and the effectiveness of fact-checking/debunking using the EU-HYBNET Meta-Analysis Survey Instrument for Evaluating the Effects of Disinformation and the Effectiveness of counter-responses" (Arcos and Smith 2021). The above also has its justification, associated with the unknown or little-known phenomenon of hybrid threats. Although hybrid threats have been a part of communities since ancient history, their global perception has become evident only recently. Newness, however, is not what determines the necessity of a scientific concept.

Relevant proof of the importance of coordinating the operational work of law enforcement agencies within the European Union as well as in third countries is the European Multidisciplinary Platform Against Criminal Threats (EMPACT), which brings together specialists – law enforcement agencies, courts, European Union agencies and others – who together build safe countries and a safe Europe (Bazarkina 2022). It is crucial to be aware that all dangerous types of criminality have exceptionally strong defence mechanisms, which, on the one hand, make it difficult to detect illegal criminal activity and, on the other hand, means law enforcement agencies and courts are faced with a need for evidence, which they must subsequently overcome when proving criminal activity (Szabová and Vrtíková 2022).

Security, which is provided on a daily level by members of the Police Force, is a key article that needs to be assessed, taking into account academic research and professional discussion. Scholarly publications that treat the building and maintenance of security should generalise essential facts and emphasise the specifics that need to be examined and evaluated.

Hybrid threats are undoubtedly a phenomenon that affects and endangers security. Professional publications focused on this issue specify, assess and clearly define their specific elements or their associated contexts. Therefore, we consider reflecting on our study's data as justified, too.

In the context of hybrid warfare, the vital question of the adequacy of the response to its challenges looms ahead. Ukraine, as well as the countries of the EU and NATO are facing new threats that demand that democracies change their activities to find new forms and methods of ensuring national security. Hybrid warfare as an undeclared war takes place with the integrated use of military and non-military instruments, which principally changes the nature of war (Bratko, Zaharchuk and Zolka 2021).

From the above, it is evident that when learning the essence of the risks arising from hybrid threats, the police and security authorities should welcome the opinions of citizens and society regarding the risks – their origin and existence – encoded in these activities. Experts from the practical environment, particularly police and security authorities, reveal, investigate and evaluate how these activities are assessed and their competencies and responsibilities for predicting or controlling these subjects. They also predict what kind of negative consequences will result from carrying out hybrid threats and what results and effects will appear. They further determine whether it is possible to implement hybrid threats when carrying out countermeasures, and if so, then what kind, when and where – especially for conducting police and security activities (Buzalka 2012). A summary of the issue of hybrid threats is also provided by research, in which the goal was to identify the main components of the EU's approach in combatting hybrid threats. The author concludes that the "open architecture" of the theory of hybrid threats enables vast possibilities for interpreting hybrid threats and thus improving practical measures and theoretical approaches to security problems that arise in a society (Bazarkina 2021).

We also point out that it is essential to reflect on the study of hybrid threats from several points of view. We have chosen to respond to security and its provision, but the economic, sociological or political points of view are also essential. Hybrid threats are often studied extensively in the literature dealing with international relations. However, given the authors' other aims in studying the issue of hybrid threats and their professional focus, we can also mention research on the changing paradigm of security from the economic point of view (Balcaen, Du Bois

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and Buts 2022). The pioneer in this area was Pieter Balcaen, who focused on this field and laid the foundations for its further development.

## **3. Research Methodology**

Our research aimed to look at the essence and importance of knowledge of the four pillars, which need to be understood in connection with the concept of hybrid threats in general, but also in a specific focus on active members of the Police Force and experts from applied practice – from the workplace for hybrid threats and disinformation. This workplace fulfils the intention of the EU and the government of the Slovak Republic to systematically monitor, evaluate, analyse and react to operations aimed at spreading potentially harmful information. These aims were set with a view to precise research and reflecting on emerging questions in theory.

The research methodology we conducted focused on a specific sequence aimed at knowledge of specific contexts. When carrying out the research, the primary specifics needed to be addressed in the framework of further research were determined through scholarly methods, analysis, synthesis, deduction, observation, comparison and generalisation. The determined research questions were the most important element when investigating the selected issue. At the same time, these research questions helped in a purposeful and comprehensive perception of the concept of hybrid threats and their perception in building and ensuring the security of the Slovak Republic. We will answer the specific research questions subsequently and adapt the structure of our article accordingly. The research questions devised based on theoretical knowledge and knowledge from applied practice were as follows:

- 1. "Why is it important that security, but also threats to it, be perceived in connection with the development of current threats?
- 2. How do "first contact" police officers, Police investigators, students of the Police Academy in Bratislava future members of the police and experts from applied practice perceive the essence of hybrid threats?
- 3. What basic pillars forming the concept of hybrid threats are important for understanding hybrid threats?
- 4. How is it possible to effectively build the awareness of students of the Police Academy in Bratislava future members of the Police Force regarding the issue of hybrid threats? Is it necessary to ensure international cooperation in building purposeful education within the security forces following the danger of hybrid threats?

The first research question contains two logical and content-related questions for a better overview and acceptance of logical connections. When identifying the key questions and deficiencies detected by applied practice, we further directed our research towards a specific study of the theoretical but also primarily practical nature of defining the fundamental pillars of hybrid threats and the importance of their knowledge Police Force by members. Subsequently, through analysis, synthesis, a study of the professional literature and investigation of the theoretical nature of hybrid threats, specific associations related to the four basic pillars of hybrid threats need to be identified when defining the concept of hybrid threats and are essential for understanding hybrid threats and their purpose, were defined. Based on the research results, measures will be proposed on both the theoretical and practical levels to avoid the negative impact of hybrid threats on society and to create possibilities for preventing hybrid threats.

As part of the research, from May to July 2023, guided interviews were conducted using pre-formulated questions based on the research questions and the essence, or four pillars, of the concept of hybrid threats among:

- active members of the Police Force 50 "first contact" police officers with more than 3 years of experience who are in contact with citizens daily,
- 48 Police Force investigators of the general crime department with more than 4 years of experience,

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- 120 students of the Police Academy in Bratislava, who are clearly expected to be active members of the Police Force after graduation and
- experts from applied practice from the National Security Office, who fulfil tasks related to the identification of hybrid threats and have been in their position for more than 3 years. These experts supplemented our scholarly knowledge and the findings from controlled interviews with members and future members of the Police Force with relevant facts.

The mentioned sample of respondents was selected to find relevant facts about the knowledge and perception of the issue of hybrid threats by active as well as future members of the Police Force, who will share to an increased extent in maintaining and building the country's security. Guided interviews were also conducted based on previous experiences to determine the most important findings that will help when conducting further research.

These principle relevant facts also helped lecturers prepare and construct topics in the scope of lifelong education for members of the Police Force and public administration employees, which is also currently running as part of the national project "Increasing Slovakia's resilience to hybrid threats by strengthening public administration capacities", whose main aim is to increase Slovakia's resistance to the effects of hybrid threats by introducing a complex set of measures, including optimising processes in public administration entities, adjusting the regulatory framework, increasing capacities and acquiring new competencies and skills by organs of public administration. The project is being implemented by the Ministry of the Interior of the Slovak Republic in cooperation with four partners: the Police Academy in Bratislava, the Ministry of Defence of the Slovak Republic, the Ministry of Foreign Affairs and European Affairs of the Slovak Republic and the Office of the Government of the Slovak Republic.

When processing the presented study, we also accepted the fact that the analysis of hybrid threats, the pillars important for understanding hybrid threats, the building and maintaining the security of the Slovak Republic, including knowledge of the concept of hybrid threats within the Police Force, requires an interdisciplinary approach, which means creating a logical link between the strategy being built and the selected tactics being used.

## 3. Results and discussion

After assessing the acquired knowledge, the perception of the meaning and essence of hybrid threats is important for the country's development and, of course, for the perception of its security. Hybrid threats are often perceived as a modern danger threatening individual countries' safety and security. Still, it must be pointed out that hybrid threats were also present in the distant past, though insufficient attention was paid to them. With the ever more frequent endangering of the security of individual countries, including through hybrid threats, awareness of their constructs and importance have begun being asserted among the broad professional and lay public.

It is important that hybrid threats are gradually beginning to be presented at scientific forums, and through various studies and scientific projects, its essential facts, which affect the security environment not only in specific countries but also from the global security point of view, are being determined. This is also perceived in applied practice, as was determined during the guided interviews. The security environment worldwide has undergone several principle changes in recent years, resulting in a change in already known conventional threats, which have acquired an entirely new dimension and increased intensity due to the development of technology. It is important to emphasise the need at all times and under all circumstances to anticipate security breaches, including attacks that threaten at the national and transnational levels.

Why is it essential that security and its threats are perceived in connection with the development of current threats? How do "first contact" police officers, police investigators, students of the Police Academy in

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## Bratislava – future members of the police and experts from applied practice – perceive the essence of hybrid threats?

As mentioned, the international security environment is dynamically changing and developing, and the development and progression of hybrid threats are also directly related to this fact. "Security" has been mentioned several times, but no definition has been provided. Security, as such, has yet to be clearly defined. There are several definitions of the term and its content; however, it is possible to say that security is an exceptionally complex and multidimensional phenomenon containing many areas and dimensions. Among them are international and national security. In general, however, it is a state when the given actor – an individual or a state – does not feel danger or imminent threat. Different countries understand the concept of security differently, which was also one of the outputs of the guided interviews. For this reason, the perceptions of the hybrid threats themselves also differ. This fact also prompted us to devote ourselves to the basic pillars of hybrid threats during the research.

Security is an important part of every society, and its specific perception is only possible if we also know the individual dangers that can disrupt its construct. The best guarantee of security, peace, development and stability are states respecting democratic values and human rights, which function predictably in an international framework based on rules. Observing the principles and standards of international law and rules of conduct provides basic protection, particularly for smaller states (Conception of the Security System 2023).

The perception of security on the part of our respondents differed within the framework of specific opinions. Still, in the overall overview, all the respondents -100% – understand what security is. The next question we asked aimed at determining the perception of current threats that can negatively affect security. We asked respondents directly about their perception of hybrid threats in terms of their professional and future professional classification, and 40% of them -30% students and 10% members of the "first contact" Police Force – said they had never encountered this term. This confirmed for us the need to address the issue of hybrid threats.

One of the essential forms that effectively support responsibility and consistency when applying elements that ensure awareness of the existence of and fight against hybrid threats is education in the form of training and courses, but also the inclusion of this topic in university curricula in specialised subjects. Education and awareness of the possibilities of threats are one way to prevent them or minimise their impact.

Awareness, cooperation of competent subjects on a multidisciplinary level and continuous progress in preventing threats at the national or international level are key, as confirmed by experts from practice. An element for increasing Slovakia's resistance to hybrid threats is also to increase the level of security awareness of the public and public authorities about the risks associated with hybrid threats. It is essential that the academic community, including the researchers themselves, address this issue with a clear element of thoroughness and importance.

The first research question we formulated confirmed that it is necessary to find key answers for the subsequent interpretation and knowledge of hybrid threats in society. During the guided interviews, we also came to believe that members of the Police Force and future members of the Police Force need to acquire such predispositions, based on the results of quality research and practical experience, that will help them secure their tasks in the most adequate conditions possible. A total of 90% of active Police Force respondents welcomed that someone is interested in whether they are aware of hybrid threats and that they can discuss with someone the effectiveness of building security in the context of the possible occurrence of hybrid threats in our country. However, historical contexts also need to be taken into account, as do the current state of the law, knowledge of theory and the need for applied practice and national and international legal aspects, while also considering the need for a high guarantee of the protection of fundamental rights and freedoms (Čentéš and Šanta 2018).

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## What basic pillars forming the concept of hybrid threats are important for understanding hybrid threats?

The next question we asked respondents related to the basic pillars that, in our view, need to be understood in connection with hybrid threats. With this question, only 5% of the respondents, specifically the investigators, could name the four basic pillars of hybrid threats. This indicates that this issue needs to be discovered, and knowledge regarding hybrid threats needs to be deepened. We then consider it justified, also in connection with the above, to define these four pillars of hybrid threats: actors, tools, domains and phases. For an illustrative example and a more precise understanding, we present these four pillars graphically in Figure 1.



Figure 1. The concept of hybrid threats.

## Actors of hybrid threats

For our study, we differentiated the actors of hybrid threats, i.e., direct initiators, into state and non-state actors. These hybrid threat actors use different tools to achieve strategic aims. We consider it essential to point out that to achieve their goals, actors use various tools aimed at one or more important domains, but also at the sensitive interface of these domains, and they thus become significantly more dangerous for the defence strategy of individual states (Chambers 2016). They endeavour to achieve the target either by direct or gradually using various forms of fraud and through communication interactions (Arcos, Gertrudix, Arribas and Cardarilli 2021). As an example, we note that sanctions are, above all a financial tool that can be considered an alternative to military tools. Still, they also have an important diplomatic and, with all probability, economic impact for both parties. On the other hand, a well-conducted intelligence operation can reduce the enemy's military capabilities without affecting a diplomatic solution. In most attacks, it is possible to recognise the primary dimension, but sometimes it is intentionally hidden and thus remains unknown (Filipec 2022).

One of the several common features characterising the actors of hybrid threats is that all such actors make a maximum effort to attack the rules of legal principles, that is, the basic values of democracy. Legal principles are the basis of criminal law and general law (Kurilovská 2013). During the last decade, "strong and ambitious authoritarian regimes that systematically suppress political pluralism and the free sustainability of power have increasingly applied the same international principles" (Walker and Ludwig 2017).

It is evident from the above-stated that achieving goals is not only about competition or the defeat of competing states but also includes non-state actors whose practices are not aimed at the military acquisition of territory but at gaining control over the population. Globalisation and digital networks enable actors of hybrid threats to the free flow of information between every individual with Internet access and have brought incredible opportunities and challenges. Thus, under hybrid threats, we also often find a presentation of a creative method of connecting new and old tools, which becomes an important tactical instrument of action for those who lack the skills or opportunities to assert their strategic interests otherwise. This type of power can also be labelled the power of the

Source: Authors' processing according to the available scientific literature.

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weak. If a more fragile actor can purposefully combine the attack tools he has available, he can attack even the strongest opponent (Van Raemdonck and Meyer 2022)

Such a combination of attack tools helps the actor achieve his strategic aim without being detected, without resistance, and without reacting to the attack. At the same time, using the power of hybrid threats permits the actor to minimise the risk of open conflict. Therefore, hybrid threat actors are often inclined to influence the decision-making process itself, the decision-making centre, within their target. We can speak, for example, of business operations, decisions of individuals during elections, decisions of those who practice and shape policies and legislation, who perform activities in the public interest, in the state interest, etc. An actor's activities can be successful even if he uses only some elements of hybrid threats; therefore, it is undoubtedly necessary to investigate and monitor the initial stages of the influence of hybrid threats through their actors.

In connection with hybrid threat actors, during the guided interviews, we reflected on the need to define the actors themselves, as well as their specific activities, because exactly half of the respondents, i.e. 50%, were able to state that hybrid threat actors can be divided into state and non-state actors, though only twenty respondents could define their specific activities.

## **Instruments of hybrid threats**

When conducting conflicts, tools from the whole spectrum of methods known under the acronym DIMEFIL – the basic tools of DIME [Diplomacy, Information, Military and Economics] in the environment of FIL [Financial, Intelligence and Law enforcement] – are applied.

- D diplomacy/politics applying influence and exerting pressure verbally and by acts of official political representation;
- I information media, social networks and other means of disseminating information, their manipulative use, disinformation campaign and propaganda;
- M military force this may be an open threat, a demonstration of military presence and alertness, direct combat use or various forms of covert deployment of individuals, small groups and infiltration of the attacked state using them;
- E economy various forms of economic pressure the imposing of customs duty, an embargo, the denial of supplies of raw materials or energy, a ban on the use of transport or a transport route, destabilisation of crucial industries, businesses, etc.,
- F finance destabilisation of a currency, stocks and bonds markets, the banking sector, influencing key financial institutions;
- I intelligence activities of intelligence services, espionage, recruitment of collaborators, especially state or political officials for anti-state activities;
- L public order and the rule of law the use of various subversive activities attacking values, legal and other aspects of the social order, e.g. inciting unrest in the attacked country using ethnic, religious or social dividing lines in a society, or using a wide range of terrorist attacks and other typically criminal methods, for example, kidnapping, blackmail and intimidation (Filipec 2022).

The essential fact is that these tools are interconnected to achieve the most effective impact. If the actors use several tools effectively, it becomes necessary to react adequately to the given situation and to be able to predict their subsequent course of action. It therefore follows from the professional literature that hybrid threats are carried by actors in different environments (Sanz-Caballero 2023). The essence of the individual tools was discussed within the guided interviews with the respondents, who emphasised the importance of knowing these tools in their current and future use.

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It was confirmed that the research sample was selected appropriately because the confrontation of suggestions from future and current Police Force members predicted facts that still need to be resolved within the research. This is also evidence that identifying risk and danger in relation to a specific hybrid threat shows the concrete details and consequences of the hybrid threat, which may have an additional negative nature. According to certain indications, the carrying out hybrid threats by the identity of risks can usually be predicted (Hullová 2020). It can be stated that the action of hybrid threats is conditioned by the intention of the addressee to assess risks because carrying out hybrid threats is an intentional activity; that is, it is not an accident that occurs without a cause.

## **Domains of hybrid threats**

Domains comprise another important pillar for understanding hybrid threats. For illustrative purposes, allow us to display hybrid threat domains through Figure 2.



Figure 2. Domains of hybrid threats.

Source: Schmid (2019).

Hybrid threat domains are key areas of the state targeted by individual tools of hybrid threats. Constructive and conceptual knowledge of these domains is important while also recognising the essence of the tool's impact on a specific domain and the possibility of affecting the functioning of the state after an attack. Accepting the suggestions of experts who will consider the need for a clear definition of essential domains that hybrid threats can endanger is justified. Only if such domains are known will it be possible to secure them and thus maintain the security of all objects.

Not every tool and activity directed at a specific domain is a hybrid threat; however, not all activities within the domain are important, even for a hybrid threat actor. For our study, we chose the domain of law within specific domains for a more specific definition. We chose this domain intending to highlight clear elements that may be at risk from hybrid threats in the context of the law.

In the current understanding of what constitutes the legal domain, it can be stated that this is a collection of legal regulations, actions, processes and institutions, including their normative and physical manifestations, which are or can be used to achieve legal or extra-legal effects in the context of the hybrid threat campaign. Within the legal domain, the hybrid threat actor has the opportunity to choose from a wide range of legal provisions to support the campaign against hybrid threats, including the use of legal boundaries and loopholes, which, of course, facilitate

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his activity and provide him with space and opportunity for use, but also the misuse of national law of the relevant country to obtain its benefit and success (Savolainen et al. 2019).

The action of hybrid threat actors in the legal domain causes conflicts, which subsequently appear in society. These conflicts disrupt the state's proper functioning and affect individuals, institutions, and the legal authorities responsible for maintaining and protecting security. Such conflicts also have an interpersonal nature and can lead to a severe disruption of social relations, which currently fall under the legal category of criminal offences (Šišulák 2020). These existed in the distant past, too. Still, for a society, regardless of the period it is found in, binding rules of behaviour that are not violated and that no one tries to attack or abuse for their benefit – creating disinformation and the like – were and still are necessary for its functioning. Thus, attacking the legal domain is a suitable method for an actor to attack yet another domain because the use of legal possibilities makes it easier to access the social or cultural domain.

We note that it is important to know the following facts for the theoretical and applied dimensions of presenting our research results. The legal field can also be differentiated into national and international law, and it is thus important to state that these areas of law can be used very inappropriately for political purposes. Compared with other domains, the legal domain mainly depends on the actor's perception of the aim. We emphasise that legislation – the law – is a significantly intensive tool because it can convey a moral basis, which can then be used for other negative, harmful activities (Sweijs, Zilincik, Bekkers and Meessen 2021).

The legal domains were discussed in more detail with respondents during the guided interviews. The influence of hybrid threats on the legal domain fundamentally affects them and their views, whether the topics are headed towards the fact that the legal level in the Slovak Republic needs to deal with specific boundaries, which can be a suitable space for the actors of hybrid threats. They also pointed to specifics that may influence the state's security – hoaxes, slippery slope arguments, doxing – but at the same time, they, as members of the Police Force, are restricted and cannot act without violating another legal provision. In support of their opinions, we state that it is also necessary to direct the adjustment of the legal framework in our country so that we can effectively prevent and expediently eliminate the impact of hybrid threats on the legal domain in the Slovak Republic.

## **Phases of hybrid threats**

The last pillar we will focus on is the individual phases of hybrid threats, and we will also do so through an illustrative example, Figure 3.



Figure 3: The concept of hybrid threats.

In the preparation phase, the final goal of a hybrid threat actor is to have his target voluntarily make damaging decisions and take incorrect actions. Suppose the actor comes to the stage where there will be a escalation plan

Source: Cullen et al. (2021).

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towards a military conflict. In that case, the actor will attempt to infiltrate the given state's internal environment, including by strategic manipulation. In this phase, the patience of the actor is important (Cullen 2021). The essence of this first phase is that the actor prepares and creates a suitable environment for his subsequent successful action. The actor's activities in this phase are challenging to detect because his intentions could be more explicit. The primary aim of these activities is to compel the state, i.e. the target of hybrid action, to start making negative, even damaging decisions in line with the actor's interests. The activity in the preparatory phase can be characterised as actions aimed at facilitating change in the organisation or a specific environment (Oyserman and Lee 2008).

Based on discussions with experts from practice, we can state that revealing the actor's activity during this phase is vital; therefore, we must find effective tools to help us do this. If such an actor is revealed during this preparatory phase, it can be anticipated that his activity will be minimised afterwards. An effective tool, for example, is the targeted protection of the safety of individuals, companies, organisations and all elements that may be an actor's target and, thus, hybrid threats. Based on the above, the task is to systematically monitor, assess, analyse and respond to activities that have the potential to polarise society, introduce uncertainty and thus undermine the legitimacy, credibility and ability of state institutions to act as well as the democratic constitutional order, ultimately hurting the security interests of the Slovak Republic.

The destabilisation phase is when the actor intensifies his activity, for example, in a campaign – carrying out several operations. In this phase, the actor aims to obtain the most information possible to threaten his target as effectively as possible. The actor's activity here is increasingly apparent, but the actor does not admit to this agility. A problem that practice also identifies lies in the fact that the target state being threatened by the actor does not have sufficient evidence to prove the action of the hybrid threat actor reliably. During this phase, it is difficult to detect when the actor changes the mode of his activity (Schmid 2017).

Aside from those mentioned above, the destabilisation phase uses various grey zones between traditionally considered separate areas, but in today's security environment, they are, in fact, closely connected and intertwined. This is, for example, the boundary between external and internal security, the perception regarding friend and enemy, the interface relating to legislation, the virtual and the real world and the understanding of peace and war. It then follows that this phase affects several domains – legal, military, social, political, economic, cyber and public administration. The basic difference between the preparatory and the destabilisation phases is mainly in connection with the response to the actor's activity in a specific domain.

Experts pointed out to us the fact that during this phase, a systematic response to an actor's activity is inappropriate because the actor is acting with the aim of long-term strategic interest. Therefore, it is necessary to ensure through gradual, purposeful action the constructive elimination of the actor's influence on the boundaries of individual domains and their vulnerable components because if the actor does not reach the desired state, his activity either returns to the preparatory phase or initiates the escalation of his activity. This depends on importance, the strategic objective, the response, and other opportunities.

The pressure phase – hybrid war. In this phase, the actor goes beyond the scope of furtiveness with his activities. In this case, the sharp end of the escalation spectrum of hybrid threat activities is already occurring, and the key element is the use of force to achieve one's purpose; thus, the nature and character of the entire conflict turn into war. In this phase, the actor uses a combination of covert and open military operations, which are accompanied by other tools, such as information operations or cyber attacks (Wither 2016).

In this phase, the nature of the actor's activities changes to an act of force through which he forces the enemy to do his will (Clausewitz 1976). Hybrid warfare is specific in combining several hybrid threats; it combines cyber attacks, terrorism and insurgency in a series of assaults using information and communication technologies.

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Hybrid warfare is not a new phenomenon; its presence in modern war operations, such as those in Ukraine and Russia, is a challenge, especially for the security conditions in Europe (Asmoro, Marsetio, and Putro 2022).

The third research question we formulated aimed to clarify the four specific pillars that should be known to understand the concept of hybrid threats. In the previous sections, we summarised theoretical knowledge and knowledge from experts from practice and members of the Police Force, who also offered us suggestions, opinions and justified facts related to actors, domains, tools and phases of hybrid threats. We appreciate that experts from practice provided us with specific deficiencies they perceive in practice and pointed out specifics related to guaranteeing security.

# How is it possible to effectively build the awareness of students of the Police Academy in Bratislava – future members of the Police Force – regarding the issue of hybrid threats? Is it necessary to ensure international cooperation in building purposeful education within the security forces following the danger of hybrid threats?

An essential component of the research was also the possibility of effectively building the awareness of students of the Police Academy in Bratislava – future members of the Police Force – about the issue of hybrid threats. The most effective method for building awareness is targeted academic research and then translating its results into pedagogical practice within specific, individual subjects, such as priority, criminal law, investigation, informatics, criminology and security management. Even within the framework of our research, the issue is gradually being transformed into the teaching process, and students are becoming familiar with the specifics associated with the subject.

Our guided interviews revealed that the students value such an initiative and ask about specifics they could also encounter in practice. It can be seen that they are aware of the importance of this issue and realise that to ensure the security of our country, it is necessary to detect all the potential threats at the national and international levels.

In association with the above, the research also aimed to ensure international cooperation in building purposeful education in the security forces concerning the danger of hybrid threats. This substantial part of the research reflected the essential need for international cooperation with universities in other countries so that education reflects both national and global needs in the context of effectively combatting hybrid threats. What is stated is justified by differentiated experiences and possibilities of individual higher education institutions abroad, which allow us to recast specific, verified experiences into our teaching process.

## 4. Conclusions

From the knowledge we acquired when processing the presented study, we conclude that building and maintaining the security of the Slovak Republic within the Police Force through knowledge of hybrid threats is exceedingly important. Relevant practical information provided by respondents during guided interviews can be seen as part of the research, and a correlation can be found between them on the theoretical and scientific levels. This is an effective prerequisite for limiting the spread of hybrid threats and their associated dangers in our country.

From the point of view of the main goal – identifying the four pillars that must be understood in connection with the concept of hybrid threats and a specific focus on the Police Force or members of the Police Force and experts from practice, from the National Security Office – the main goal was fulfilled on the scientific, professional and practical sides through research questions that were discussed with four categories of respondents. Partial reactions are contained in the text of this paper and in chapter 4 – Research results and topics for discussion.

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In the case of building an effective approach among members of the Police Force and public administration employees concerning the perception of possible threats and hybrid threats, it can also be assumed that building and maintaining security in the Slovak Republic will be at a significantly higher level. Relevant objects – members of the Police Force and public administration employees – will perceive the risks of hybrid threats and work with information that will be verified, which is a vital basis for identifying the phenomenon of hybrid threats.

In the given context, we want to highlight with these findings the importance of the methodology for realising the knowledge of risks from hybrid threats (Hullová and Fidler 2022). In a broader sense of the word, knowledge methodologies are schemes of approaches and programmes verified by practice and theory in achieving a set goal. In the narrower sense of the term, we label respecting the delegated competencies in the purposeful design of procedures that lay the foundations for its effective and efficient implementation as the *methodology of criminal-police knowledge* (Lisoň and Vaško 2018).

The knowledge presented herein contributes to the research and development of building security and the elimination of hybrid threats at the national and international levels because hybrid expansion in the information space is also spreading, and there is no reason to believe that hybrid threats are decreasing or disappearing (Tkachuk et al. 2021). Hybrid aggression is part of our society and endangers the security of democracies.

Carrying out the research and the national project, in the framework of which this study is presented, will significantly improve the preparedness of public administration authorities and members of the Police Force at the central and regional levels to detect, analyse and implement targeted measures against hybrid threats (Korauš, Kurilovská and Šišulák 2022). Building up human resources and technical capacities and implementing educational and communication activities will significantly increase our country's resilience to various forms of hybrid threats in the relevant domains. A targeted audit of vulnerability and subsequent proposals to amend and supplement regulatory frameworks will fill in system weaknesses against hybrid activity and support the fight against hybrid threats.

Our *de lege ferenda* suggestions based on the knowledge we acquired when conducting this research are with certainty the following: Creating a methodology for Police Force members that would help them identify the risks of hybrid threats; a change in legislation that would make it possible to punish selected manifestations of hybrid threats; a more effective system of information on the phenomenon of hybrid threats; and the expansion of research opportunities in this area.

The ambition of the presented study is to contribute to the scholarly debate, which is of great importance within the given issue and requires precision and clarity of all attributes related to it. Empirical research has demonstrated the need for continuous comprehensive knowledge of the risks of hybrid threats. In connection with the issue of hybrid threats, it is essential to emphasise the need for a constant flow of transformations in the development dynamics of this specific phenomenon. The transfer of knowledge in the mentioned system needs to take place such that one output in the form of knowledge is at the same time input to another, leading to new knowledge. The emergence, quantitative and qualitative change of the information nature of the risks of hybrid threats – their origin, growth, partial paralysis, and complete deactivation – form a solid chain in the environment and time (Hullová and Fidler 2022). These facts must be accepted by all interested parties, including members of the Police Force, who, in line with the competencies delegated by the law, take part in identifying hybrid threats and their danger, but, of course, also in reducing their occurrence.

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**Prof. Dipl. Eng.. Antonín KORAUŠ, PhD., LL.M., MBA**, Academy of the Police Force in Bratislava, Sklabinská 1, 835 17 Bratislava, Slovakia. ORCID ID: https://orcid.org/0000-0003-2384-9106.

Assistant Prof. JUDr. Patrícia KRÁSNÍ, PhD., LL.M., Academy of the Police Force in Bratislava, Sklabinská 1, 835 17 Bratislava, Slovakia.

ORCID ID: https://orcid.org/0000-0003-0079-9652.

Assoc. Prof. Dipl. Eng. Stanislav ŠIŠULÁK, PhD., MBA, Academy of the Police Force in Bratislava, Sklabinská 1, 835 17 Bratislava, Slovakia. ORCID ID: <u>https://orcid.org/0000-0003-4727-9582</u>.

**Dipl. Eng. Stanislava VESELOVSKÁ, PhD.**, Pan-European University in Bratislava, Faculty of Economics and Entrepreneurship, Tematinská 10, 851 05 Bratislava, Slovakia. ORCID ID: <u>https://orcid.org/0009-0005-5616-018X</u>

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## THE ROLE OF ICT IN TRANSPORT AND LOGISTICS PROCESSES MANAGEMENT\*

Aurelija Burinskienė

Vilnius Gediminas Technical University, Faculty of Business Management, Department of Business Technology and Entrepreneurship, Saulėtekio al. 11, LT-10223, Vilnius, Lithuania

E-mail: aurelija.burinskiene@vilniustech.lt

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**Abstract.** The complexity of managing transport and logistics processes is a massive challenge in finding optimal management solutions that meet the requirements of green development. There are questions about management support for transport and logistics processes. In addition, the subtleties of developing solutions for maintaining existing transport and logistics activities highlight the complex nature of transport and logistics management processes. The article focuses on applying advanced solutions for the practical management of transport and logistics processes. In the transport and logistics sector, an increase in new suppliers of telemetry systems is observed every day, which has been going on for 4-5 years, and this is statistically visible in the IAA Transportation 2022 records of one of the largest biennial transport and logistics exhibitions. There is an evident growth in the number of participants of manufacturers and service providers of telemetry systems, which since the exhibition held in 2016 has more than doubled, while around the world, the number of new companies supplying telemetry systems has increased to more than 300 per year. The growth of competitiveness also impacts the development of functions that provide new opportunities for customers to make their business more efficient or to receive services that ensure a comfortable life. Digital information generated by vehicles, which, when systematized, is presented to the end driver, is gradually becoming the future of this area of business and leads to responsible resource utilization, monitoring, control, and utilization of user-friendly technologies, leading toward a more sustainable future. An analysis of scientific papers has proven that the theoretical link exists between telemetry systems and their application in the transport sector; however, the judge research gap is in applying different quantitative methods for solving transport problems with the help of telemetry solutions.

Keywords: transport; telemetry; telematics; information platform; information; ICT; management

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## 1. Introduction

Globally, Europe stands out as an innovative pioneer in transportation and logistics. This region prioritizes technological advancements focusing on intelligent transportation systems (ITS) and Europe emphasizing the sector's digital transformation. As exemplified by the European Commission's May 17, 2018 document, EU strategic initiatives aim to establish the European Union as a leader in automated and interconnected mobility systems. These approaches underscore the importance of integrated IT systems for efficient transport and logistics management. Such a strategy leads to optimized resource usage, reduced emissions, and enhanced living and working conditions, benefiting stakeholders such as customers, service providers, and carriers.

The EU, United Nations, and G20 countries increasingly implement policies and actions to promote sustainability. Promoting sustainability at the municipal level is quite common in sustainable mobility and transport (Gallo et al. 2020). Policies promoting sustainable mobility can be divided into environmental, social, economic and technological. Sustainable transport policy includes climate, air quality, safety, and traffic safety. Gaia-X is a European initiative that aims to create an open and secure digital ecosystem, allowing companies and individuals to share data while maintaining control through secure identity and trust mechanisms, with a decentralized architecture linking various providers of computing elements. Catena-X is a project aligned with Gaia-X principles, focusing specifically on the automotive industry, providing a global data space that connects suppliers through a trusted and interoperable data-driven value chain, emphasizing data sovereignty and ownership, and illustrating a practical use case for a general data system constructed in the cloud (Zhang & Qi, 2021; Pörtner, Möske & Riel, 2023).

This scientific article aims to study not only the possible impact on future companies in the transport and logistics sector but also to build on the available practical knowledge acquired through a literature review. There is also a desire to analyze the current situation in the transport and logistics sector, to present the expected future trends, the principles of operation of telemetry systems and how the latter could help to manage transport fleets more efficiently. With the emergence of more and more suppliers of telemetry systems, there is a problem – the lack of interface between all these systems, which would allow transport and logistics companies to use the information provided by several such systems. By leveraging the integration of information and communication technologies (ICT) alongside emerging wireless communication and cloud computing tools, an exceptional opportunity arises to establish a comprehensive system. This system has the potential to adeptly oversee intricate processes sustainably, thereby mitigating risks and avoiding unsustainability.

Dynamic systems could empower logistics decision-makers and stakeholders to observe real-time processes and proactively anticipate potential delays and complications while adhering to eco-conscious and user-friendly approaches. Such enhancements translate to heightened efficiency, customer information precision, and an enriched participant experience.

A definite answer cannot yet be given to the entire transport and logistics sector because the process has just begun. It is fascinating to observe it from the outside, both by the prominent representatives of this sector and in the actions of medium or small ones, by digitizing the processes of enterprise management and trying to make the most efficient use of the available human and technical resources.

Vehicles generate many data, from driver driving readings to technical information. If all vehicles on the roads would systematize the information generated and transmit it to a shared vehicle information network system (i.e. platform) that would be available, such information could make it possible to control the flow of vehicles on the roads, provide technical equipment manufacturers with information on the wear and tear of specific components, such as brake pads, during the operation of the vehicle under different conditions, etc.

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The structure of the paper consists of four sections. The first section presents the role of information and telematics systems in the transport and logistics business. The second section describes the principle of operation and functionality of information and telematics systems. The third section focuses on the application of platforms to support the transport and logistics processes management. The last fourth section shows the literature review results on telemetry usage in transport.

## 1. The role of information and telematics systems in the transport and logistics business

Information and telematics systems are relatively new and must be more visible and constantly changing (Atkins et al., 2022). This has increased the interest of researchers in understanding how different public figures can adapt information and telematics systems to improve and facilitate different forms of change. This new area of research focuses in particular on the study of how information and telematics systems can be used by businesses, households, governments and other stakeholders to encourage the development of services in the transport and logistics sector.

In the era of global connectivity, managing transport and logistics processes has become crucial for companies, including large-scale deliveries, resource sharing and data sharing, to improve service delivery and enable more sustainable and efficient operations (Choi et al., 2019; Dano et al., 2021). It is, therefore, vital to propose information and telematics systems adapted to the transport and logistics sector.

According to Musaigwa et al. (2022), the application of information and telematics systems depends to a large extent on the integration of data from vehicles and cargo (Du et al., 2019; Liu et al., 2022) and cooperation between companies, including those operating in the transport and logistics sector. In particular, the automotive, IT, and high-tech sectors are increasingly dependent on information and communication technologies to manage the physical processes of transport and logistics (Roussat et al., 2023), and transactions often involve interaction with each other.

By applying advanced solutions, companies gain a competitive advantage. This has led to increased interest in providing services in the sector and has recently been systematically reviewed in research and development. The scope and diversity of datasets have expanded in response to the increasing volume and variety of data used for transaction exchanges (Zhang et al., 2022). With the introduction of these revolutionary technologies, the focus was on maximizing total value creation. This change has led to the introducing of innovative transport and logistics process management models that reflect a dynamic response to the changing industrial environment (Dolgui, 2018).

Previously, until 1990, companies relied on electronic data exchange and freight transport systems for data exchange and interconnection (Demir, 2020). These systems facilitated access to data for analysis and helped companies anticipate demand (Hu et al., 2021), promote better collaboration, speed up transportation and logistics processes, reduce costs, and improve customer service (Attaran et al., 2023).

Over the past decade, companies have integrated Business Intelligence technologies and predictive analytics solutions, as noted by Lorenc & Burinskiene, 2021). These technologies have allowed a comprehensive understanding of transport and logistics processes, simplified decision-making processes, and provided insights into local optimization (Barbosa-Povoa et al., 2018). Companies face the challenge of seamlessly integrating into their transportation and logistics networks today. Although many international companies have common resources, they seek new methods and effective implementation models (Light et al., 2015). Systematic data analytics allows companies to receive alerts and make optimal decisions quickly.

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Hodapp et al. (2022) emphasize the importance of organizations using integrated IT solutions to drive business growth and leverage the practical insights generated by the growing variety of potential opportunities.

Before attempting to understand the possible vision of the future interface of technical devices, telemetry systems and the platform's business model, it is necessary to analyze the current situation in the transport and logistics sector. Like other business sectors, the latter is inevitably forced to change and accept innovations created by information technology, which makes it possible to optimize the daily processes of this type of work, which can be done by identifying the current situation and applying the correct ways to solve the problem to it.

The primary purpose of this subdivision is to find out, identify and study the trends in the transport logistics supply chain in today's market and the emerging problems faced by representatives of this sector. Supply chain activity is changing dramatically, and experts predict these changes will only increase soon (Wallace et al., 2021). The scientific transport article identifies ten main trends that will significantly impact the spheres of transport logistics and supply chains (Stank et al., 2015). The main characteristics are presented below:

- Systemic focus optimization of the entire supply chain network, creation of customer value;
- Information synthesis information is entirely shared, and general interpretation and analysis of
  processes help to improve work efficiency;
- Cooperative relations shared commitments and creation of benefits, total systemic benefits;
- Demand formation proactively formed demand, creation of total systemic benefits;
- Data transformation constantly changing conditions, information and its processing;
- Flexible network integration dynamic selection of partner customers in information systems according to the necessary criteria in the current situation;
- Process optimization leading to reduction of CO<sub>2</sub> emissions and sustainability benefits.

The above trends and the resulting problems are aimed at optimizing the supply chain and opportunities to improve the processes used in the future based on information found in scientific articles. These points are closely related to integrating information technology and telematics systems into the activities of transport logistics companies and existing business management systems, which require reliable, adequately processed and systematized timely data. Tracking and telematics systems can become essential factors that will enable or prevent the implementation of these trends, the development of the transport business and the optimization of processes. However, the transport logistics business is not limited to the supply chain, although it is one of the essential factors, and the transportation activity itself is of particular importance.

Although cars remain the dominant force in the various types of transport sector for most people, many different transportation options are observed daily (Wallace et al., 2021). Various startups in this sector can achieve impressive results quickly and offer a new way of transportation. World-class companies such as Uber, Grabtaxi, more widely known in Lithuania Taxify, CityBee offer their customers alternative transportation services for short and long distances. Young drivers are more likely to use the services of these companies, thus not obliging themselves to buy a car, insurance premiums or the costs necessary to maintain the car's technical condition. Uber can be used as an excellent example for adapting the platform's business success in the transportation sector, which started its activities as a limousine rental company and did so by phone. By generating the idea of creating a platform that combines a network of people looking for transportation and people providing transport services, Uber has been an unprecedented success. At the same time, drivers working at Uber enjoy a more significant number of passengers and more frequent bookings. Consumers pay a lower price than for taxi services. One can call an Uber car or cancel it with a few-click telephone assistance. It is a success story that has already happened and has become a trend today. At the same time, in Forbes magazine, the authors single out six main potential transportation trends that will change humanity's current understanding of transportation in the future (Stank et al., 2015):

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- Autonomous vehicles vehicles that are not controlled by hands and feet are already a reality today; fully autonomous vehicles will become a reality shortly;
- Electric vehicles the basis of such vehicles are transit buses, minibuses, and vehicles that can travel relatively short distances are becoming increasingly economically attractive and can travel longer distances without stopping to charge the battery;
- Networked vehicles traffic conditions and intensity become achievable in vehicles, as vehicles have an internet connection and can share information;
- Shared use as the need for information dissemination increases, the need for mobility tools increases so that shared options enable mobility without the most frequently unused private cars;
- Efficient multimodal network by receiving a large amount of data from different vehicles, it becomes
  possible to adapt and change the arrival/departure schedules according to the needs of the driver; it is
  additionally possible to choose one of several proposed route options for achieving the final destination;
- Newly designed vehicles lighter vehicles are already becoming a trend, and this is also an important factor in extending the distance of electric vehicles.

There is a high probability that it will not take a long period to see entire fleets of vehicles that will be autonomous, consumers will be able to share cars and reach their travel points, and all vehicles will be connected to a shared network, which will make it possible to control the flow of transport movements and optimize vehicle congestion in cities or high-importance roads.

However, for all the innovations of the future, which are predicted in the management of vehicle fleets, a system will be needed that will be able to connect technical solutions with information technology platforms. Without this interface, it isn't easy to imagine a smoothly functioning system that provides users with convenient vehicle control and the necessary tools with the help of which this process can be controlled. These days, prototypes of suitable design technical devices are still being sought to ensure the sustainable and spontaneous capture and transmission of vehicle-generated data to the end user. Such information systems are not interconnected, but the creation of a platform that combines these systems into a platform whole would make it possible to search for points of contact between common systems and problem areas of the joint transport fleet and try to solve them by creating additional technical equipment or an information technology system.

## 2. The principle of operation and functionality of information and telematics systems

Systems such as information technology, tracking or telematics are usually made up of the following elements – an information processing device, an information recording and storage device, a telematics component that collects the generated information, in other words, a sensor, and a device that sends collected, systematized information from the vehicle to other devices, which can use GPRS (mobile communication), Internet connection or wireless Internet connection Wi-Fi (Porter et al., 2015). All of the above elements of information technology, tracking or telematics systems can be configured and inserted into the selected vehicle, be it a tow truck, semi-trailer, passenger car or ship, as needed. An information processing device controls the information recorder, sensors and the information transfer device, thus combining these elements into a single functional system that can not only receive data but also exchange it with each other or transmit it to the necessary third tool - a telephone application or an online portal - by generating messages about specific parameters, such as driving speed, traffic conditions, changes in the technical characteristics of the vehicle, etc., on the vehicle and to warn its user, owner or other person involved of the need to take appropriate action to remedy the problem. Such a message can be generated as an SMS message to the assigned phone number, an e-mail to the responsible person, or an event tile presented as a certified document (Porter et al., 2015).

There is not a single principle of operation of telematics systems (Porter et al., 2015). The components that make up this type of system are usually the same, but the programming of these components can change and have
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several different variations. An essential part of such systems is a programmable, configurable information processing device that performs various functions in different systems. The processor can be programmed to react, identify certain pre-programmed situations and inform the end user about them. In this way, the risk of the human factor is reduced since the user is not obliged to create the necessary messages or warnings about the vehicle or the entire transport fleet himself since this is done for him by the processor and thus conditionally limits, which effect the functionality of information, tracking or telematics systems.

It is also possible to program the information programming device so that it automatically updates the software of all the components that make up the common telematics system, analyzing the flow and quality of the data sent (Porter et al., 2015). This function generates enormous benefits for a typical, everyday user who does not have to worry about updating equipment, visiting a service partner and other issues that use time and resources, since this function generates huge benefits for a typical, everyday user who does not need to worry about updating equipment, visiting a service partner and other issues that use time and resources, since this function generates huge benefits for a typical, everyday user who does not need to worry about updating equipment, visiting a service partner and other issues that use time and resources, since this function generates huge benefits for a typical, everyday user who does not need to worry about updating equipment, visiting a service partner and resources, since this function generates huge benefits for a typical, everyday user who does not need to worry about updating equipment, visiting a service partner and other issues that use time and resources, since this function generates huge benefits for a typical, everyday user who does not need to worry about updating equipment, visiting a service partner and other issues that use time and resources, since this function generates huge benefits for a typical, everyday user who does not need to worry about updating equipment, visiting a service partner and other issues that use time and resources, since this function generates huge benefits for a typical, everyday user who does not need to worry about updating equipment, visiting a service partner and other issues that use time and resources, since this function generates huge benefits for a typical, everyday user who does not need to worry about updating equipment, visiting a service partner and other issues that use time and resources, since this function generates huge benef

Another example of the functionality of telematics systems is the unconditional communication of several vehicles and exchanging information with each other (Porter et al., 2015). Thanks to the tracking telematics system, cars can be connected to a shared network, where information received from all vehicles on this network is collected, processed and systematized, and feedback is created with the selected information for each vehicle according to the criteria necessary for it at that time. This creates the possibility of implementing a prototype of an autonomous vehicle and integrating it into the transport, transport and logistics or supply chain sectors by simplifying transportation processes.

New telematics systems, methods, functions, and values to be created will or will become a strong basis in the transportation of the people of the future, in the transport and logistics or supply chain sectors, based on the processing of generated data and its integration into existing systems (Guenkova et al., 2015). The data being developed makes it possible to understand the places of efficiency of the transport and logistics sector, which, if optimized, could lead to more efficient work, resource utilization and, of course, the profitability of companies in this sector.

Based on the divisions of tracking telematics systems proposed by the scientific article, it is possible to form four of the most common, comprehensive parts that define the possible functions of systems of this type (Englebrecht et al., 2014):

- Traffic condition information position at the given moment and movement of other vehicles or pedestrians;
- Vehicle information vehicle technical standing data, pending maintenance or repair;
- Environmental information the condition of the road and current or future weather conditions;
- Driver behaviour information monitoring of driving efficiency, economy and safety of equipment, as well as protected functions – notifications warnings that help the driver to properly assess the situation and make appropriate decisions.

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Traffic condition information – M2M (a machine transmits information to another machine) platforms are an essential condition allowing several different vehicles to communicate autonomously and share the available information (Booysen et al., 2012). Vehicles can automatically, without user intervention, reschedule an existing route to a new one, having received information from other vehicles about road accidents, congestion or unforeseen situations that do not allow the intended section to be overcome as quickly as planned. This function is crucial in the cargo transportation, transport and logistics sector, especially in the auto industry, where cargo must be delivered at a particularly accurate time, otherwise, the entire production process is stopped, and the company of the manufacturing industry loses huge money with each late minute, and the transport logistics company is obliged to pay a penalty of the amount of the value of the cargo for outstanding obligations. With this system, such situations can be avoided.

Vehicle information – has proposed to use smart devices as an alternative to the OBU (additional equipment for accessing vehicle data) to obtain ECU (Electronic Vehicle Control Control) information remotely. The ECU is usually achieved using the OBD-II connector standard in the transport manufacturing industry by connecting a wireless additional component to it, which transmits all the generated data. In this way, the data generated by the vehicle can be reached at a considerable distance from the vehicle. Also, based on the same principle, it is possible to install an automatic auto-event detection system, for which a GPS position should be added to the existing components, and a smart device and an accelerometer can generate it.

Environmental information – the main technical elements necessary for this function are the GPS position and the accelerometer. One of the first road condition monitoring systems has been developed to detect map anomalies on the road, such as unexpectedly appeared potholes, fallen trees, etc., using the already mentioned technical means (Eriksson et al., 2008). Later, this system was supplemented with sensors that generated messages and could send them and warn the driver and other persons about the information received.

Driver Behaviour Information tool was developed as the first finite driver monitoring system (Johnson et al., 2011). The system they designed can detect, identify and classify aggressive or non-aggressive driving manoeuvres according to the results obtained using data generated by the accelerometer, gyroscope, magnetometer and GPS. Later, additional functions were added that made it possible to classify drivers according to the driving stylistics and allocate effective driving scores based on this, and this system became extremely popular in the transport and logistics sector when evaluating drivers and paying additional bonuses for work according to the available effective driving score or looking for answers to the question - why the set efficiency of the company is not achieved.

The principle of operation of telemetry systems remains similar to the technical equipment that captures and systematizes the data generated by the vehicle. Of course, the quality and functionality are different; it all depends on the final production and the monthly service cost, but the platform creation should be fine with this. However, the problematic location could be the amount, size and processing of the generated data since the amount of information the language talks about is enormous.

## 3. The application of platforms to support the transport and logistics processes management

Four meanings of the platform are defined, which are described based on the leverage method and the architectural openness of the platform's structure (Nowicka, 2021). Types of platforms:

- Organizational platforms;
- Product family platforms;
- Market brokerage platforms;
- Ecosystem platforms.

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This subsection is designed to understand the basic logic of the ecosystem platform, which combines the characteristics of two other platforms: product families and market intermediaries. The ecosystem platform operates on an architecturally open principle, thanks to which external resources such as suppliers, manufacturers and customers are managed. This platform uses three different methods of the type of leverage, which allows you to generate a higher yield with the available resources. This is done by recombining available resources, projects and standards (leverage of production), facilitating the creation of new goods or services (leverage of innovation) and manipulating market pricing mechanisms, possibly reducing friction. Reduction in transaction search costs (transaction leverage) (Thomas, 2014).

It is argued that platforms can mobilize added value that may not be visible to the public and thus help them to make broader and more efficient use of available resources and time or provide expert, creative opinions that would contribute to the implementation of ideas for participants in an open infrastructure system (Chase, 2015). Control in this type of system or community is the division of participants into developers and consumers of products or services. Evaluation of the work of the platform takes place through a positive created network effect, which is an inevitable cycle, during which the creators of the platform, taking appropriate strategic actions, grow the value of the platform, attracting new users who again influence the new cycle with additional progress of the platform (Parker et al., 2016). Business logic is based on various interactions and open problematic issues, which requires coordination so that both the consumer and the creator or supplier of the service can make the most of the added value created and use it as simply as possible. Control is a prerequisite for the platform, it is necessary in order to differentiate the best users from the worst and remove the latter from the platform by ensuring its high-quality functioning (Lane et al., 2017). The management system is also a necessary tool to control the conditions of consumer participation on the platform, distribute value-sharing issues between consumers, or resolve disputes between consumers and suppliers.

To achieve a positive change in the network and global development, it is important:

- Achieving a critical mass of value creation (Evans and Schmalensee, 2016);
- To take care of real-time adaptation, mentoring and management of the consumer community (Choudary, 2015);
- To ensure that the chosen policy of presenting values on the platform is important for its creators and users (Parker, Van Alstyne, Choudary, 2016).

It is claimed that the two components of the platform are essential, although sometimes they are forgotten, which distinguishes the platform's business model from the traditional linear business model (Choudary, 2015). These components are:

- Rapid adaptation to changing consumer consumption habits and patterns;
- The ongoing process of assessing the state of the platform.

These are the essential mechanisms of operation of the platform that follow from the sources of information retrieval and the management structure of the platform. Traditionally, currency exchange in economic transactions is considered to be the equivalent of money, but in the case of platforms, information or social currency, as an example, one can give reputation, is the same value, sometimes perhaps even higher, generating instruments than monetary transactions, which is created through value-added activities that can be created by platforms (Choudary, 2015).

At the core of this research lies a pioneering approach by constructing a management structure tailored to the dynamics of transport and logistics processes. Here, "management structure" refers to a systematic handling of transport and logistics processes. The basis of this approach is the integration of data transport and logistics processes and operational management rules. Responding to diverse transport needs and challenges by integrating new management rules and increasing support for multispectral transportation and logistics activities.

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To understand whether and how the platform business model correlates with management structure fulfillment requirements must be used as essential concepts to support the business model of platforms. These principles are: (1) Value; (2) Flow of values; (3) General flow; (4) Affinity; (5) Perfection.

The first principle. The value concept also combines improving the quality of a product or service and delivery action, while constantly gradually reducing costs for suppliers and the cost of a good or service for consumers (Womack and Jones, 1996). Platforms collect information from each transaction, storing this information in both directions, taking into account the level of satisfaction of both the supplier and the user after the provision or receipt of the service (Moazed and Johnson, 2016). The information collected is then adapted to the algorithms used on the platform in order to create a system in which the most suitable suppliers are paired with the needs of individual consumers and the latter remain satisfied. In addition, platforms reduce the overall cost of processes by eliminating intermediate links such as brokerage companies. The basic meaning of the ecosystem platform directly correlates with the definition of value creation.

The second is the flow of values. The flow of values consists of three critical points:

- Solving the problem;
- Information management;
- The physical task of transformation.

The flow of values is the approach to a linear business model, where the platform, although trying to solve the problems the potential user faces in the desired way, does not work in the same way as the flow of values, more like a network of values. The platform can only work properly if it pairs the required manufacturer service provider with the right user and generates a maximum value on both sides (Parker, Van Alstyne & Choudary, 2016). In this aspect, the platform and flow of values coincide.

The third principle is the general flow. Organizations turn their attention to a stable general flow that connects one process with another without any extraneous interference that could complicate the work. The ecosystem platform replaces entire companies and the services they offer, an example of which can be used by intermediary companies of the whole value chain when a new platform business model is introduced, which eliminates the constant competition in intermediate chains, which is the usual daily practice of liner businesses (Parker, Van Alstyne & Choudary, 2016). The ecosystem platform expands the concept of general flow from the interface of individual companies and individual projects to a common ecosystem platform, where it is possible to find the best solution for a particular project from existing proposals or agree on the preparation of such a proposal.

The fourth – thrust – is embedded in the platform's business model logic. A successful platform creates a network effect, which creates additional value for each platform participant every time a new supplier or user of a product or service joins the platform. All this can be described as a growing double attraction - when a new supplier arrives, new customers are attracted, or with an increase in the number of consumers, additional suppliers appear willing to meet the resulting consumer demand on the platform. Meanwhile, the owner of the platform balances demand and supply by changing the pricing of the services or products provided (Evans & Schmalensee, 2016).

The fifth principle is perfection. The platform business model is a powerful tool for achieving perfection. Such a business model competes with conventional linear business models and other platforms, which means double competition. In the future, there are expected to be more ways for consumers, service providers, and product providers to become part of different but simultaneously similar functionality platforms (Parker, Van Alstyne, Choudary, 2016). Participants in these several platforms can become the key to pursuing perfection soon. The cycle of real-time feedback on the received service with the management of a vast flow of information already makes it possible to solve particular problems, such as waste related to the production process, and an appropriate

management system prevents such activities (Choudary, 2015). The constant pursuit of perfection is integrated into the platform's curation processes and platform management systems.

All five principles are naturally integrated into the success factors that determine the functioning of the ecosystem platform. It is possible to single out the general flow as an essential factor that strongly contributes to the implementation of successful projects, and conventional intermediation companies with linear operations often need to be able to ensure the high-quality performance of this process. In conclusion, the platforms' business model highlights the importance created by understanding and evaluating the value relevant to the consumer, which should have been more often underestimated or overlooked earlier (Pekuri, Pekuri & Haapasalo, 2013).

#### 4. The review of literature on telemetry usage in general and in transport

During the literature review, the author tries to identify a research gap in the application of telemetry systems in transport. The literature review consists of two stages. First, the author applied bibliometric analysis, and later on - the comparison analysis, which shows the popularity of quantitative methods when telemetry is used to solve transport problems.

The author performed a bibliometric analysis of the application of telemetry systems. In Table 1, we see that the application of telemetry has a long history, starting from 2008, when the most cited publication appeared. The next stage of the telemetry development was in 2017, which included 2 most cited papers, which appeared and left behind papers from 2014-2016 had lower popularity. Later on, 2 new papers were published in 2018 and 2020 accordingly, but their citation is still low and are close to 100 citations per paper.

Publications	Number of citations higher than 100 citations per paper
Hunkeler et al. (2008)	412
Naik et al. (2017)	291
Light (2017)	257
Thangavel et al. (2014)	230
Singh et al. (2015)	223
Froiz-Míguez et al. (2018)	122
Mishra & & Kertesz (2020)	117
Yokotani et al. (2016)	106

Table 1. Most cited papers focusing on telemetry

The bibliometric analysis shows three clusters: IT-related cluster, Internet of Things setup cluster and the application of telemetry solution cluster. IT-related cluster focuses on platform setup questions: sensors, monitoring, control, servers and working conditions. Internet of Things setup cluster includes security, network, protocols, blockchain and algorithm questions. The last application cluster specifies the performance, evaluation, scenario, industry, smart city and other topics.

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Figure 1. Bibliometric analysis of publications focusing on telemetric systems

Figure 1 shows the three clusters named earlier, which are equal sized and have an almost identical number of topics: the first cluster (marked in red) includes 27 items, the second cluster (marked in blue) -21 items and the last cluster (marked in green) -24 items.

The author revised the usage of quantitative methods in telemetry and its application in transport. The research results are presented below in Table 2 and divided into mathematical parts, simulation methods, heuristic, hybrid and analytical methods.

Types	Modeling technique	Solution methods	Authors investigating telemetry systems	Authors investigating telemetry systems in transport
Mathematical programming	Single-objective	Linear programming (LP)	Castro et al. (2021)	
methods	Multi-objective	Mixed integer linear programming (MILP) Fuzzy-goal programming Dynamic programming Queuing model Non-linear programming	Dallanora et al. (2022) Anjum et al. (2022) Pereira et al. (2023) Ali et al. (2023) Ji et al. (2023)	Peng et al. (2023) Lin et al. (2019)
Simulation methods	System dynamics (SD)		Darbali-Zamora et al. (2021)	De Rango et al. (2022)
	Discrete event (DES)		Evans et al. (2022)	

Table 2. The quantitative methods and models for investigating telemetry systems in transport

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Heuristic methods	Simple heuristic	Simulated annealing heuristics (SAH)	Bhamare et al.	
			(2019); Tan et al.	
			(2021)	
	Artificial intelligence (Al) techniques	Markov chains	Jadon et al. (2021)	Pearson et al. (2022)
	_	Petri nets	Hassanien et al.	
(20		(2020); Kherba-che		
			et al. (2023)	
		Bayesian network modeling	Yakimov et al. (2022)	
		Fuzzy logic		Teran et al. (2020)
		Artificial Neural network		Fam et al (2021)
		Grey system and rough sets	Hassanien et al. (2020)	
	Meta-heuristic approach	Genetic Algorithm (GA)	Wei et al. (2021)	
		Evolutionary Algorithm (EA)	Hassanien et al. (2020)	
		Differential evolution algorithm	Abdelghafar et al. (2022)	
		Particle swarm optimization (PSO)	Qu et al. (2021)	
		Ant Colony Optimization	Zhao et al. (2023)	
		Greedy Randomised Adaptive search	Kristiansen et al.	
		procedure	(2019)	
Hybrid model	Hybrid simulation			
Analytical model	Multi-criteria decision	Analytical hierarchy process (AHP)	Yin et al. (2022)	Othman et al.
	making (MCDM)			(2022)
In total			22 publications	6 publications

The results show that many meta-heuristic methods are used to apply telemetry solutions. However, these methods are not applied in transport area. The application of telemetry solutions involves, in most cases mathematical and simulation methods. In situations when telemetry solutions are used in transport AHP method and some artificial intelligence techniques, system dynamic simulation and several multi-objective mathematical programming methods are involved. This literature review shows that telemetry application for transport is much more rarely presented than a general application of telemetry solutions. In most cases, general telemetry solutions are oriented to IT problem-solving situations. The number of publication presented by the end of Table 2 shows that the application of telemetry solutions for solving general problems are almost 4 times higher than the use of telemetry solutions for solving transport issues.

# Conclusions

The transport and logistics sector is undergoing a time of change when changes are gradually coming to conventional linear business models, which are inevitably related to digitalization. New technical devices are being developed that are expected to help solve emerging problems at the time of the giver and will help to properly prepare for future trends, which will inevitably force specific changes in the business.

Technical equipment installed at the vehicle can provide vehicle information. Telemetry systems offer the opportunity to transfer the generated and systematized data over long distances, accumulate it and analyze it for specialists in their field, thus trying to find ways to make work processes more efficient, make better use of human or technical resources and improve the indicators of enterprises.

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However, such interfaces between information technology systems and technical devices in vehicles are so far isolated and are not combined into a shared network that would connect all service providers and users with a common platform. The creation of such a platform would make it possible to provide higher-quality services at a more affordable price, taking into account the individual needs of users. Ensuring a quality service in the market would expand the consumer base, which would create additional demand that would have to be met by existing service providers or open the door to new market players, ensuring even greater competitiveness in the market. For now, it would be too bold to claim that the platform's business model linking hardware, telemetry systems, developers and users of these systems is a clear future for this business segment. Looking at the success stories of the big players of other segments in adapting the business model of the platforms, it is realistic enough to apply it in the transport and logistics segment to create added value.

Thanks to the platform occurrence, it will also be possible to systematize the information generated by a considerable flow of vehicles and make targeted use – to reduce traffic congestion on roads heavily overloaded with the flow of cars, to collect information about the technical characteristics of vehicles by operating them in different climatic conditions, ensuring a higher quality product adapted to specific markets in the future.

The literature review results show a research gap in applying telemetry solutions for solving transport problems. The application of telemetry solutions in transport is almost 4 times lower than their application for IT and other areas. Contemporary publication from 2019-2023 shows the application of telemetry solutions in the transport sector is still promising.

Such innovations are needed in the face of increasing global demand for efficient transportation and logistics, coupled with a growing emphasis on sustainability and eco-friendly practices. The potential impact of this research is far-reaching, enhancing efficiency, reducing costs, and contributing to the broader goals of environmental stewardship and economic growth. These intelligent components are pivotal in automating green practices, effectively reducing sector volatility and vulnerability to unforeseen disruptions, climatic shifts, and other adverse factors. This alignment concurs with global governmental initiatives emphasizing intelligent transport systems to foster sustainability and meet stringent environmental standards.

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Aurelija BURINSKIENĖ ORCID ID: <u>https://orcid.org/0000-0002-4369-8870</u>

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# INNOVATION PERFORMANCE OF EU COUNTRIES IN THE CONTEXT OF RESEARCH AND DEVELOPMENT EXPENDITURES\*

# Katarína Belanová<sup>1\*</sup>, Peter Golha<sup>2</sup>, Rudolf Sivák<sup>3</sup>

<sup>1,2,3</sup>University of Economics in Bratislava, Dolnozemská cesta 1/b, 852 35 Petržalka, Slovakia

*E-mails:* <sup>1\*</sup><u>katarina.belanova@euba.sk</u> (Corresponding author); <sup>2</sup> <u>petergolha@hotmail.com</u>; <sup>3</sup> <u>rudolf.sivak@euba.sk</u>

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Abstract. Innovations are essential to economic reality, mainly due to growing domestic, international or world competition. The contribution is focused on comparing the innovation performance of EU countries with an emphasis on Slovakia using the European Innovation Scoreboard and the Regional Innovation Scoreboard. The aim is to verify the dependence of the innovation performance of EU countries on research and development expenditure. According to the European Innovation Scoreboard 2023, the classification of Member States into performance groups remains unchanged compared to the previous year, still showing a geographical concentration. Performance gaps between Member States narrowed between 2016 and 2023. Slovakia belongs to countries with a relative performance below 70% of the European Union average, while its innovation performance is growing more slowly than in the EU. According to the Regional Innovation Scoreboard 2023, all regions of Slovakia belong to the emerging innovators of the upper third, except the Bratislava region, which is included in the group of moderate innovators of the upper third. All regions have increased their performance. An increase in research and development expenditures is required to improve the current situation in the innovation policy of the Slovak Republic. This conclusion is derived considering a significant interdependence between research and development expenditures and innovation performance was confirmed by regression analysis.

Keywords: Innovations; research and development (R&D); the EU

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#### **1. Introduction**

In the European Union, innovation is crucial for increasing competitiveness in a worldwide globalized economy. Since the Slovak Republic is a part of its structures, the need for innovation and innovation policy becomes very

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important. It is evident that today, relying on the comparative advantages of cheaper costs is no longer possible. It is necessary to achieve sustainable economic growth by effectively applying innovations. With the help of the national innovation policy, it is desirable to create an innovation system that will actively support the implementation of innovations in enterprises, improve cooperation between the private and public sectors, coordination within entities involved in innovation activities, and transfer of technologies and results of research and development (R&D) into practice.

Influenced by various factors, innovation performance varies from country to country. In this context, the need to measure the innovation performance of the economy is gaining importance.

There are several ways to measure and evaluate the country's innovation performance. The article provides an evaluation of the innovation performance of the Slovak Republic through a comparison with EU countries using the European Innovation Scoreboard (EIS) and the Regional Innovation Scoreboard (RIS). The evaluation of the innovation performance of countries in the EIS 2023 is based on the so-called Summary Innovation Index (SII), which is also the basis for determining performance group membership (innovation leaders, strong innovators, moderate innovators and emerging innovators).

Amount of expenditure and intensity of R&D, i.e. the share of R&D expenditure on GDP (GERD% - Gross Expenditure on R&D), are two of the key indicators used to monitor the resources devoted to science and technology worldwide.

As we will document in the part Results, the innovation leaders are spending significantly more on R&D than countries that are the least successful innovators. A typical example is Sweden, which, in the long term, spends on R&D compared with the GDP, the most considerable financial amount and belongs to innovation leaders in the EIS.

Following this fact, our research is based on an assumption of correlation between the expenditure on R&D and the innovation performance, i.e. a higher % in spending on R&D should consequently also increase the innovation performance of an individual country.

The goal is to verify the dependence of a country's innovation performance on R&D expenditure. The author used statistical methods to achieve this goal, especially regression and correlation analysis. It was confirmed that there is a significant interdependence between R&D expenditure and innovation performance.

# 2. Theoretical background

In contrast to other policies already implemented at national or regional levels, innovation policies are a relatively new issue (Halásková and Halasková, 2015). As Pazour and Kučera (2009) state, innovation policy is closely connected with R&D policy. Their common aim is to support R&D. Innovation is understood as a result of successful R&D. Schot and Steinmueller (2018) state that there are three frames for innovation policy: R&D, systems of innovation and transformative change.

Total R&D expenditures on GDP (GERD) are a crucial R&D indicator. Several authors dealt with the relationship between GERD and innovation performance, mainly through regression analysis. In connection with the allocated total R&D expenditure, researchers' main interest is evaluating R&D efficiency (e.g. Conte et al., 2009 or Aristovnik, 2012).

According to empirical studies, regions with a high intensity of R&D activities are also the most efficient performers. Bednář and Halásková (2018) determined both static and dynamic components of convergence and

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divergence in innovation performance and R&D expenditures for aggregated data within Western European NUTS 2 regions in the years 2009-2012. Boschma (2005) indicates that geographical proximity has positive and negative effects on innovations. Similarly, Morollón and Garcia (2023) analyzed the geographical distribution of the investment effort in R&D in the European Union. It has been observed that there is undoubtedly an intense concentration of European R&D funds in the most dynamic areas capable of promoting more advanced and competitive research projects. Cooke (2001) presents a systematic account of the idea and content of regional innovation systems following discoveries made by regional scientists, economic geographers and innovation analysts.

Many authors dealt with the influence of innovations and performance of companies (e.g. Kulicke and Krupp, 1987; Du et al., 2020; Radenovic et al., 2023; Fedyunina and Radosevic, 2022; Zhang et al., 2022; Akad and Deger, 2023; Naidoo, 2023; Khorshid et al., 2023). Wang and Guan (2017) identified a positive correlation between the state government subsidy of the enterprise sector and the innovation performance of this sector. Cohen and Levinthal (1989) suggest that R&D generates new information and enhances the firm's ability to assimilate and exploit existing information. Albulescu and Draghici (2016) argue that innovation performance is not only due to higher business support. Private and public funds should support R&D.

Wang and Thornhill (2010) mentioned possibilities of how to finance R&D on microlevel. Gertler (2001) concludes that while regional and firm-level arguments, on their own, do not provide an adequate explanatory framework for understanding how firms' practices are determined, national-level theory needs to be made supple enough to accommodate a significant role for regional institutions and the agency of the firm.

Sarpong et al. (2023) propose a sustainable pathway model for achieving an economically viable sustainable innovation system. Many other authors also recognize the crucial importance of investments in R&D for more sophisticated and sustainable innovations (e.g., Holt et al., 2021; Xu et al., 2021; Ganda, 2019).

Regarding Slovakia, there have yet to be many empirical studies realized. Fabova and Janakova (2015) stated that the low innovation performance of the SR is the reason for its low competitiveness. Ivanová and Masárová (2018) evaluated the innovation performance of regions of the Visegrad Group, emphasizing human capital. Janoskova and Kral (2019) analyzed the impact of the SII indicators in terms of the total value of the SII using samples from the V4 countries.

Kučera and Fil'a (2022) proved a significant interdependence between R&D expenditure, innovation performance and the EU countries' economic development level. Higher R&D expenditures are an essential precondition for faster economic growth, represented by GDP per capita. Technological progress influences GDP and dynamic growth is not possible without innovation.

# 3. Research methodology

Concerning verifying the dependence of the innovative performance of the country on R&D expenditure, a hypothesis was set, and its integrity was verified through regression analysis (Figure 1).





The primary sources of information include the secondary data in the European Innovation Scoreboard 2022 (for the Summary Innovation Index) and the related EUROSTAT datasets within the EU countries (for the amount of expenditure on R&D). The Limitation of the research lies in the fact that the research data on GERD for 2022 has yet to be published. Another limiting factor is that the number of EU member states is stable.

Due to the data availability (GERD %) for 2022, SII 2022 and GERD 2021 data were used. EIS 2022 evaluates countries for the year 2021.

The analytical tools used include regression and correlation analysis. The analysis was used to confirm or refute the hypothesis. It examines a possible correlation between two indicators. The author assumes that the value of the dependent variable (Y - innovation performance) is affected by a change in the value of an independent variable (X - expenditure into R&D).

## 4. Results and discussion

## 4.1 Innovation performance of EU countries

One of the most recognized indices for evaluating countries' innovation performance is the European Innovation Scoreboard, which can be described as an overview of the innovation results of countries. It provides a comparative analysis of the innovation performance of the countries of the European Union according to several

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indicators. It has been operating under the auspices of the European Commission (EC) since 2011. It helps countries assess the strengths and weaknesses of national innovation systems or identify challenges they should address to improve in the given areas. The survey also evaluates the European Union's overall position in innovation, science and research compared to the advanced world economies of other countries such as the USA, Canada, China, and Japan (EC, 2023a).

The latest edition of the European Innovation Scoreboard 2023 distinguishes between four main types of activities with 12 innovation dimensions, capturing 32 indicators. The EIS 2023 uses data related to the actual performance in 2022 for 11 indicators, 2021 for six indicators, 2020 for 13 indicators and 2019 for two indicators.

Each main group includes an equal number of indicators. The indicators that are included in the measurement are listed in *Table 1*. The indicators change and are supplemented from year to year. Each group and all indicators have the same weight, based on which the so-called performance score is calculated - the SII. In addition to determining the value of the index, the given country's development is monitored over time and compared with other countries of the European Union (EC, 2023a).

FRAMEWORK CONDITIONS	INNOVATION ACTIVITIES
Human resources	Innovators
1.1.1 New doctorate graduates (in STEM)	3.1.1 SMEs with product innovations
1.1.2 Population aged 25-34 with tertiary education	3.1.2 SMEs with business process innovations
1.1.3 Lifelong learning	
Attractive research systems	Linkages
1.2.1 International scientific co-publications	3.2.1 Innovative SMEs collaborating with others
1.2.2 Top 10% most cited publications	3.2.2 Public-private co-publications
1.2.3 Foreign doctorate students	3.2.3 Job-to-job mobility of Human Resources in Science & Technology
Digitalization	Intellectual assets
1.3.1 Broadband penetration	3.3.1 PCT patent applications
	3.3.2 Trademark applications
1.3.2 Individuals who have above basic overall digital	3.3.3 Design applications
skills	
INVESTMENTS	IMPACTS
Finance and support	Employment impacts
2.1.1 R&D expenditure in the public sector	4.1.1 Employment in knowledge-intensive activities
2.1.2 Venture capital expenditures	4.1.2 Employment in innovative enterprises
2.1.3 Direct government funding and government tax	Sales impacts
Firm investments	4.2.1 Medium and high-tech product exports
2.2.1 R&D expenditure in the business sector	4.2.2 Knowledge-intensive services exports
2.2.2 Non-R&D innovation expenditures	4.2.3 Sales of product innovations
2.2.3 Innovation expenditures per person employed in	Environmental sustainability
Use of information technologies	4.3.1 Resource productivity
2.3.1 Enterprises providing training to develop or	4.3.2 Air emissions by fine particulates PM2.5 in
upgrade ICT skills of their personnel	industry
2.3.2 Employed ICT specialists	4.3.3 development of environment-related technologies

#### Table 1. The EIS 2023: indicators

Source: own compilation according to the EIS 2023

The SII is the basis for the classification of EU countries into four performance groups:

• *Innovation Leaders* are all countries with a relative performance in 2023 above 125% of the EU average in 2023.

• *Strong Innovators* are all countries with a relative performance in 2023 between 100% and 125% of the EU average in 2023.

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• *Moderate Innovators* are all countries with a relative performance in 2023 between 70% and 100% of the EU average in 2023.

• *Emerging Innovators* are all countries with a relative performance in 2023 below 70% of the EU average in 2023 (EC, 2023a).

Figure 2 shows Denmark is the best-placed country in the EIS 2023, overtaking Sweden. Sweden has held the leading position for several years. Other innovation leaders are the countries of Finland, the Netherlands and Belgium (in the shades of dark green). Austria, Germany, Luxembourg, Ireland, Cyprus, and France are "strong innovators" (in the shades of light green), and Estonia, Slovenia, Czech Republic, Italy, Spain, Malta, Portugal, Lithuania, Greece and Hungary are considered to be "moderate innovators" (in the shades of yellow). Croatia, Poland, Latvia, Bulgaria, Romania, and Slovakia belong to the group of "emerging innovators" (in the shades of orange).





In the EIS 2023, the distribution of Member States within the performance groups remains unchanged compared to the previous year. Hungary has made significant progress and moved into the higher-performing "moderate innovators" group. At the same time, France and Luxembourg have seen a slight decline in performance compared to the EU eight years ago. It highlights the need for continuous efforts to improve innovation capabilities in these regions.

Between 2016 and 2023, performance gaps between Member States narrowed, notably within the "strong innovators" and "moderate innovators" groups. However, the distribution of performance groups still shows a geographical concentration. Northern and Western Europe are home to innovation leaders and the most vital innovators, while Southern and Eastern Europe are home to the most moderate and emerging innovators.

The global position of the EU has mostly stayed the same since last year. The EU has closed part of its performance gap with Australia. China's performance level is almost at the same level as the EU. Regarding innovations, Slovakia's strengths lie in the automotive and engineering industries. The IT sector is growing relatively quickly, too. The performance of the Slovak Republic as an innovator is at the level of 65.6% of the European average, which is above the average of emerging innovators (54.0%). However, innovation performance is growing more slowly than in the EU, thus moving away from the EU's performance. According to the EC, Slovakia's relatively strong points in the area of innovation include the export of medium and high-tech goods, the sale of innovative products, lifelong learning, and spending on innovations that are not related to R&D.

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Based on a survey, the EC considers Job-to-job mobility of Human Resources in Science & Technology, R&D expenditure in the business sector, government support for business R&D, low number of patent applications and low-risk capital investments to be the weak points of the country. Compared to the previous assessment (EIS 2022), Slovakia recorded the most significant improvement in lifelong learning, the sale of innovative products and the innovation of business processes. On the other hand, the most significant year-on-year deterioration occurred in technologies related to the environment, in the category of innovative SMEs cooperating with others and designing applications.

Innovations are essential in developing socio-economic development not only of countries and regions. The Regional Innovation Scoreboard, a supplement to the EIS, deals with the evaluation of the innovation performance of the regions. The assessment occurs similarly to the EIS, and the regions' innovation activity is measured at the country level. The number of indicators in the RIS is reduced from 32 to 21, mainly due to the unavailability of data at the regional level. Most indicators are identical; some are removed, and others are changed or estimated. The indicators used in the RIS 2023 are included in Table 2 (EC, 2023b). The average performance score, the RII, is calculated from the indicators. Based on the value of the RII, the regions are divided into four performance groups: innovation leaders, strong innovators, moderate innovators and emerging innovators. Unlike the EIS, each group has three more subgroups, with the upper third indicated by a (+) sign and the lower third by a (-) sign.

According to RIS 2023, Slovakia is an Emerging Innovator and includes four regions: Bratislava region, Západné Slovensko, Stredné Slovensko, Východné Slovensko. Bratislava region (SK01), the capital region, is a Moderate Innovator +, and the other three regions are Emerging Innovators + (Figure 3). Performance has increased for all regions. Only for Stredné Slovensko (SK03), performance increased at a higher rate than that of the EU (8.5); for the other regions, performance increased at a lower rate.



Figure 3. Position of SR's regions within regional performance groups *Source:* own processing according to the RIS 2023

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The level of sub-indicators influences the overall assessment of regions' innovation performance. Table 2 shows the scores of indicators for regions in Slovakia compared to the European average.

Indicator	Bratislava Západné region Slovensko		0	Stredné Slovensko		Východné Slovensko		
indicator	SK	EU	SK	EU	SK	EU	SK	EU
Population aged 25-34 having completed tertiary								
education	169	157	81	76	80	74	109	101
Population aged 25-64 participating in lifelong								
learning	203	79	58	22	87	34	113	44
International scientific co-publications	363	235	52	34	77	50	87	56
Most-cited scientific publications	75	26	98	35	157	56	112	40
Individuals who have above basic overall digital								
skills	110	80	99	72	101	73	96	69
R&D expenditures in the public sector	153	104	49	33	95	65	75	51
R&D expenditures in the business sector	116	66	101	58	85	48	88	50
Non-R&D innovation expenditures	75	72	117	114	100	96	119	116
Innovation expenditures per person employed	107	63	108	64	87	51	89	53
								90
Employed ICT specialists	200	190	38	36	56	53	94	
SMEs with product innovations	135	59	66	29	123	53	98	43
SMEs with business process innovations	135	69	72	37	127	65	81	41
Innovative SMEs collaborating with others	123	74	72	44	141	85	78	47
Public-private co-publications	217	195	70	63	86	78	96	86
PCT patent applications	106	42	114	46	80	32	87	35
Trademark applications	149	98	72	47	86	57	88	58
Design applications	81	54	101	67	117	78	103	69
Employment in knowledge-intensive activities	123	161	124	162	87	113	73	95
Employment in innovative SMEs	115	65	85	48	111	63	95	54
Sales of new-to-market and new-to-enterprise								
innovations	141	116	58	47	62	51	138	113
Air emissions in fine particulates (PM2.5) in								
Industry	117	85	105	76	96	70	92	67
Performance 2023 relative to EU in 2023	139.1	91.3	85.3	56.0	94.1	61.7	94.6	62.1

#### Table 2. The RIS 2023: indicators

Source: own compilation according to the RIS 2023

#### 4.2 Linear regression analysis

A fundamental element of the innovation process is R&D, as it provides new knowledge, technologies and innovative solutions. Countries that invest more in R&D have a more substantial base for innovation and are more likely to be able to implement innovation projects successfully. In addition, higher R&D spending can help companies maintain a competitive edge in innovation.

Figure 4 shows the development of expenditure on R&D in the period 2010-2021 for the Slovak Republic and the EU.

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Figure 4. Development of expenditure on R&D in the period 2010-2021 for the Slovak Republic and the EU *Source:* own processing according to EUROSTAT data

As Figure 4 depicts, the European average of spending on R&D is slightly above 2% of GDP, while the Slovak Republic does not even reach 1% of GDP. This lagging behind the countries of the European Union in the share of R&D investments negatively affects Slovakia's overall innovation performance and economic competitiveness.



**Figure 5.** GERD (%) in EU countries *Source:* own processing according to EUROSTAT data

*Figure 5* compares R&D expenditures within the EU in 2011 and 2021. The highest investments in R&D were achieved by Sweden (3.35% of GDP), Austria (3.22% of GDP), Germany (3.13% of GDP), Finland (2.98% of GDP), Denmark (2.81%) etc. The Slovak Republic invested only 0.95% of GDP in R&D in 2021, significantly below the EU average (2.27% of GDP). This indicates that countries that invest more in R&D tend to achieve higher innovation scores.

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We applied regression analysis to analyze the dependence between the level of innovation performance and GDP per capita.

After the initial analysis through visual assessment using X to Y depending chart, we chose a suitable mathematical function of which the curve best reflects the relationship between observed variables. Considering the nature of the data applied, a linear function has been used. *Table 3* contains the result of the regression analysis.

Table 3. The regression analysis output: R&D expenditure and innovation performance

Regression Statistics				
Multiple R	0,744485153			
R Square	0,554258144			
Adjusted R Square	0,536428469			
Standard Error	19,86454963			
Observations	27			

#### ANOVA

	df	SS	MS	F	Significance F
Regression	1	12266,65413	12266,65	31,08627	8,48E-06
Residual	25	9865,008298	394,6003		
Total	26	22131,66243			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	51,05163965	8,612966523	5,9273	3,47E-06	33,3129	68,79038	33,3129	68,79038
X Variable 1	24,63145494	4,417796723	5,575507	8,48E-06	15,53283	33,73008	15,53283	33,73008

#### Source: Own research

Since the significance F - F test for the statistical significance of the model is at 8,48E-06, which is considerably less than 0,05, we accept the hypothesis of the model significance. The exponential model used to analyze the dependence between innovation performance and GDP per capita has proved to be statistically significant (Table 4).

Table 4. Summary of correlation an	regression	analysis	output
------------------------------------	------------	----------	--------

hypothesis	Confirmation/refusal	Multiple R	R - square	Significance F
H1	YES			
H1.0	YES	0,74	0,55	8,48E-06
H1.1	NO			

Graphical interpretation of the result from the regression analysis is shown in *Figure 6*, which confirms a positive relationship between the amount of R&D expenditure and the innovation score (SII). The result follows an empirical study conducted in Slovakia (Kučera and Fila, 2022).

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If we focus on countries that invest a more significant percentage of GDP in R&D and are in the leading positions in this regard, such as Germany, Austria, Sweden, Finland or Belgium, according to Figure 6 they achieve a visibly better score in innovation performance. However, despite the high dependence between the amount of R&D expenditure and the value of the innovation score, there are exceptions. An example is Cyprus, whose R&D expenditure reaches an even lower percentage of GDP than Slovakia, and despite this, it is much better at evaluating innovative activity. This can be due to many factors affecting the innovation score's value. Cyprus has better results in the field of innovation in businesses and also in international cooperation in the field of R&D.



**Figure 6.** Interdependence between R&D spending and SII 2022 *Source:* own processing according to EUROSTAT data and EIS

*Note:* Sweden S, Austria AT, Belgium BE, Germany D, Finland FI, Denmark DK, Netherlands NL, France FR, Slovenia SI, Czechia CZ, Estonia EE, Portugal PT, Hungary HU, Italy IT, Greece EL, Poland PL, Spain ES, Ireland IE, Croatia HR, Lithuania LV, Luxembourg LU, Slovakia SK, Cyprus CY, Bulgaria BG, Latvia LT, Malta MT, Romania RO

In this regard, the National Strategy for Research, Development and Innovation 2030 was approved in the Slovak Republic, containing a plan with 91 measures with deadlines, key performance indicators and an attached budget. By 2030, public spending on R&D is set to increase by an average of 14% per year, reaching around  $\in$ 1 billion by the end of the decade. Together with private investment in research, the aim is to bring the country's R&D intensity – GERD – to the level of the EU average of 2% (ERA Portal SR, 2023).

## Conclusions

Innovations are a prerequisite for increasing the competitiveness of the economy. Their primary driving force is R&D. Every country of the EU is therefore trying to increase R&D spending while focusing on ensuring its efficiency.

The contribution provides an evaluation of the innovation performance of the SR through a comparison with EU countries using the EIS. According to the EIS 2023, the distribution of Member States within the performance groups remains unchanged compared to the previous year, still showing geographical concentration. Between 2016 and 2023, performance gaps between Member States narrowed. Slovakia is among the countries with a

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relative performance below 70% of the European Union average, while its innovation performance is growing more slowly than in the EU. According to the RIS 2023, all regions of Slovakia are placed among the emerging innovators of the upper third, except the Bratislava region, which is included in the group of moderate innovators of the upper third. Performance has increased for all regions. A positive relationship between the amount of R&D expenditure and the innovation score (the SII) was confirmed by regression analysis. As the research data on GERD for the year 2022 were not published when the survey was realized, the SII 2022 and GERD 2021 data were used. Another limiting factor of the research lies in the number of stable EU member states. We did not monitor the contribution of individual components of innovation or their number; we observed the contribution of the overall innovation performance of the EU countries. The study's novelty is that only some empirical studies have been realized. Moreover, the realized study also compares the SR's innovation performance with EU countries. Its result follows empirical research conducted in Slovakia (Kučera and Fil'a, 2022).

Following the results, the author considers an increase in spending on R&D to be a necessary condition for improving the current situation in the innovation policy of the SR.

Regarding further research directions, as innovations (as well as the SII) depend on many factors, we suggest creating a multiple regression model in the future to refine the results. It will also be interesting to see the development of innovation performance of the SR and its position within the world, resp. EU or V4 countries in future rankings. That could help determine the strengths and weaknesses of the national innovation system and identify challenges that the SR should address if it wants to improve in the given areas.

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**Katarína BELANOVÁ** is an associate professor at University of Economics in Bratislava. Research interests: corporate finance, innovation performance of countries. **ORCID ID**: 0000-0003-2634-9238

**Peter GOLHA** is an external doctoral student at the University of Economics in Bratislava. His dissertation thesis is focused on regulation and risk management in banks.

**Rudolf SIVÁK** is a professor at University of Economics in Bratislava. His research interests include corporate finance, esp. tze issues of capital structure and risks and uncertainty in finance.

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#### Clarivate Analytics

# **PROMOTING MEDIA LITERACY: LITHUANIAN STUDENTS' EXPERIENCE\***

Gražina Čiuladienė<sup>1</sup>, Gintarė Gulevičiūtė<sup>2\*</sup>, Rūta Latinytė<sup>3</sup>, Arvydas Guogis<sup>4</sup>

Mykolas Romeris University, Ateities Street 20, Vilnius, Lithuania

*E-mails:*<sup>1</sup> <u>grazina.ciuladiene@mruni.eu</u>; <sup>2\*</sup><u>gintare.guleviciute@mruni.eu</u> (Corresponding author); <sup>3</sup> <u>ruta\_latinyte@mruni.eu</u>; <sup>4</sup><u>arvydasg@mruni.eu</u>

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**Abstract.** Media literacy is rich and multifaceted (Rosenbaum et al., 2008). Existing literature underscores the importance of promoting media literacy. Media literacy education aims to help young people who are active media consumers improve their interpreting and judging skills and become independent media producers, as well as develop a critical understanding and active participation (Aydemir, Demirkan, 2021). The research attempts to provide documentation of implementing media literacy education in one university community. It focuses on presenting quantitative and qualitative data to gain insights into how particular instructional practices and curricula may help develop students' media literacy comprehension. The case study of implementing media literacy education at a local setting (university) showed that students were highly satisfied with the learning experience. Research results showed that most students could recommend including media literacy subjects in other study programs, defined many gained skills, positively evaluated the topics and recognized the importance of media literacy education.

Keywords: media literacy; media literacy education; digital literacy; critical thinking

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JEL Classifications: D83, L82

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## 1. Introduction

Being media literate refers to better dealing with the media (Rosenbaum et al., 2008). A media literate person is believed to understand the role of media and other information providers, critically assess the content, and make informed decisions as a user and producer of media content (Koltay, 2011 cited in Jamil et al., 2022). The degree to which a person is media literate influences his/her ability to critically explore complex relationships between information, entertainment, ideologies, and power (Funk et al., 2016).

And it is education that plays a primary role in promoting critical thinking regarding the media or related issues (Rosenbaum et al., 2008). Media literacy education has been identified as a means to enhance the information capacity of individuals. Individuals can learn to criticize stereotypes, dominant values, and ideologies produced by the media and critically examine and evaluate media content through media literacy education (Kellner, Share 2007). Moreover, media literacy education is believed to help counteract the media's adverse effects (Cheung, Xu, 2014). It refers to empowering to differentiate between fake news and accurate information and combat propaganda "which incites racism, hatred, conspiracy theories, violence, and radicalization" (Jamil et al., 2022, p.61).

Although teens and older students are considered the primary audience in most media literacy education initiatives (Santos et al., 2017), addressing media literacy within higher education is also important. Schmidt (2013) has claimed that university students might not be media literate, and addressing media literacy competencies is a neglected area at the university level. Sengl and Heinke (2023) stress that media literacy initiatives are primarily aimed at education on journalism, but it should be implemented in other educational directions.

**This study aimed to** explore the implementation of media literacy education in a local setting (university). It was **a case study** using questionnaires and interview analysis to collect data in the field. The research questions focused on reflections from students participating in a newly implemented media literacy course. There was evaluated the effectiveness of the university instructional approach over a one-semester teaching process by collecting data to explore the **research questions**:

1) what are students' views on the teaching session they have attended?

2) What knowledge and skills do students consider important for a media-literate person?

3) What are the students' views on the contribution of study subject? (How media literacy intervention aligns with their perspectives on media literacy).

The study offers insights into how to teach media literacy from a students' perspective.

## 2. Theoretical background

The definition of media literacy is being "hotly debated" (Jakub et al., 2020). How media literacy is defined depends on the actors and stakeholders involved (De Leyn et al., 2022). It may vary on a very broad understanding of the concept when media literacy is used as an umbrella term encompassing information, digital, critical, and news (Jacub et al., 2020). For instance, The EU Media Literacy Expert Group (MLEG) employs an umbrella expression. It defines media literacy as "all technical, cognitive, social, civic and creative capacities that allow a citizen to access, have a critical understanding of the media and interact with it" (https://digital-strategy.ec.europa.eu/en/policies/media-literacy) even though the Romer et al. (2023) research questions the possibility to nurture civic participation by media literacy education. The broad definition refers to the media education approach expanding audiences' understanding of how they communicate and engage with media (Higdon and Huff, 2022). On the other hand, there are also attempts to define the concept more precisely,

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separating the terms: "media literacy sees media as a lens or window through which to view the world and express oneself, while information literacy sees information as a tool with which to act upon the world" (Livingstone et al., 2008, Maksl et al., 2017).

One of the quite widely accepted definitions refers to the ability to access, analyze, evaluate and create media messages across a variety of contexts/in various forms (e.g., language, moving images, music, sound effects) (Hobbs et al., 2022; De Leyn et al., 2022). Thus, emphasis is made on the foundational competencies (Hobbs et al., 2022).

Becoming skillful accessor refers to gathering (identifying, locating) and using quality resources (Fry, Seely, 2011). Efficient operation in a new media environment is important due to the challenge of media consumers navigating the large quantity of online information. Using relevant, reliable, and authoritative resources gathered and shared in various media content information helps to meet the information needs. Besides, relevant, reliable information is needed to make informed decisions. Hwang et al. (2021) agree that media literacy education helps to protect from disinformation messages.

Analyzing refers to critically questioning the information that is seen, heard, and used. Enabling the development of criticizing and questioning skills encourages students to think critically about media representations and to move away from oppressive and knowledge transfer-based approaches. Critical thinking and understanding are required to distinguish and decode reality, predominant values, ideologies, and gender representations constructed by the media. Critical thinking and questioning are at the heart of critical media literacy (Aydemir and Demirkan, 2021). Nagumo et al. (2022) stressed that critical thinking and reading of the media can be fostered by media literacy. Critical media literacy supports efforts to unmask biases, hidden agendas, and the economic structures of media representation and information (Friesem, 2019).

Becoming a critical evaluator of media encompasses determining what information is reliable and not and how signs of trustworthiness or credibility cues are exploited (Jacub et al., 2020). It is in line with the attempt to combat the growing tendency of some producers to systematically produce false information, making those online artefacts appear trustworthy (Jacub et al., 2020). It is essential to improve the skills of media consumers to identify false information in the era of "fake news phenomena" (Jacub et al., 2020). Being responsible message consumers encompasses understanding the political, social, and economic contexts in which media messages influence individuals and societies (Hobbs et al., 2022). DiGiacomo et al. (2023) stress that education institutions should play an essential role in supporting the preparation of an informed citizenry. Scifo and Di Maggio (2021) agree and emphasize that it could be challenging for educational institutions.

Creating skills in the context of media literacy education refers to being a responsible message creator and taking action to use the power of communication and information for social good (Hobbs et al., 2022). Furthermore, critical media literacy encompasses the ability to use the media as a tool for social transformation beyond critical text analysis, leading to the teaching of conscious effort towards the improvement of equality and justice, as well as to the creation of a better society (Aydemir, Demirkan, 2021).). Critical media literacy education may not be sufficient if students only learn to recognize and analyze problematic media content. Moreover, students should be mentored to become responsible and effective media producers capable of contributing to social transformation (Aydemir, Demirkan, 2021). A further suggestion is to add a social-emotional component, i.e. skills related to observing and applying "netiquette", which refers to using appropriate language online (De Leyn et al., 2022). Learning to create one's own media message is an important step "toward developing interpretive proficiency in a post-truth era" (Friesem, 2019).

"Media literacy is the whole of knowledge, skills, and attitudes that allow citizens to deal with the complex, changing and mediatized world in a conscious and critical way. It is the ability to use media actively and

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creatively, aimed at societal participation." (Van Audenhove et al., 2018). Activating media literacy competencies is multifaceted, contextual, and situational (Schilder et al., 2016; Wuyckens et al., 2021). The emphasis in media literacy education might range widely, including informed citizenship, aesthetic appreciation and expression, social advocacy, self-esteem, and consumer competence (Jacub et al., 2020). Many curricula and suggested methods exist under the banner of media literacy. Media literacy education varies with pedagogical context: what is taught is relative to the demographic and institutional context of the education (Jacub et al., 2020). Hendrix-Soto and Nash (2023) state many difficulties of implementing media literacy curricula and facilitating learning in a digital information landscape. Park et al. (2021) define that customized digital literacy curriculums and technology should be based on different age groups and other aspects.

Activities to improve media literacy skills (accessing, analyzing, evaluating and creating) might vary in accordance to subjects and additional specific aims. Sedelmaier et al. (2023) developed competence-oriented learning settings, which could be applied at a university level. Alehpour et al. (2022) research showed that media literacy lesson plan titles should be connected with teacher experience and previous knowledge. In addition to developing media literacy skills, Aydemir and Demirkan (2021) aimed the subjects (pre-service teachers) to notice gender roles and cultural stereotypes presented in media messages, question and criticize gender-related cliches, predominant values, and ideologies in the media, and develop a negative attitude towards and respond to gender inequality in the media. Thus, a gender-integrated media literacy curriculum was designed. However, common features of the media literacy curriculum are attempts through observation, problem-solving, critical thinking, creative thinking and communication.

## 3. Research methodology

This research focuses on presenting both **quantitative and qualitative** data. A **case study** explored implementing media literacy education in a local setting (university).

**Organizational structure and overview of the study subject.** Mykolas Romeris University (MRU) is a social sciences specialized university whose studies and research areas are educational science, economics, humanities, communications, politics, psychology, sociology, and management. University has 5819 students. There are 21 MRU studies programs implemented in English: 10-in the first cycle of studies 17 – in the second cycle.

The study subject under analysis in this study is the "New Media Communication and Journalism in the Era of Disinformation". It was included as a mandatory course unit of 6 ECTS into the content of the bachelor's degree study program "Communication and Digital Marketing" taught in both English and Lithuanian language at Mykolas Romeris University. This program covers the topics of communication, marketing, management, design, and creativity that will be useful for working in business organizations or in creative industries. The subject "New Media Communication and Journalism in the Era of Disinformation" was taught in the third semester (autumn) of the study program and aimed to develop students' skills of media literacy, such as critical engagement with media content, information and visual verification, content development for social media tools and others, applying conventional and new tools and mediums, using case studies from Lithuanian and world practice.

The study subject resulted from a cooperation partnership with IREX – in 1968, a nonprofit organization committed to global development and education was founded. The organization provides innovative programs to improve the quality of education, strengthen independent media, foster pluralistic civil society development, and reduce conflict. The study subject was implemented under Irex's "Media Literacy in the Baltics" grant program. Irex also provided the material for the course Learn to Discern (L2D) and training for the lecturers on discerning disinformation from reliable information within the current media landscape.

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**Course guidelines.** The curriculum was designed by 2 educators contributing with individual expertise. The main topics of team lecturing are provided in Table 1.

Table 1. The curriculum topics of "New Media Communication and Journalism in the Era of Disinformation" subject

DEVELOPED SKILLS	Accessing	Analyzing	Evaluating	Creating	
MAIN TOPICS	The specifics of ne practice in the post-tr	w media and journalistic uth era	Conditions for misl the conflict	eading information:	
including	Media business mod of journalists and news and media cont	els, ownership, the work editors, editorial policy, ent creation	The theory of the conflict, the examples of conflicts in society,		
Subtopics	Professional social r bloggers and podcas chambers.	nedia accounts, vloggers, sts. Algorithms and echo	The psychological as opinions.	spects of confronting	
	Targeted intentions: t theories, slander, cyb hate speech, cyber-bu propaganda (trolls, be blocking).	ake news, conspiracy er-attacks, stereotypes, illying, computational ots, account hacking and	The cultures of argur	nentation and fights	
	Fact-checking, invest information sources. media.	igative journalism, ethics, Privacy issues in social	Conflict resolution escalate conflict inter	skills: how to de- raction.	

#### **Data collection instruments:**

- 1) participants' course evaluation (feedback on the course);
- 2) participants' opinions provided during the interview.

Students' feedback was collected using an institutional questionnaire titled "Questionnaire regarding the quality of teaching the subject of the studies". It is one of the institution-created quality assurance indicators. University seeks to ensure that there is appropriate and timely quality control. Analyzing students' feedback is intended to safeguard the teaching-learning processes. The institutional questionnaire examines student satisfaction levels on the courses and is administered to each student after the course is delivered and the exam is passed.

## The quantitative questionnaire addresses six aspects, such as

- 1) general information about a respondent;
- 2) opinion on the content of the study subject, objectives and results;
- 3) opinion on applied methods of teaching and learning;
- 4) opinion on the evaluation criteria of the subject;
- 5) opinion on the material and tools for independent studies of the subject;
- 6) general evaluation.

There is also a space left to write comments at the end of each section. There is also an open-ended question due to the students' recommendation of the study subject to others.

To measure the satisfaction levels of the participants with their overall learning experience of the study subject utilize a five-point Likert scale (5 - fully agree, 4 - agree, 3 - neutral, 2 - disagree, 1 entirely disagree). Data is

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being collected anonymously. The questionnaire is completely voluntary and did not alter students' activities, classes, or the assessment process. The responses are collected via an online system. Data obtained were analyzed using descriptive statistics (percentages, frequency distributions).

**Questions of face-to-face interviews** with students were focused on their understanding of media literacy and its importance, the most interesting/relevant topics, personal skills gained from the course and presentations, creative assignments, improvements and recommendations of this course to students from other programmes.

The content analysis method examined the students' views on the study subject they attended. Content analysis reveals and compares worldviews, attitudes, prejudices, and ideas. Similar data are gathered around common themes. In the last content analysis stage, the findings were interpreted by considering the relationships between the themes obtained from the data. Furthermore, the quotes from students' views were presented as the closest natural equivalent of the source during translation.

The participants in this study were second-year students enrolled in the Institute of Communication during the Autumn term of the 2022-2023 academic year. The total enrollment is 100 students. The quantitative study group consists of 61 students. In the group, the number of female students (79%) is higher than that of male students (21%). This is consistent with the gender profile of those studying social sciences in Lithuania. The qualitative study group consists of 12 students, 4 male and 8 female.

## 4. Results and discussion

**Quantitative Research Results.** Students reported a high level of satisfaction with the learning experience. As shown in Table 2, the overall satisfaction of the course is high. Almost 90 percent of respondents reflected that they were satisfied with the quality of the course (fully agree with the given statement).

Table 2. Evaluation of "New Media Communication and Journalism in the Era of Disinformation" subject learning experience

Aspects of evaluation	High level of satisfaction percent (fully agree with it)		
	An average	Evaluations of Separate items	
Satisfaction with course content	87.3	At the beginning of the term, the programme of the taught subject, the schedule of the classes, the results of the studies, and a list of compulsory and optional literature are clearly defined	85.5
		The requirements, defined at the beginning of the studies, did not change throughout the studies	86.6
		The lecturer is tolerant; they never discriminate against attitudes, nationality, clothing style, gender etc.	87.7
		Communication with students is performed in a professional and proper manner	87.7
		The established schedule is followed (the classes start and end on time, all the classes/seminars/exercises, etc., take place)	88.9
Satisfaction	87.8	The teaching of the themes of the subject is consistent and clear	88.9
with methodology of		The material of the studies is provided in such a way that the taught subject is interesting to the students	88.9
lectures		The selected study methods help to understand the subject	87.77
		The tasks of independent work help to join theory and practice	87.77
		Independent thinking is encouraged to express one's own opinion, analyze, discuss and criticize things	88.9
		Options are created to choose how to complete independent tasks (for example, to select a topic and introduce it creatively, etc.)	87.77
		Attention is paid to the complicated issues for students by giving additional time to	84.83

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Satisfaction		The procedure, methods and criteria of the evaluation of learning outcomes are explicit from	85.5
with the		the beginning of the studies of the subject, and they are followed	
evaluation	86.7	The accumulative evaluation system is applied for the evaluation of the learning outcomes	88.9
criteria of the		The deadlines for completing the works are real	84.83
study subject		It is enough time allocated for comment on the works completed by the students	87.77
		The information about advancement is always available during all the studies of the subject	84.36
		Academic dishonesty (violation of the principle of fair competition, copying from somebody	88.9
		else, plagiarism or other dishonesty in relation to the assessment of learning outcomes) is not	
		tolerated	
General evaluation	87.8	The knowledge and skills acquired during the lectures on this subject will be useful for me	87.77
		I am satisfied with the quality of the content (topics) of the study subject	87.77
		I am satisfied with the quality of teaching the study subject	86.63
		I would recommend employing the teacher of this subject for next study year	88.9

**Qualitative Research Results.** Interviews with the students were based on analyzing their approach to media literacy and its importance, the most interesting/relevant topics and personal skills gained from the course, and recommendations of this course to students from other programmes.

When analyzing answers about how students can define media literacy, the ability to identify media types and content, connection with media types, and specific competencies were mentioned. Media literacy's importance was expressed by considering information purpose, credibility, and objectivity towards information (see Table 3).

Table 3. Category - approach on media literacy and its importance

Subcategory	Empirical study statements (indicators)
	"() Media literacy is identifying different media types and messages they send." [E1]"() an expanded
Approach	conceptualization of literacy that includes the ability to access and analyze media" [E2]; "When we speak of media, it
	encompasses print media, such as newspapers, magazines and posters, and theatrical presentations, tweets, radio
	broadcasts" [E3]; "() ability to create, reflect and take action, using the power of information and communication to
	make a difference in the world" [E4]; "() is not restricted to one media" [E6, E8, E11]. "Set of competencies essential
	for work, life, and citizenship." [E12].
Importance	"Being able to understand these various forms of information with an ability to make sense of what is presented is a key" [E4]; "It is important when using various forms of media to consider the purpose of the information you are viewing, the credibility of the source, and the conclusion about the viewpoint or position being presented." [E7]; "Given the technological developments in the past few years, we are bombarded by images, views, write-ups, and videos that seek to sway us to a particular way of thinking. Therefore, readers or viewers need to view the media objectively to find out or analyze what is being presented." [E8]; "In a perfect world, both sides of every argument or depiction would be presented, and we would be able to make informed decisions based on the information we receive in the media; however, most often, people create media to influence you in one particular way, and we need to recognize this." [E11]

After analyzing the results of the most interesting/relevant topics and personal skills gained from the course, an ability to conduct research and use communication and digital marketing, presentation skills as the most valuable for the informants could be defined. Most stated that all topics are relevant and interesting (see Table 4)

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Table 4. Category -the most interesting/relevant topics and personal skills gained from the course

#### Subcategory Empirical study statements (indicators)

E10, E12]

	"() it helps the students to independently research and learn in the field of communication and digital
Gained skills	marketing achievements, new media and other emerging technologies, trends, and prospects of Lithuania and the world"
	[E5]; "() understanding the principles of self-help and the ability to adapt them to ensure continuous development in a
	changing socio-economic environment" [E7]; "Ability to socially make use of communication and digital marketing
	creatively with virtual work environments in defending the universal values of human rights, freedom of speech, and
	freedom of information." [E6]. "Confidence to publicly present your research work with the tools and resources acquired
	from the lectures and seminars." [E10].
Topics	"All topics of the subject's lectures" [E6, E7]; "an independent study of the chosen topic by preparing a
	presentation, and a creative task in a group" [E8]; "Conflict resolution and critical thinking topics. [E1, E2, E3, E4, E9,

The results showed that students were willing to recommend the course – most of them stated that it could be included in other study programs' curricula (see Table 5).

Table 5. Category - recommendation of this course to students from other programmes

Subcategory	Empirical study statements (indicators)
	"() it helps and assists to be able to name and explain key discourses and views surrounding new media
Main	and their relation to old/mature media" [E1]; "() to be able to understand and explain the influence of new media
recommendation	on different groups of customers" [E5, E6]; " () course can be recommended to all study programs students."
arguments	[E3, E4, E5, E7, E9, E10, E12]; "Mostly course can be recommended to other communication, education,
	information technologies, management related study programs." [E1, E2, E6, E8, E11].

#### Conclusions

The analysis of the scientific literature showed that the definition of media literacy can be connected with critical understanding, communication and engagement with media, creation of media messages, using reliable resources. Critical thinking can be defined as the most common competence gained by media literacy education. After completing media literacy courses, students should not just detect misinformation but also be able to produce trustworthy content. There are many curricula and suggested methods for teaching media literacy, and it can be challenging to customize.

The case study of implementing media literacy education at a local setting (university) showed that students were delighted with the learning experience of "New Media Communication and Journalism in the Era of Disinformation" subject. Satisfaction with course content, methodology of lectures, evaluation criteria of the study subject and general evaluation reached almost 90 percent satisfaction. Interviews with the students also showed positive results – most students could recommend including this subject in other study programs, they defined many gained skills, positively evaluated the topics and recognized the importance of media literacy education.

The study's novelty is based on evaluating media literacy-connected subjects from the university students' point of view. Both media literacy and media literacy education are under-researched areas in Lithuania. Still, there

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have been just a few studies addressing their importance, reflecting upon pedagogy and curriculum development from different perspectives, and exploring educational initiatives.

Limitations of the study - the study examined the implementation of media literacy education at a local setting (university) in Lithuania, and the conclusions cannot necessarily be applied to other cases.

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Gražina ČIULADIENĖ. Associate professor at Mykolas Romeris Universitu. Research interests: conflict resolution, peace & conflict studies, mediation.

ORCID ID: https://orcid.org/0000-0002-8054-0781

**Gintarė GULEVIČIŪTĖ** is a lecturer. She received M. Sc. in Electronic Business Management from Mykolas Romeris University. Her areas of interest are digital marketing methods in digital platforms, e-commerce models for emerging markets, citizen science. ORCID ID: <u>https://orcid.org/0000-0003-1974-3982</u>

**Rūta LATINYTĖ** is a lecturer dr. at Mykolas Romeris University. Her areas of interest are cultural anthropology, semiotics, creative writing, creative industries, communication. ORCID ID: <u>https://orcid.org/0000-0002-9933-8874</u>

**Arvydas GUOGIS** is a professor in political science, public administration and sociology at Faculty of Public Governance and Business at Mykolas Romeris University, dealing with the topics of social policy, welfare state, new public governance. ORCID ID: <u>https://orcid.org/0000-0001-8371-3556</u>

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#### Clarivate Analytics

# DISPROPORTIONS OF THE GREEN ECONOMY IN THE SELECTED COUNTRIES\*

# Viktorija Pceļina<sup>1</sup>, Olga Lavrinenko<sup>2</sup>, Alina Danileviča<sup>3</sup>

<sup>1,2,3</sup> Daugavpils University, Institute of Humanities and Social Sciences, Parades Str. 1-421, Daugavpils, LV-5401, Latvia

*E-mails*:  $\frac{1}{2}$ *vikapchela*(*a*)*inbox.lv*;  $\frac{2}{2}$ *olga.lavrinenko*(*a*)*u.lv*;  $\frac{3}{2}$ *alina.danilevica*(*a*)*u.lv* 

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**Abstract.** One of the main objectives of the economic policy of the European Union is to reduce the differences in the development levels of its member states or a process of real convergence to ensure balanced and sustainable economic development and growth in the EU countries. Each country strives to contribute to its prosperity. The authors analyse and compare the dynamics of green economy development in the EU countries in the period 2015 - 2019 to clarify whether there is convergence or divergence, and this way, answering the question of whether disparities in the green economy development between the EU member states increase or decrease during this period. The study used logical analysis and synthesis, monographic and analytical research of economic, theoretical, and empirical sources (at the international level), statistical analysis methods, Barro regressions, and a cartographic method.

Keywords: green economy; economic convergence; economic divergence

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JEL Classifications: C43, O44, O52, O57, R11, Q30

## **1. Introduction**

Since the late 1960s - early 1970s, society has begun to pay special attention to the problems of environmental protection and rational use of natural resources. Transition to sustainable economic development includes addressing global challenges related to global population economic growth, replacing non-renewable resources with alternative resources, preserving conditions for the reproduction of renewable resources, and reducing environmental pollution. Green economy generally supports addressing these challenges ((Istudor et al., 2021; Wei et al., 2021; Jiang et al., 2022; Rezk et al., 2023). it is necessary to identify the factors influencing the green economy and indicators that characterise these factors to assess the green economy development in the EU countries in the period 2015 - 2019,

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As the volume of international trade increases, the parties' interdependence also increases. Therefore, the economic situation of countries and their stability are critical. This, in turn, generates the necessity for poorer countries to reach the level of developed countries. Economic convergence refers to the convergence of economic parameters and levels of countries' or regions' development over some time. The opposite process is called economic divergence.

Almost all economists engaged in long-term economic development consider the problem of real convergence in their research. However, many address this issue indirectly, analysing factors of production - capital, labour, natural resources, technological progress, and human capital in long-term economic development. This study attempts to develop an indicator characterising the green economy in the EU countries that meets the following criteria which characterise their scientific and practical relevance (Eglītis, 2008): objectivity of data, objectivity of results, theoretical validity of data and proportions, objectivity of weighting factors, possibility to decompose the indicator, and possibility for practical application.

## 2. Review of literature

A green economy means the economic growth and stability of the natural environment at the same time, jobs for restoring the natural environment, improving the quality of the natural environment, rational and efficient use of natural resources and their reasonable consumption, reducing energy consumption, using resource-saving, environmentally friendly and innovative technologies, preserving natural capital and its development, improving the quality of human capital, using renewable resources, waste reduction and recycling of raw materials for the well-being of present and future generations. Current and future generations must have natural resources and a clean environment. A "Green" economy is usually understood as an economic system compatible with the natural environment, environmentally friendly, ecological, and socially just for many groups (Fulai, 2010). A "Green" economy is a low-carbon, resource-efficient and socially inclusive economy. "Green" economy also includes developing and implementing specific policy instruments to protect the environment (Swart & Groot, 2020). Thus, the analysis carried out by the authors of this study shows that according to the closest definition given by Swart and Groot (Swart, Groot, 2020) and consistent with the objectives of this study, the green economy is an economic system that is compatible with the natural environment, harmless to the environment, environmentally friendly, and socially just.

Based on the sources analysed Pearce, Markandya, and Barbier (1989), Hoken, Lovins and Lovins (2002), Kennet and Heinemann (2006), Brand (2012), Ryszawska (2013; 2015; 2017), as well as the research carried out by Jevons (1924), Walras (1874), and Veblen (1899), analysing the availability of data in EUROSTAT and OECD databases, the authors determined the following factors and sub-factors that characterise the green economy development (Table 1).

Factors	Sub-factors	Indicators				
	Protection of biological	Area of organic farming, % of used agricultural land				
		Protected territories, dry land, % of the total land area				
	urversity	Surface area, % of national territory				
	Conservation of limited resources	Share of fuel in final energy consumption, %				
Ecological factors		Supply, transformation, and consumption of oil and oil products, thousand tonnes				
		Supply, transformation, and consumption of solid fossil fuels, thousand tonnes				
	Development of renewable energy sources	Share of renewable energy in total final energy consumption, %				
		Renewable energy sources in electricity, %				
		Non-energy material productivity, GDP per unit of consumption of household materials				
Economic	Decoupling economic	Degree of use of recyclable materials, %				

Table 1. Green Economy Factors, Sajvazianub-factors, and Indicators

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factors	growth from natural	Level of household waste recycling, %				
	resources	Resource productivity, %				
		Consumption of household materials per capita, tonnes per capita				
	Sustainable concumption	Primary energy consumption, %				
	Sustainable consumption	Final energy consumption, %				
		Household final energy consumption by fuel, %				
		Energy productivity, GDP or revenue by amount of energy consumed				
	Energy efficiency	Energy dependence, %				
		Energy taxes by paying sector, %				
		Electricity supply, transformation, and consumption, gigawatts per hour				
		Average CO2 emissions per km of new passenger cars, g CO2 per km				
Social	Social responsibility of companies and investors in the ecological sector	Revenue from taxes on the natural environment, %				
responsibility		Greenhouse gas emissions per capita, tonnes of CO2 equivalent per capita				
factors		Eco-innovation index, index (ES=100)				
		CO2 emissions from production, tonnes				

Source: developed by the authors based on sources by Pearce, Markandya and Barbier (1989), Hoken, Lovins, and Lovins (2002), Kennet and Heinemann (2006), Brand (2012), Ryszawska (2013), Jevons (1924) and Walras (1874), Veblen (1899)

#### 2. Methodology

To assess the green economy factors and sub-factors, it is necessary to unify the indicators presented in Table 1. Unification of indicators is the reduction of statistical data to a certain type for further assessment of sub-factors, factors, and the overall green economy indicator in the segment [0:10] (Lavrinenko, 2015; Čižo et al., 2018):

$$x'_{ij} = \frac{x_{ij} - x_{\min j}}{x_{\max j} - x_{\min j}} + 10 - \text{stimulant for indicators;}$$

$$x_{ij} = \frac{x_{\max j} - x_{ij}}{x_{\max j} - x_{\min j}}$$

 $x_{max j}$   $x_{min j}$   $x_{10}$  – destimulant for indicators; where  $x_{ij}$  – value of the unified indicator in the country,  $x_{minj}$  and  $x_{maxj}$  – respectively, the minimum and maximum values of a certain indicator in the EU countries during the period under study.

Values of the green economy indicator in each country are defined as the arithmetic mean of each factor characterising the green economy. The value of each factor is determined as the arithmetic mean of sub-factors characterising certain factors. The value of each sub-factor is determined as the sum of unified indicators characterising the sub-factors of green economy development. Convergence is the process of steady convergence of parameters to a certain level and the convergence of development levels in different countries or regions in the area under study. Divergence is an increase in disparities and differences in the development levels in the area under study and its indicators in different countries or regions. Historically, some of the first studies on convergence were the concept of a mixed economy and various welfare state models (e.g., Mill, Galbraith). With the transition of planned economies to a market economy in the late 20th century, ideas of convergence were applied to establish the convergence of legal systems, regions, and institutions. In this case, convergence is understood as the convergence of social and economic development levels of countries, regions, industries, etc. The two concepts of convergence that are best known in this context are interrelated but cause different effects on socioeconomic policy:  $\beta$ -convergence (Barro, Sala-i-Martin, 1992) and  $\sigma$ -convergence (Sala-i-Martin, 1996a, Sala-i-Martin, 1996b, Islam, 2003). According to  $\beta$ -convergence, countries with the lowest values of the indicator under study in the initial period are, on average, characterised by higher growth rates during the integration process. The so-called growth-initial level regressions, in which the dependent variable is the growth rate and the independent variable is the initial level of the indicator, are used to estimate  $\beta$ -convergence. The simplest regression of this type is like the following:

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 $y_i = a + \beta \ln(x_it-T) + e$ , where  $x_it-T - indicator$  at the point in time prior to the current point in time t for T periods (as a rule, the initial period of integration or another point in time significant for the development of the integration grouping),  $\beta$  - coefficient to be estimated,  $y_i$  - the average growth rate in the i country for T periods, calculated as  $\ln(y_it)/\ln(y_it-T)$ , e - random deviation. The sign of the coefficient  $\beta$  is an indicator of convergence. If  $\beta < 0$ , a high level of the indicator at the initial moment of time correlates with a relatively lower growth rate.

In contrast to  $\beta$ -convergence,  $\sigma$ -convergence implies a decrease in the standard deviation of the indicator value over time, smoothing the divergence between countries. The ratio of the standard deviation to the mean (variation coefficient) is another indicator that is often used if there is a trend in the time series. However,  $\beta$ -convergence does not always imply  $\sigma$ -convergence: in the situation where a group of richer and poorer regions is constantly changing (due to deterioration of the economic situation in the rich regions and economic improvement in the poor regions), but the overall level of the gap between the rich and poor regions is constant, there is no  $\sigma$ -convergence (Sala-i-Martin 1996a, Sala-i-Martin 1996b, Barro and Sala-I-Martin 1995; Lavrinenko, 2015; Čižo et al, 2018).  $\sigma$ -convergence is based on a statistical approach: the analysed indicators are variance, standard deviation, variation coefficient, etc. (Quah 1993; Quah 1996; Quah 1997). However,  $\beta$ -convergence is a prerequisite for  $\sigma$ -convergence to exist (Sala-I-Martin, 1993). Some studies also determine  $\sigma$ -convergence based on the analysis of indices, for example, the Theil index, the Gini index, the Atkinson coefficient, etc. (Gini 1912; Gini 1909; Theil, 1967; Atkinson, 1970).

The only difference between the panel approach (Coulombe, Lee, 1995; Evans, Kim, 2005) and the Barro regression is that the panel analysis is conducted for a panel. Since the number of observations increases, the estimates will have more accurate characteristics. In addition, peculiarities of specific regions are also considered. Some scientists have developed other methods for determining convergence (divergence). D.Quah was one of the first scientists who criticised the Barro regression. The regression is dependent on the choice of the initial point of time and does not consider changes in the income distribution by region (country). Quah uses Markov chains to simulate changes in the sampling distribution. As a result, the author receives transition matrices from one state to another. Time series research (Loewy, Papel, 1996; Carlino, Mills, 1996; Lau, 2009) is also used to test stochastic convergence - a gradual decrease to a certain level ( $\alpha$ ) of the mathematical expectation of the difference between two series. According to the concept of stochastic convergence, inequalities between regions (or countries) do not disappear entirely but stabilise at a certain level.

$$\lim_{t\to\infty} \parallel X_t - Y_t \parallel = \alpha$$

In the scientific literature, an approach also considers the spatial dependence of observations - the correlation between observations corresponding to nearby regions (Battisti, Vaio, 2008). In these models, a matrix of spatial weights is introduced to account for the spatial factor – a matrix of distances between objects, which is included in the final regression as one of the factors. Therefore, sigma- and beta- convergences, and stochastic convergence are the main concepts of convergence. Statistical methods, the Barro regression, Markov chains, the study of time series for stationarity, and the panel approach are the main approaches to studying region convergence or divergence. The authors chose statistical methods and the Barro regression as the most appropriate methods to achieve the purpose of the study. The downsides of this method are not significant for this study because it is necessary to determine the convergence in a specific period since 2015, but changes in the distribution of the value of the indicator under study for specific regions in this period can be specified by applying the following methodology. To determine the problematic values of the green economy index by country, it is necessary to analyse both the dynamics of the indicator values and the analysis of the country's position by the indicator under study in relation to other countries. Thus, it can be assumed that the negative dynamics of the indicator's value relative to other countries is a signal of the so-called problem.

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According to the logic described above, the indicators are divided into four problem groups (see Table 2) based on the following algorithm (Ajvazyan, 2005):

- the first group includes indices whose values deteriorate relative to the values of previous periods and values in the ranking of other countries (the first problem class);

- the second group includes indices whose values deteriorate relative to other countries and improve or remain at the same level relative to the values of previous periods (the second problem class);

- the third group includes indices whose values deteriorate relative to previous values but improve or remain at the same level relative to the ranking of other countries (the third problem class);

- the fourth group includes indices whose values improve relative to previous values and the ranking of countries (the fourth problem class).

## 3. Assessment of the Green Economy Index Values

To analyse which EU countries have the highest and lowest overall index of the green economy development trends and to compare years 2015 and 2019, the authors divided the results obtained on the green economy development trends and their factors into 5 quintiles (from the lowest overall index to the highest overall index). Quintile 1 includes EU countries with the lowest total scores, quintile 2 includes EU countries with low total scores, quintile 3 includes EU countries with average total scores, quintile 4 includes EU countries with high total scores, and quintile 5 includes EU countries with the highest total scores. The results are shown on the maps.



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In 2015, the values of the Green Economy Index were distributed as follows: quintile 1 includes Germany, Hungary, Luxembourg, Poland, and Romania; quintile 2 includes Belgium, Lithuania, Estonia, Ireland, France, and Cyprus; quintile 3 includes Bulgaria, the Czech Republic, Finland, Spain, and Malta; quintile 4 includes Greece, Croatia, Slovakia, Italy, Latvia, and Portugal; quintile 5 includes Austria, Sweden, Denmark, Slovenia, and the Netherlands. Thus, Austria, Sweden, Denmark, Slovenia, and the Netherlands have the highest values of the Green Economy Index; Germany, Luxembourg, Hungary, Poland, and Romania have the lowest values of the Green Economy Index.



Figure 2. Green Economy Index Values by Quintiles in EU Countries in 2019\ Source: developed by the authors based on the results obtained

In 2019, the values of the Green Economy Index were distributed as follows: quintile 1 includes the Czech Republic, Germany, Cyprus, Hungary, and Poland; quintile 2 includes Bulgaria, Estonia, Ireland, Lithuania, Luxembourg, and Romania; quintile 3 includes Belgium, Spain, France, Malta, and Slovakia, 4th quintile includes Greece, Croatia, Latvia, Austria, Portugal and Finland, and quintile 5 includes Denmark, Italy, the Netherlands, Slovenia and Sweden. In 2019, Denmark, Italy, the Netherlands, Slovenia, and Sweden have the highest green economy development trends, while the Czech Republic, Germany, Cyprus, Hungary, and Poland have the lowest ones. Therefore, the increase in the values of the green economy index during the period under study is observed in Malta, Finland, and Luxembourg; the decrease in the values of the green economy index during the period under study is observed in Hungary, Spain, and Ireland.

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		Position relative to other countries		
	Improve or remain the same			
Position of the country relative to its own indices in the past (dynamics)	Deteriorate	Bulgaria, Czechia, Denmark, Greece, Cyprus, Latvia, Malta, Austria, Poland, Slovenia	Germany, Estonia, Ireland, Lithuania, Hungary, Portugal, Romania, Slovakia, Finland	
	Improve	-	Belgium, France, Croatia, Italy, Spain, Luxembourg, Netherlands, Sweden	

#### Table 2. Problem Matrix

Source: authors' calculations based on (Ajvazyan, 2005).

The problem levels of countries according to the values of the Green Economy Index and places in the country ranking in 2015 and in 2019 are established. The first problem group includes countries according to indices whose values **deteriorate** relative to the values of previous periods and values in the ranking of other countries (the first problem level): Bulgaria, Czechia, Denmark, Greece, Cyprus, Latvia, Malta, Austria, Poland, and Slovenia. The second group includes countries according to indices whose values **deteriorate** relative to other countries and at the same time **improve** or remain at the same level relative to the values of previous periods (the second problem class): Germany, Estonia, Ireland, Lithuania, Hungary, Portugal, Romania, Slovakia, and Finland. The third group includes countries according to indices whose values deteriorate relative to previous values but improve or remain at the same level relative to the trid problem class) and does not include any EU country. The fourth group comprises countries according to indices whose values (the third problem class) and does not include any EU country. The fourth group comprises countries according to indices whose values (the third problem class) and does not include any EU country. The fourth group comprises countries according to indices whose values, the first problem class): Bulgaria, Czechia, Denmark, Greece, Cyprus, Latvia, Malta, Austria, Poland, and Slovenia.

Thus, in most countries, the values of the green economy index deteriorated relative to 2015 in the period under study; Germany, Estonia, Ireland, Lithuania, Hungary, Portugal, Romania, Slovakia, and Finland also deteriorated their position in the country ranking. A more detailed study into the reasons for the situation described above requires more thorough research, but it is out of the scope of this article.

## 4. Green Economy Convergence and Divergence

We will test the  $\beta$ -convergence hypothesis on the green economy index values in the EU countries in the period 2015 - 2019.  $\beta$ -convergence is considered a prerequisite for  $\sigma$ -convergence (Sala-i-Martin X., 1996a, p.1325-1352., Sala-i-Martin X., 1996b, p.1019–1036).

The authors built a regression of the growth of green economy index values from 2015 to 2019 on the baseline in 2015, where the dependent variable is the growth rate and the independent variable is the index's baseline.

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Table 3. Regression model						
constant β valu						
$y=a+\beta x, where$ $y=ln(z_ekon2019/z_ekon2015),$ $x=ln(z_ekon2015)$	-0,396	0,329	0,094			

Source: authors' calculations based on European statistical data

Based on the data presented in the Table 2, we get the equation  $\ln(g\_econ 2019/g\_econ 2015)=0.396+0.329\ln(g\_econ 2015)$  and since  $\beta=0.329>0$ , the assumption of convergence of the green economy index values in the EU countries in the period 2015 - 2019 is not confirmed. However, it should be noted that the p-value is 0.094, which falls within the interval from 0.05 to 0.1. Therefore, there is only a trend for the divergence of the Green Economy Index values in the EU countries in the period under study.

The data obtained also suggest that there is  $\sigma$ -divergence of the Green Economy Index values in the EU countries in 2015 - 2019. To find out whether the green economy in the countries under study is characterised by  $\sigma$ -divergence, general indicators of variation are used - the amplitude of variation and the standard deviation. They are calculated based on the formula (Чижо, Игнатьева, Лавриненко 2018):

$$R = X_{\text{max}} - X_{\text{min}};$$
  
$$\sigma = \frac{\sum (x_i - \overline{x})f_i}{\sum f_i},$$

where  $X_{\text{max}}$  and  $X_{\text{min}}$  is the highest and lowest values of the indicator; ...  $\overline{x}$  indicator mean values;  $x_i$  indicator variants;  $f_i$  frequency; i = 1, 2, ..., n number of variants.

Based on the abovementioned information, the constructed indicators of relative variation will be used: amplitude coefficient and variation coefficient. They are calculated based on the formulae:

$$K_{R} = \frac{X_{\max} - X_{\min}}{\overline{x}};$$
$$(V_{\sigma}) = \frac{\sigma}{\overline{x}},$$

 $\delta$  - standard deviation,  $\overline{x}$  - average value,  $X_{\max}$  и  $X_{\min}$  –the largest and smallest value of a characteristic in the sample population

Variation markers	2015	2019	
Range coefficient, $(K_R)$	0,4	0,5	
2000 = 100%	100%	125%	
Variation coefficient, $(V_{\sigma})$	0,06	0,1	
2000 = 100%	100%	167%	

Table 3. Variation and amplitude coefficients of the Green Economy Index in the EU countries in 2015 and 2019.

Source: author's calculations

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The Table shows that after 4 years the "polarisation" of the Green Economy Index values in the EU countries increases, and the rise in the variation coefficient by 67% proves it. It means that there was an increase in the differences in the Green Economy Index values, which is confirmed by  $\sigma$ -divergence of the Green Economy Index values in the EU countries in the period 2015 – 2019.

## 5. Conclusions

In 2015, Austria, Sweden, Denmark, Slovenia, and the Netherlands have the highest overall index for the green economy trends, while Germany, Luxembourg, Hungary, Poland, and Romania had the lowest overall index for the green economy trends. In 2019, Denmark, Italy, the Netherlands, Slovenia, and Sweden had the highest overall green economy trend index, while the Czech Republic, Germany, Cyprus, Hungary, and Poland have the lowest index.

After 4 years, the "polarisation" of the Green Economy Index values increased, as evidenced by the 67% increase in the variation coefficient - there was an increase in the green economy differences, confirmed by the  $\sigma$ divergence of Green Economy Index values in the EU countries. There is a trend of  $\beta$ -divergence in the EU Green Economy Index values in 2015 - 2019. The statement that countries with initially higher values of the Green Economy Index increase their level faster and countries with initially lower green economy levels increase their level more slowly has not been confirmed. More detailed research into this statement is required to find the reasons for the increasing disparities. Moreover, it defines the direction for further research in this area.

The problem matrix revealed negative trends in the dynamics of the Green Economy Index in 2015 - 2019. The most problematic group of countries (Bulgaria, Czechia, Denmark, Greece, Cyprus, Latvia, Malta, Austria, Poland, and Slovenia) are those that have seen both a decline in the Green Economy Index and a deterioration in the country ranking over the period under study. A group of countries (Germany, Estonia, Ireland, Lithuania, Hungary, Portugal, Romania, Slovakia, and Finland) in which their indices' values deteriorate slowly so that their ranking position does not deteriorate is considered problematic. A group of countries lead both in the dynamics of their index values. In the overall ranking, countries that improve their Green Economy Index values rapidly outperform others: Belgium, France, Croatia, Italy, Spain, Luxembourg, Netherlands, and Sweden.

Therefore, we can conclude that disparities in the Green Economy Index in EU countries do not decrease but increase, indicating that the EU cohesion policies in this area are ineffective.

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Victoria PCHELINA is Mg. oec. Student of Daugavpils University. Her research interests: regional economics ORCID ID; https://orcid.org/0000-0002-9652-1569

**Olga LAVRINENKO** is Dr. oec, Leading researcher at the Institute of Humanities and Social Sciences of Daugavpils University, Latvia. She has status of experts of the Latvian Council of Science in the field of economics and entrepreneurship. Her research interests: regional economics, sustainable economic development. ORCID ID: https://orcid.org/0000-0001-7383-3749

Alina DANILEVIČA is Dr.oec, Researcher at the Institute of Humanities and Social Sciences of Daugavpils University, Latvia. She has the status of Expert of the Latvian Council of Science in the fields of economics and entrepreneurship, sociology and social work. Her research interests: regional economics, investments, investment climate (entrepreneurial environment).

ORCID ID: https://orcid.org/0000-0002-2749-2725

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# DYNAMIC MODEL OF THE EFFICIENCY OF SMALL ENTERPRISES

## Agnieszka Parkitna<sup>1</sup>, Magdalena Gądek<sup>2\*</sup>

<sup>1</sup>Wroclaw University of Science and Technology, 27 Wyb. Wyspianskiego st. 50-370 Wrocław, Poland <sup>2</sup>WSB Merito University in Wroclaw, Fabryczna 29-31 st., 53-609 Wrocław, Poland

*E-mail:* <sup>1</sup>*agnieszka.parkitna@pwr.edu.pl*; <sup>2\*</sup>*magdalena.gadek@wsb.wroclaw.pl* (Corresponding author)

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**Abstract.** Previous considerations on the theory of the efficiency of small enterprises in the literature have not led to the creation of a comprehensive model. This is due to the ambiguity of the concept of efficiency and the lack of consistency in the subject matter. In the traditional approach, the efficiency measures needed to be improved for managing small organisations that compete in a turbulent environment. The measures included in the literature mainly refer to financial issues, whereas to a minimal extent, they refer to the future efficiency of the organisation. Therefore, the need to organise the problems raised in theoretical and research areas was indicated. This study aims to create a dynamic model of efficiency in a small enterprise. Quantitative analysis based on a representative sample of 455 organisations allowed the verification of the hypotheses, resulting in a comprehensive model of the efficiency of small enterprises. The empirical model coincided with the conceptual model. The model was validated on a sample of 336 service companies. On this basis, the company's efficiency occurs in a continuous cycle of its elements: economic efficiency, manufacturing efficiency, and effectiveness.

Keywords: Small and medium enterprises (SME); economic efficiency; effectiveness; manufacturing efficiency

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## 1. Introduction

In a hyperdynamic environment (Freeman and Reed 1983) (Ashkenas et al. 2002) (Schumpeter 2017), characterised by phenomena of the black swan type (Beliaeva et al. 2020), the effectiveness of small enterprises is determined by the prompt adaptation to changes (Ștefănescu 2018). These should ensure the organisation's anticipatory response to the environment's requirements (Perechuda 2018), (Bonnet and Lehtimaki 2020). *"Creative Destruction"* is now (McKnight et al. 2001; Mohr et al. 2010) the driving force behind the small and medium-sized enterprises (Lerner 2006), (van Stamm and Trifilova 2009), (Metcalfe 2004). Thanks to this rotation, the economy is still "reincarnated" (Kalvet and Kattel 2006). Remarkable changes in today's world go beyond supply and demand imbalances or technological advances (Ryfkin 2001), (Vavrecka et al. 2021).

Micro and small enterprises assimilate relatively quickly to the changing environment, but their mortality rate is high (Kortelainen et al. 2012). Understandably, small entrepreneurs struggle with finding a reliable recipe for high efficiency in the conditions of internationalisation and globalisation (Kazlauskaitė et al. 2015). The very specificity of the operation of small enterprises conditioned by limited resources (Owusu et al. 2019), (Bretherton and Chaston 2005), (Wach 2008), (Wang and Clegg 2018), (Wasiuzzaman 2019), (Alshami 2019) and no cash reserves (Ghalke et al. 2022) it is a barrier in itself that is difficult to overcome in the pursuit of high efficiency. However, many examples in the business practice of SMEs focus solely on short-term financial performance, overlooking essential needs that determine long-term success (Rubio-Andrés et al. 2022).

The SME sector is perceived as an absolute stimulus of the economy (Eyre and Smallman 1998), (Berger and Udell 1998), (Audretsch and Thurik 2000), (Jamali et al. 2009) and a reason to build the economic potential of countries. The literature studies confirm the recognition of its crucial role in creating stability and growth of the economy (Wijewardena et al. 2008), (Komkov et al. 2011), particularly in countries where the share of small enterprises in the total GDP is relatively high (Kotey and Meredith 1997). Therefore, the problem of the efficiency of enterprises in the SME sector becomes essential, which may be related to the factors determining the activity in a single country (Sajnóg 2015).

The unambiguous concept of organisational effectiveness and methods of its assessment has long been an unresolved subject of interest for both theoreticians and practitioners. Theorists made attempts to develop generalised models (or sets of criteria) based on different paradigms, enabling the description of the organisation in terms of its effectiveness and conditions for shaping it (Argyris and Schön 1974), (Cherns 1976), (Quinn and Rohrbaugh 1983), (Quinn 1988), (Kaplan and Norton 1992), (Kaplan and Norton 1993, 1996), (Argyris 1994) (Cilliers 2005), (Gatarik and Born Rainer 2012). Managers conducting diagnostic and intervention activities in organisations face the problem of the multiplicity of such models (taking into account sets of criteria) (Carton and Hofer 2010). It means continuously monitoring activities to ensure high efficiency in using resources and all business processes (Skowronek-Mielczarek and Bojewska 2017).

The analysis of the literature shows that many authors typology efficiency, defining it from different perspectives (Pasour 1981), (Drucker 2005), (Harrington 1926), (Cunningham 1977), (Hamrol 2001), (Samuelson and Nordhaus 2005), (Yarnada 1972), (Campbell 1977), (Clark et al. 1980), (Romani, John et al. 1981), (Xenophon and Holden 2010). It can be concluded that the vector of the organisation's success is the solution to the practical problem of measuring and evaluating its efficiency (Holcomb and Holmes 2005), (Beer 2009).

This literature analysis shows a methodological gap in the research on the efficiency of small enterprises. This is due to the equivocal understanding of the concept of efficiency and how an efficiency model is constructed. Current achievements in this area are characterised by inconsistency in the subject matter, research is selective, and does not cover the entirety of issues of organisational efficiency. The aim is to suggest a grounded methodology to construct the dynamic model of efficiency. The article is an attempt to fill the research gap in theoretical and practical dimensions.

# 2. Literature review and theoretical background

The results of the literature research presented in the table confirm that the efficiency problem is still relevant, and a comprehensive model must be developed. The table shows the areas related to the study of SMEs' efficiency and the scope of research in these areas. The adopted layout of the literature research presentation was the background to create the grounded methodology allowing the construction of the dynamic model of efficiency.

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Table 1. Literature review

Areas of Efficiency	Scope and content of the study				
economic efficiency	• an attempt to specify and determine which of the success factors is particularly important for the				
	effectiveness measured by the results of enterprises (Wu and Wu 1994; Wu 1996)				
	• economic efficiency indicator measured by the financial result using series of interviews (Hudson et al. 2001)				
	<ul> <li>relationship between the economic results of SME enterprises and the variables including quality.</li> </ul>				
	time, flexibility, the level of financial result, customer satisfaction, human resources and gender of the owner (Glancey 1993; Davies et al. 2002; De Zoysa and Herath, Siriyama 2007)				
	<ul> <li>total sales and profitability of enterprises (O'Cass and Weerawardena 2009)</li> </ul>				
	<ul> <li>resources processing into products and revenues research conducted on the domestic market (Szymańska 2010)</li> </ul>				
	• the interaction between an SME's profitability and the owner's personality (Steinerowska-Streb 2012); the manager's influence as a determinant of the company's profits. (Steinerowska-Streb 2012)				
	• methods of supporting effective management of the most significant importance for the development of entrepreneurship and identify the most frequently used methods by business owners (Siemieniak 2014)				
	• the impact of the family (or non-family) nature of the firm on the relationship between environmental and financial performance of the firm (Garcés-Ayerbe et al. 2022)				
	• the socio-emotional benefits of appointing women as family directors, and how some of these specific female characteristics (desire to pass the business on to future generations, long-term commitment and willingness to protect the family's reputation) prove beneficial to the performance of the family business (García-Meca and Santana-Martín 2022)				
	• links between a company's internal Corporate Social Responsibility and its implementation. The results of this study showed that two internal activities, employee behaviour related to strategic renewal and behaviour related to new business ventures, partially mediate the link between internal CSR practices and company performance (Giang and Dung 2022)				
	• Corporate Social Responsibility (CSR) and knowledge-based resources, i.e. intellectual capital (IC), improve financial results. (Mutuc and Cabrilo 2022)				
	• The impact of family ownership on the performance of small and medium enterprises (SMEs) in the context of internal and external governance mechanisms. On their basis, a positive bidirectional relationship was claimed between performance and promoter ownership without the moderating effect of internal governance (Ghalke et al. 2023)				
the organisation's manufacturing	• the relationship between the goals achieved and the need to adopt a new management strategy (Baruk 2006)				
efficiency	<ul> <li>Polish authors attempted to investigate critical factors of scalability of enterprises in the SME sector (Parkitna and Galus 2017)</li> </ul>				
	• the impact of international experience on the efficiency of small and medium enterprises measured by company results was confirmed (Camisón and Villar-López 2010; Franz et al. 2018).				
	• digital technologies are employed to increase the efficiency and effectiveness of the relationship of digital communication (Salo et al. 2020) which is the result of following the changing world in which the role of social media and the development of e-commerce is increasing (Kmecová et al. 2021)				
	• high managerial dominance does not guarantee success; other factors are needed to promote innovation in small businesses and ensure their growth (Harel et al. 2021)				
	• the pursuit of goals is associated with less formal practices, carried out on privately owned small and medium-sized family businesses (Michiels et al. 2022)				
	• strategic agility positively influences performance in both developed and emerging markets (Vrontis et al. 2022)				
	• a close relationship between innovation, entrepreneurship and productivity growth in the high-tech sector (Haltiwanger 2022; Piccinetti et al. 2023)				
	• the attempts to establish single measures of organisational effectiveness were unsuccessful; the				
	researchers examined the relationship between overconfidence as a character trait of owners/managers and organisational resilience in terms of the effectiveness of the organisation's business processes carried out				

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	(Kunz and Sonnenholzner 2023)			
external factors	<ul> <li>lack of unambiguous results in the area of exploration of companies' reactions to changes in the environment and the impact of SME development and obtaining external business advice while controlling the impact of SME characteristics on age, production/services, advanced technology, the level of innovative skills of the workforce, exports and the number of competitors (Robson and Bennett 2000)</li> <li>context of internationalisation and the impact of economic transformations on the development of SME enterprises (Bateman et al. 2002)</li> <li>efficiency barriers included external and internal obstacles; research studies have verified the degree of survival of the company by selecting and taking into account characteristics, context and the degree of inclusion in the entrepreneurial network in France (Abdesselam et al. 2004); the research has shown a</li> </ul>			
	<ul> <li>relationship between the effectiveness measured by the development of enterprises such as SMEs and innovation in areas related to ecology (Roy et al. 2016; Ebrahimi and Mirbargkar 2017)</li> <li>exploration of firms' responses to environmental changes significantly dependent on internal factors that are fundamental to achieving efficiency and success (Ashkenas et al. 2002; Bretherton and Chaston 2005), such as: speed of action, flexibility, trust, integration of activities, innovation and e-business (Salder et al. 2020); research conducted in Malaysia confirms the relationship between innovative capacity and operational efficiency (Iranmanesh et al. 2021)</li> <li>the success of enterprises depends on a combination of the following conditions of institutional quality: accountability of the voice, political stability, quality of regulation and the rule of law (Lv et al. 2021).</li> </ul>			
effectiveness	<ul> <li>factors influencing the development of small and medium enterprises on the market in the region; in a situation of economic and technical difficulties and intense competition, the ability to maintain the company's operations and, ensure its survival and avoid liquidation plays an important role (Lachiewicz 2013; Nowicki 2013)</li> <li>impact of a creative strategy on efficiency; the result only partially confirmed the existence of a positive relationship between the dimensions of creative strategy and the efficiency of assessing using subjective measures and contradicted (Dyduch 2013)</li> <li>relationships between such factors as entrepreneurial characteristics, product and financial issues, social ties and human capital, and the market success of the company have been demonstrated (Nishantha</li> </ul>			
	<ul> <li>and Pathirana 2013; Umar et al. 2022); additionally, the relationship between age (and size) and export intensity (and performance) is moderated by the type of management in a given type of SME, given an SME-type (Dubey and Das 2021)</li> <li>the impact of the national research and development (R&amp;D) programme in the field of technological innovations on the effectiveness of small and medium-sized enterprises (Park 2014)</li> <li>the relationship between gender and the growth objectives of companies, i.e. turnover, profit professional level and new markets (Cabeza-García et al. 2021; Ting et al. 2021); when organisations are focused on increasing sales, profits, employees and new markets, they are more likely to face difficulties when the managers are women. On the other hand, when company goals are linked to increasing innovation, brand reputation and relationships with other companies, companies are more orientated towards resilience when they are not led by women (Casprini et al. 2022)</li> </ul>			
efficiency	<ul> <li>no empirical results have been identified that would suggest which factors are most strongly correlated with critical performance dimensions (Ha-Brookshire, Jung 2009)</li> <li>in "high-performance enterprises", belonging to the SME sector, the level of efficiency is monitored using a wide range of efficiency indicators; however, the study described in the literature lacked a detailed description of the research tool, evaluation model and a set of indicators measuring efficiency (Zbierowski 2013)</li> <li>the relationship between the efficiency measurement and the accuracy of the performance measurement has been recognised by scientists around the world (Koźmiński 2008; Koźmiński and Latusek-Jurczak 2017)</li> <li>system and the development efficiency of small and medium-sized enterprises was confirmed (Gębczyńska, 2017)</li> </ul>			

## Source: Own elaboration

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Concluding the above considerations, the main research question is as follows: *What is efficiency, and how do the individual components of efficiency create its model?* Moreover, a group of detailed questions was developed, based on which supplementary questions were formulated: *Question 1. Does efficiency depend on the type of business? Question 2. Does efficiency depend on the number of people in the enterprise?* 

The hypotheses formulated complement the proposed research questions:

 $H_{P0}$ : A statistically significant reciprocal relationship exists between the model elements and the efficiency.  $H_{P1}$ : The efficiency between the distinguished types of activity differs significantly.

 $H_{P2}$ : The efficiency between distinguished groups by the number of people in an enterprise is significantly different.

In the traditional approach, the efficiency measures turned out to be insufficient for managing small organisations (Gębczyńska 2017). A mere increase in economic efficiency is not enough to change the overall use of resources. Certain principles should be applied in planning to achieve cost-effectiveness, which is challenging in small enterprises (Burchard-Dziubińska et al. 2014). Excellence in managing parts of an organisation's operations is not enough to ensure a dynamic balance of operational efficiency. In the management of fragmentary areas of the enterprise, there is a tendency to emphasise the effectiveness of the performance of a given function at the expense of losing the overall efficiency- the effectiveness of the level of achieved goals of the entire organisation (Oleksiuk 2014).

The search for opportunities to increase the efficiency of a modern organisation to ensure its competitiveness considers management processes (Osbert-Pociecha 2013). In managing the company's efficiency, time must be regarded as one of the resources. The time analysis of processes is used to assess the efficiency of the company's operations. It is sometimes a determinant of readiness and the ability to take on challenges and take advantage of emerging opportunities. The very reduction of the processing time leads to increased market competitiveness (Sarnowski 2013).

# 3. Methodology

# 3.1. Concept of a theoretical mathematical model

The performance paradox refers to the weak correlation between the efficiency indicators and the effectiveness itself, understood as a performance measurement (Meyer and O'Shaughnessy 1993; Meyer, M and Gupta 1994). Over time, performance indicators tend to lose the ability to measure efficiency, making it impossible to distinguish between effective and ineffective actions (behaviours).

As a result, the relationship between actual and reported activities is reduced, often resulting in an overly optimistic assessment of reality. Therefore, this paradox does not refer to the activity itself but to the effects of its measurement (van Thiel and Leeuw 2002).

In summary, the construction of such a model that can be used to measure efficiency reliably is significant in the aspect of the organisation's limited resources (Nieplowicz 2014). Therefore, considering the importance of small business performance management, our goal was to solve the research problem. The present study has attempted to cover the missing links and find research gaps on the subject matter.

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Managing the efficiency of a small enterprise is a process, and knowledge of the dimensions of efficiency will build the right background for development (Li and Hu 2002).

The efficiency of an SME we define as the entirety of the activities of its owners in the area of economic and manufacturing efficiency (performance), the effectiveness of a small organisation aimed at achieving success (reflecting the ability to create a success of the enterprise at a specific moment in time when certain external factors operate).

Based on the stages of research proceedings in empirical sciences (Bunge 2017), our analysis of the literature concluded that:

- efficiency is a subject of science that can be measured and acted on in a specific direction as a controlled entity,
- enterprises from the SME sector, due to their specificity, are not subject to the rules for large enterprises
- there needs to be a comprehensive model of the efficiency of a small organisation in the literature on the subject.

To carry out a practical verification of the research problem, we conducted qualitative research with owners of small businesses. The interviews were based on the goal grid and the SMART method. (Specific, Measurable, Ambitious, Realistic, Time-bound). The stages of the research procedure we adopted allowed us to formulate the main goal and set unequivocal research goals, which are:

- organising the concepts of the efficiency of a small organisation,
- developing a small business efficiency model.

As a starting point for creating the model, changing how it is understood is necessary. Therefore, we assumed that the main objective of an enterprise's activity is to maximise the value for the owners. This general objective consists of specific objectives, which can be grouped as follows:

- growth of the enterprise understood as an increase in the volume of production and, consequently, sales, i.e., manufacturing efficiency,
- development of the enterprise understood as the introduction of new products and expansion of operations into new markets, i.e., effectiveness of market activities,
- making profits understood as gaining funds for both the growth and development of the enterprise, i.e., economic efficiency.

We assumed that important aspects influencing efficiency are:

- correct estimation of future expenditures economic efficiency,
- performance of previously planned tasks manufacturing efficiency
- the expediency of outlays; outlays incurred are adequate for implementation, and the objective achieved determines the effectiveness.

Therefore, from the perspective of management theory and business practice in the case of micro and small enterprises, it seems justified to modify organisation objectives from the perspectives of efficiency and market success (Table 2).

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The overarching objective of the business	Levels of efficiency	Main objectives	Specific objectives	Management objectives
		Result	Profitability = Maximise	Cost optimisation
	Economic efficiency		Liquidity = Optimisation of	Receivables
Maximising the			the operating cash level in	Liabilities
owner's wealth			circulation	Stock
increase in the value of	Manufacturing efficiency	Growth	Productivity = ability to	New products
the SME company			make use of resources	Investment in development
the Bivil company	Effectiveness	Development	Optimisation of market	Satisfying customer
			positioning strategy =	requirements and needs
			Strengthening market position	Advertising and marketing

#### Table 2. Objectives of the enterprise

Source: Own elaboration

The efficiency management process will be divided into three areas: results, growth and development. The efficiency of SMEs should be considered together as a triad of relationships between the three components: economic efficiency, manufacturing efficiency and effectiveness of operations, which are defined as follows:

- economic efficiency (*E<sub>e</sub>*) an action where the result obtained exceeds the expenditure incurred to obtain it (Kotarbiński 1974; Kazlauskaite and Buciuniene 2008; Szudy 2013; Górski and Parkitna 2017; Griffin 2017) in the case of SMEs perceived as operating cash in circulation = result with because it is less susceptible to manipulation than the financial result,
- the organisation's manufacturing efficiency ( $M_e$ ), (Barasa et al. 2019) (Guinee et al. 2007) (Sarmiento et al. 2007) (Mullen et al. 1996), i.e. performance (Knedler 2002), in the context of the original meaning of the term as a feature of the operation the proper performance of something in the given time (Harrington 1926), in relation to the original paradox of efficiency understood as productivity (Meyer and O'Shaughnessy 1993; Meyer and Gupta 1994) and not the meaning of efficiency as an evaluation of good work. In this sense, a firm is efficient if, making full use of its resources, it produces goods for which there is market demand without unnecessary stockpiling (Sulmicki 1978). In general, productivity could be defined as the efficiency changes between periods (Jubilee et al. 2021a), (Jubilee et al. 2021b). Productivity results from technological progress, which emerges from the capacity of (new and incumbent) economic agents to generate and commercialise innovations (Lafuente et al. 2020).
- effectiveness  $(E_n)$  an action that leads to the market effect intended as an objective (Henri 2004), (Cameron 1986), (Gaertner and Ramnarayan 1983), (Pearce 2000), (Pasetta 2005).

Considering the importance of the efficiency of small enterprises, the paper attempts to solve the research problem of creating a model of efficiency.

The efficiency of an enterprise is a continuous cycle of its components.

$$Ee_0 \rightarrow Me_0 \rightarrow En_0 \rightarrow Ee_1 \rightarrow Me_1 \rightarrow En_1 \rightarrow Ee_2 \rightarrow \cdots$$

The moment of entry in the business register is the beginning of business activity. At the outset, an enterprise generally has some initial capital, determining its economic efficiency. This capital leads to the accumulation of

resources, the consumption of which determines manufacturing efficiency. The growth of the organisation determines its effectiveness in the market. The return from the market determines the economic efficiency of the new cycle, etc (Figure 1).



Figure 1. Model of the efficiency triangle in time t

The enterprise is set up to exist indefinitely, so there is no possibility of a time limit here. The efficiency triangle cycle runs from when the enterprise is established - moment 0, to the subsequent cycles in time -t = 1,..., n. The efficiency triangle is exposed to external factors determining the efficiency at a specific point in time t. The model's basic assumption is to present each company's efficiency at moment t as a point $E_f = (E_e, M_e, E_n)$  in the Cartesian reference system (three-dimensional space).

A set of ordered components determines the position in dimension  $R^3$  of each efficiency point:

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A set of ordered components determines the position in dimension  $R^3$  of each efficiency point:

$$R^{3} = \{ (E_{e}, M_{e}, E_{n}) : E_{e}, M_{e}, E_{n} \in R \}$$

The efficiency measure can be defined as the length of the vector determined based on the previously discussed parameters ( $E_e, E_n, M_e$ ). The length of the efficiency vector is expressed as:

$$\left\|E_{f}\right\| = \sqrt{e_{e} + m_{e} + e_{n}}$$

 $||E_f||$  - the length of the vector (non-negative value),

 $e_e$ - square of the length of the economic efficiency component at moment/time *t*, determined as a positive change in the economic efficiency value:

$$e_e = (\max(E_{et} - E_{et-1}, 0))^2$$

 $m_e$ - square of the length of the manufacturing efficiency component at moment/time *t*, determined as a positive change in the economic efficiency value:

$$m_e = (\max(M_{et} - M_{et-1}, 0))^2$$

 $e_n$ - square of the length of the effectiveness component at moment/time *t*, determined as a positive change in the economic efficiency value:

$$e_n = (\max(E_{nt} - E_{nt-1}, 0))^2$$

Therefore, for the first step/cycle/run, assuming negative change is not plausible a simplified form of the length of the vector determining the efficiency value can be presented as:

$$\left\|E_{f}\right\| = \sqrt{(E_{e_{1}} - E_{e_{0}})^{2} + (M_{e_{1}} - M_{e_{0}})^{2} + (E_{n_{1}} - E_{n_{0}})^{2}}$$

 $E_{e_0}E_{n_0}M_{e_0}$  the initial values are 0.

At t = 0 the company has no value yet; this is the moment of initiation of business activity, equal to the moment of entry in the register, therefore:

$$||E_f|| = \sqrt{E_{e_1}^2 + M_{e_1}^2 + E_{n_1}^2}$$

Such a description of an enterprise's efficiency is accurate since statistical evidence in the literature generalises the characteristics of vectors for a multidimensional case and the presentation of their selected properties. Assumptions:

1) All the components of efficiency are interconnected.

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- 2) Economic efficiency, effectiveness, and manufacturing efficiency vectors are linearly independent.
- 3) At t = 0 the efficiency vector components are equal to 0.

## 3.2. Sample and data collection

To verify the model, a questionnaire was constructed according to the methodology (Babbie 2004; Glasow 2005; Taherdoost 2016; Hair et al. 2013). Successive iterations determined the accuracy of the survey with 76 long-term owners, entrepreneurs and employees of organisations supporting the development of entrepreneurship in Poland. The Polish market was selected as an appropriate one because the Index agency FTSE Russell (LSEG Business 2022) has reclassified Poland from "emerging markets" to "developed markets" in 2018. Poland is the first country to be promoted to developed markets and the first time a country from Central and Eastern Europe has been qualified for this group. Evidence from the literature suggests that entrepreneurs in developing economies develop informal platforms for cooperation and financing, thus strengthening their entrepreneurial ecosystem (Guerrero et al. 2021).

We estimated the size of a representative research sample for a finite population of 2,150,000 enterprises, which is 384 complete answers with a significance level of 0.05 and an error of 5%. Using traditional and electronic distribution channels, 10,000 questionnaires were delivered to the owners of micro and small entities throughout Poland, of which 455 fully completed forms were obtained (4.55% of the total). The sample is representative of the total population of small enterprises in Poland.

According to the APA standards, the concept of validity is homogeneous and should be used to define the research tool as a whole (Pitts and Naumenko 2016). The questionnaire begins with the part concerning the external factors of the environment, which determine the efficiency of enterprises measured by its success (Scale 1. External determinants). The second part concerns economic efficiency assessment (Scale 2. Economic efficiency). The third part concerned manufactory efficiency, that is, the company skills and the assessment of the impact of its factors on the level of efficiency measured by performance (Scale 3. Manufacturing efficiency). The fourth part concerned effectiveness, achieving a market position, and assessing the impact of its factors on the level of efficiency measured by effectiveness). Parts 5 to 7 are dedicated to efficiency management. The fifth part concerned the presentation of efficiency in terms of economic efficiency management at time t, which is the result of past actions at time t - 1 (Scale 5 - Past). The sixth part concerned the recognition of efficiency in terms of manufacturing efficiency management in the current operational activity at time t (Scale 6 - Present). The seventh part concerned the efficiency of managing the effectiveness at time t in planning future market operations at time t + 1 (Scale 7 - Future). A measurement was created using a five-point Likert scale.

# **3.3. Research Framework**

To answer the research questions, we have created a conceptual mathematical model along with detailed hypotheses resulting from the research questions posed. Measurement reliability analysis was completed using Cronbach's alpha coefficient. The hypotheses were formalised and then statistically verified. Afterwards, algorithms for the hierarchical grouping of data were used. The procedure was performed using SPSS IBM Statistic and MATLAB software. The model was validated using the same tools.

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4. Research findings

## 4.1. Reliability analysis

Based on the performed calculations, we validated the reliability of all 7 scales related to the questionnaire question areas. The research tool should be considered reliable and appropriate for further data analysis. The statistical characteristics of the research sample confirmed the accuracy of the survey structure and individual descriptive statistics.

At the stage of operationalisation of the research model, we formulated hypotheses. Verification of research hypotheses is done by verifying the statistical hypothesis (Rószkiewicz et al. 2013).

## **4.2.** Verification of the main hypothesis

 $H_{P0}: \mu_{Ee} \Leftrightarrow \mu_{Me} \Leftrightarrow \mu_{En} \Leftrightarrow \mu_{Ef}$ 

 $HO_{P0}:\mu_{Ee} \Leftrightarrow \mu_{Me} \Leftrightarrow \mu_{En} \Leftrightarrow \mu_{Ef}$ 

 $H_{P0}$ : A statistically significant reciprocal relationship exists between the model elements in the triangle and efficiency.

# H0<sub>P0</sub>: There is no statistically significant reciprocal relationship between the model elements in the triangle and efficiency.

Variables do not have a normal distribution. To verify the hypotheses, we used Spearman's rank correlation (Kendall, Maurice 1948), one of the non-parametric measures of monotonic statistical dependence between random variables for independent samples.

Because the correlation coefficient between

- Economic efficiency ( $E_e$ ) and Manufacturing efficiency ( $M_e$ ): R = 0,391, p = 0 < 0,01,
- Manufacturing efficiency  $(M_e)$  and Effectiveness  $(E_n)$ : R = 0,441, p = 0 < 0,01,
- Effectiveness  $(E_n)$  and Economic efficiency  $(E_e)$ : R = 0,467, p = 0 < 0,01,
- Effectiveness  $(E_n)$  and Efficiency  $(E_f)$ : R = 0841, p = 0 < 0.01,
- Manufacturing efficiency  $(M_e)$  and Efficiency  $(E_f)$ : R = 0,712, p = 0 < 0,01,
- Economic efficiency  $(E_e)$  and Efficiency  $(E_f)$ : R = 0,779, p = 0 < 0,01,

We reject hypothesis  $H0_{P0}$  in favour of  $H_{P0}$ . Therefore, it should be assumed that a statistically significant mutual relationship exists between particular elements of the model.

The analysis of the significance of the correlation coefficients should be supplemented with the direction and strength of the relationship. All correlations between the analysed variables have a positive coefficient, meaning that the other increases along with increasing one feature. There is a weak relationship between elements of the model:  $E_n$  and  $M_e$ ,  $E_n$  and  $E_e$ ,  $E_e$  and  $M_e$ . There is a strong relationship between the individual components of the model and efficiency.

## **4.3.** Verification of specific hypotheses

Does efficiency depend on the type of business you run?

 $H_{Pl}: \mu E f_{trade} \neq \mu E f_{service} \neq \mu E f_{production} \neq \mu E f_{mixed}$  $HO_{Pl}: \mu E f_{trade} = \mu E f_{service} = \mu E f_{production} = \mu E f_{mixed}$ 

# $H_{Pl}$ : The efficiency between the distinguished types of activity differs significantly. $H0_{Pl}$ : The efficiency between the distinguished types of activity is not significantly different.

The Kruskal Wallis test result  $\chi^2 = 9,412$ , p = 0,024 < 0,05 indicates the necessity to reject hypothesis **H0**<sub>P1</sub> and adopt **H**<sub>P1</sub>, which means that the efficiency level in trade, service, production and mixed enterprises differs significantly.

Does efficiency depend on the number of people in an enterprise?

 $\begin{array}{l} H_{P2}: \ \mu_{Ef1person} \neq \mu_{Ef2-4people} \neq \mu_{Ef5-10people} \neq \mu_{Ef11-24people} \neq \mu_{Ef25-49people} \neq \mu_{Ef50people} \\ HO_{P2}: \ \mu_{Ef1person} = \mu_{Ef2-4people} = \mu_{Ef5-10people} = \mu_{Ef11-24people} = \mu_{Ef25-49people} = \mu_{Ef50people} \\ \end{array}$ 

 $H_{P2}$ : The efficiency between distinguished groups by the number of people in an enterprise is significantly different.

# $HO_{P2}$ : The efficiency between distinguished groups by the number of people in an enterprise is not significantly different.

The Kruskal Wallis test result  $\chi^2 = 30,165$ , p = 0 < 0,05 allows the rejection of hypothesis **H0**<sub>P2</sub>. The hypothesis **H0**<sub>P2</sub>. The hypothesis **H0**<sub>P2</sub> is accepted, which means that the efficiency level in enterprises with 1 person, 2-4, 5-10, 11-24, 25-49, and 50 people differ significantly in the groups distinguished in this way. Therefore, it is necessary to test the detailed hypotheses regarding the efficiency components in the studied group.

 $H_{P21}$ :  $\mu_{Ee1person} \neq \mu_{Ee2-4people} \neq \mu_{Ee5-10people} \neq \mu_{Ee11-24people} \neq \mu_{Ee25-49people} \neq \mu_{Ee50people}$  $H_{OP21}$ :  $\mu_{Ee1person} = \mu_{Ee2-4people} = \mu_{Ee5-10people} = \mu_{Ee11-24people} = \mu_{Ee25-49people} = \mu_{Ee50people}$  $H_{P21}$ : The economic efficiency between distinguished groups by the number of people in an enterprise is significantly different.

 $HO_{P21}$ : The economic efficiency between distinguished groups by the number of people in an enterprise is not significantly different.

Kruskal Wallis test result  $\chi^2 = 12,684$ , p = 0,027 < 0,05, the **H0**<sub>P21</sub> hypothesis is rejected. The hypothesis **H**<sub>P21</sub> is accepted, which means that the level of economic efficiency in enterprises with 1 person, 2-4, 5-10, 11-24, 25-49 and 50 people differ substantially.

 $H_{P22}: \mu_{Me1person} \neq \mu_{Me2-4people} \neq \mu_{Me5-10people} \neq \mu_{Me11-24people} \neq \mu_{Me25-49people} \neq \mu_{Me50people} \\ HO_{P22}: \mu_{Me1person} = \mu_{Me2-4people} = \mu_{Me5-10people} = \mu_{Me11-24people} = \mu_{Me25-49people} = \mu_{Me50people} \\ HO_{P22}: \mu_{Me1person} = \mu_{Me2-4people} = \mu_{Me5-10people} = \mu_{Me11-24people} = \mu_{Me25-49people} = \mu_{Me50people} \\ HO_{P22}: \mu_{Me1person} = \mu_{Me2-4people} = \mu_{Me5-10people} = \mu_{Me11-24people} = \mu_{Me25-49people} = \mu_{Me50people} \\ HO_{P22}: \mu_{Me1person} = \mu_{Me2-4people} = \mu_{Me5-10people} = \mu_{Me11-24people} = \mu_{Me25-49people} = \mu_{Me50people} \\ HO_{P22}: \mu_{Me1person} = \mu_{Me2-4people} = \mu_{Me5-10people} = \mu_{Me11-24people} = \mu_{Me25-49people} = \mu_{Me50people} \\ HO_{P22}: \mu_{Me1person} = \mu_{Me2-4people} = \mu_{Me5-10people} = \mu_{Me11-24people} = \mu_{Me25-49people} = \mu_{Me50people} \\ HO_{P22}: \mu_{Me1person} = \mu_{Me2-4people} = \mu_{Me5-10people} = \mu_{Me11-24people} = \mu_{Me25-49people} = \mu_{Me50people} \\ HO_{P22}: \mu_{Me1person} = \mu_{Me2-4people} = \mu_{Me5-10people} = \mu_{Me11-24people} = \mu_{Me25-49people} = \mu_{Me50people} \\ HO_{P22}: \mu_{Me1person} = \mu_{Me2-4people} = \mu_{Me5-10people} = \mu_{Me11-24people} = \mu_{Me25-49people} \\ HO_{P22}: \mu_{Me1person} = \mu_{Me2-4people} = \mu_{Me5-10people} = \mu_{Me50people} = \mu_{Me50people} \\ HO_{P22}: \mu_{Me1person} = \mu_{Me2-4people} = \mu_{Me5-10people} = \mu_{Me5-10people} = \mu_{Me5-10people} \\ HO_{P22}: \mu_{P22}: \mu_{P2$ 

 $H_{P22}$ : The manufacturing efficiency between distinguished groups by the number of people in an enterprise is significantly different.

 $H0_{P22}$ : The manufacturing efficiency between distinguished groups by the number of people in an enterprise is not significantly different.

Kruskal Wallis test result  $\chi 2 = 25,202$ , p = 0 < 0,05, the hypothesis **H0P22** is rejected **and** the hypothesis **H**<sub>P22</sub> is accepted. There are statistically significant differences in the average levels of manufacturing efficiency between groups distinguished by the number of people in an enterprise.

 $H_{P23}$ :  $\mu_{En1person} \neq \mu_{En2-4people} \neq \mu_{En5-10people} \neq \mu_{En11-24people} \neq \mu_{En25-49people} \neq \mu_{En50people}$  $H_{0P23}$ :  $\mu_{En1person} = \mu_{En2-4people} = \mu_{En5-10people} = \mu_{En11-24people} = \mu_{En25-49people} = \mu_{En50people}$  $H_{P23}$ : The effectiveness between distinguished groups by the number of people in an enterprise is significantly different.

 $HO_{P23}$ : The effectiveness between distinguished groups by the number of people in an enterprise is not significantly different.

Kruskal Wallis test result  $\chi^2 = 30,815$ , p = 0 < 0,05, the hypothesis **H0P23** is rejected. The hypothesis **H**<sub>P23</sub> is accepted, which means that the level of effectiveness in enterprises with 1, 2-4, 5-10, 11-24, 25-49 and equal to 50 people differs substantially.

# 4.4. Efficiency Triangle Empirical Model in Multidimensional Space

The result of the research is presented in a diagram as the Efficiency Triangle Model (Figure 2) in a multidimensional space for enterprises grouped by their size.



Source: Own elaboration.

To analyse the survey results, we used the hierarchical bottom-up grouping agglomeration algorithm (Table 3). As a result of successive iterations, coordinates were obtained, which are also vertices coordinates of the model elements. The obtained result is presented in the table.

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	1 person	2-4 people	5-10 people	11-24 people	25-49 people	50 people
Economic						
efficiency	0,740814	0,76609	0,80135	0,806159	0,820437	0,775362
Manufacturing						
efficiency	0,735482	0,69806	0,73528	0,757473	0,777344	0,775136
Effectiveness	0,668504	0,63551	0,71860	0,711413	0,798214	0,691304

**Table 3.** Agglomeration algorithm of hierarchical bottom-up grouping

Source: Own elaboration.

To accurately interpret the model, we have decomposed its structure. As shown in Figure 3, it is possible to show the spread in position by the size of an enterprise.



Figure 3. The distance between the selected model vertices for the distinguished groups of enterprises Source: Own elaboration

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#### 4.5. Model validation under pandemic conditions

The literature suggests that, on average, small businesses had less ability to quickly adjust to changes in regulations and demand when the pandemic hit. However, the fragility of small businesses compared to large companies outweighs their higher flexibility (Fairlie et al. 2022). For this reason, we decided to look at the behaviour of small service businesses as a specific market barometer to validate the model. Polish Agency for Enterprise Development, in publication 2020, reports the total number of service sector as 1 047 800 (Polish Agency for Enterprise Development 2020) in 2019, representing 52% of the 2.15 million of the whole business population in Poland. Therefore, determined by the number of 336 returns obtained and the population size, the maximum error of the study was set at 5% with a confidence level of 95% and a fraction size of 0.5.

The research was conducted on entities operating in the first half of 2021. The central hypothesis of the model was re-validated. The variables do not have a normal distribution; Spearman rank correlation was used.

The following correlation coefficient is given between:

- Economic efficiency  $(E_e)$  and Manufacturing efficiency  $(M_e)$ : R = 0,710, p = 0 < 0,01,
- Manufacturing efficiency ( $M_e$ ) and Effectiveness ( $E_n$ ): R = 0,432, p = 0 < 0,01,
- Effectiveness  $(E_n)$  and Economic efficiency  $(E_e)$ : R = 0,444, p = 0 < 0,01,
- Effectiveness  $(E_n)$  and Efficiency  $(E_f)$ : R = 0835, p = 0 < 0.01,
- Manufacturing efficiency  $(M_e)$  and Efficiency  $(E_f)$ : R = 0,710, p = 0 < 0,01,
- Economic efficiency ( $E_e$ ) and Efficiency ( $E_f$ ): R = 0,762, p = 0 < 0,01,

The hypothesis  $H0_{P0}$  should be rejected in favour of  $H_{P0}$ . Hence, it should be assumed that there is a statistically significant mutual relationship between the elements of the model: economy, efficiency and efficiency. The result obtained confirms the validity of the model.

## 5. Discussion

The deductive approach allowed us to create a theoretical model of efficiency based on the construct of a mathematical model. The research showed that the survey questionnaire was accurate and reliable, and the research sample was representative. The scope of the study was consistent with the purpose of the article. Selected enterprises carried out various activities and represented multiple industries and profiles according to the classification of activities. The respondents were assumed to be only owners of small and medium enterprises whose organisations have been operating on the market for more than four years.

The methodological value of this work includes the development of the model itself and its validation utilising quantitative research and the use of the hierarchical clustering algorithm. The construction of the model is based on a comprehensive approach, consisting of three elements, and it should be emphasised that it has yet to exist in literature. Model validation was performed in a turbulent pandemic environment. As other researchers have shown (Zhang et al. 2022), the development of work-from-home as a positive outcome and 'creative destruction' during the pandemic helped small businesses perform better through industry change and continue to shine after the end of stay-at-home orders. Research shows that the surrounding environment can determine the effectiveness of an SME's approach to less common types of change, such as a global economic recession triggered by a worldwide public health problem (Dejardin et al. 2022).

Our work meets the needs of business practice by proposing a theoretical model that has been tested in a turbulent environment.

Our empirical findings are consistent with our initial expectations and support the hypotheses drawn from our theoretical framework. Our analysis shows critical conclusions. Firstly, verification of the research hypotheses concerning the assumptions of the Efficiency Triangle Model showed that the empirical model coincided with the conceptual model. Secondly, the research's conclusion indicates that the Efficiency Triangle Model is correct, and the study proved that it is a verified model. Thirdly, it can be presumed that the efficiency level in commercial, service, production and mixed micro and small enterprises differs. Fifth, from the point of view of manufacturing efficiency, the size of an enterprise is also irrelevant because, from a general point of view, the efficiency of resource utilisation is essential.

## 5.1. Limitations

The aim of the study was achieved, but there were numerous limitations, mainly due to the methodological approach adopted and the data analysis techniques used. The detailed limitations are listed below.

The first limitation is a limited area of coverage. We conducted preliminary qualitative research throughout Poland on 76 business entities. The quantitative analysis covers 455 enterprises. In the case of approximately 2 million enterprises in Poland, this is a representative but still a tiny percentage. Therefore, the authors presented an extended study based on an additional sample of 336 service companies in a pandemic. The result confirms assumptions made at the stage of selecting the research sample. It allows for formulating a thesis about the broader universality of confirmed regularities in a changing environment.

The second limitation is subjectivism inherent in the specificity of research conducted in all fields of social sciences. The deductive and hybrid of naturalistic and anti-naturalistic approaches only eliminate some shortcomings. Qualitative and quantitative research has created a wide area of subjectivism for both subjects and researchers. The interviews with entrepreneurs provided a particular image of a subjective assessment of their experiences specific to the Polish market. Measurement scales allowed one to examine the foundations of entrepreneurs for specific areas, but the interpretation of point values was based on their subjective feelings. However, the negative impact has been minimised by strictly adhering to the stages of research proceedings in empirical sciences. The purpose of conducting quantitative research as a supplement to truncated qualitative study was to eliminate the disadvantages related to subjectivity.

## 5.2. Future research

To increase the universality, the model could be checked on other types of enterprises in post-pandemic reality. Therefore, the dynamic approach to efficiency could be applied in the future.

Despite the diligence and scope of the study presented in this article, issues of universal measures of the efficiency and method of their measurement in four sectors: micro, small, medium and large enterprises were not discussed. After verifying this model in the large enterprise sector, it will be possible to propose efficiency measures. Further research will concern the measurement of efficiency at time t as point.

 $E_f = (E_e, M_e, E_n)$ t in the Cartesian frame of reference (three-dimensional space).

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Considering the replication of the result, it is advisable to repeat the quantitative research using the same measurement tools in other world economies. Repetition check is significant for generating a new theory. It would be worth conducting research at a higher significance level of a representative random sample.

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Agnieszka PARKITNA ORCID ID: 0000-0002-8546-399X

Magdalena GĄDEK ORCID ID: 0000-0002-7153-8022

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**Open Access** 6

## **RISK MANAGEMENT IN A HUMAN RESOURCES INFORMATION SYSTEM<sup>\*</sup>**

Clarivate Analytics

Gabriel Koman<sup>1</sup>, Dominika Toman<sup>2</sup>, Radoslav Jankal<sup>3</sup>, Patrik Boršoš<sup>4</sup>

<sup>1,2,3,4</sup> Department of Managerial Theories, Faculty of Management Science, and Informatics, University of Žilina in Žilina, Univerzitná 8215/1, 010 26 Žilina, Slovakia

*E-mails:* <sup>1</sup> <u>gabriel.koman@fri.uniza.sk;</u> <sup>2</sup> <u>dominika.tumova@uniza.sk;</u> <sup>3</sup> <u>radoslav.jankal@fri.uniza.sk;</u> <sup>4</sup> patrik.borsos@fri.uniza.sk

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Abstract. Employee recruitment is among the most critical processes performed in businesses. Nowadays, it is more and more frequently implemented online. Companies switch to e-recruitment, utilising information and communication technologies (ICT). This article aims to identify the risks emerging while implementing such a solution and set the risk management steps to sustain the business's long-term operation. The analysis is based on secondary as well as primary data. Multiple methods were applied: observation, questionnaire survey, semi-structured interviews, case study analysis, comparison, and synthesis. The authors' original case study was created to reduce employee turnover via a new approach to the recruitment process. Research questions and hypotheses focus on examining the relationship between the length of the employee's employment and how they were approached in the recruitment process. The main findings include identifying key potential risks jeopardising the implementation of e-recruitment. The analysis concluded that no employee recruitment step in the selected business is performed online. The practical result of this research included the creation of the business's career website. This can inform the potential applicants about the business's activities. It was created to support individual activities of the employee recruitment process. Finally, recommendations were designed for the managers of other companies. They can use these in implementing ICT solutions for the recruitment process to support long-term sustainability.

Keywords: human resources information system; information and communication technologies; ICT; human resources; HR; recruitment; risks; sustainability; case study

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#### 1. Introduction

The applied motivational tools are analysed when assessing the loyalty of employees of individual businesses. In addition to financial motivation tools (such as salary), there are also working atmosphere and the work team, team-building activities, or parties of the employees of the given businesses. However, the first impression is judged to a minimal extent. The first impression can be understood as a springboard for the future loyalty of each employee (Varmus et al., 2022). This key element is primarily based on the applicant's first contact with the given business. Contact can be made via social networks, websites, or advertising on posters. Approaching applicants by any means is the most critical element in the recruitment process of any business.

In the current digital age, it is possible to solve most processes using ICT and information systems (Soviar et al., 2017; Snieska et al., 2020; Eom et al., 2022). It is the same with the recruitment process. However, the correct implementation of these technologies is important. Ferenc et al. (2017) reported that each implementation strategy must be based on the business's current situation. Since these situations change quickly, various risks can arise during the proposal's implementation. The purpose of this article is to identify risks related to the performance of ICT in the recruitment process. Due to the identification, it is possible to design and implement measures that minimise the negative impacts of risks. Identifying potential risks, even before the implementation of erecruitment, allows the business to react quickly to the emergence of potential problems.

## 2. Review of literature

Recruiting employees is one of the most critical processes of any company. This process can be defined as searching for applicants and selecting employees for a specific job in the company (Blašková, 2003; Koubek, 2007). **Employee recruitment** aims to attract the best applicants for a given job (Armstrong et al., 2015; Joniaková, 2016). One specific employee who meets the set criteria will then be selected from the pool of possible candidates (Kisi, 2022). Recruiting can also be understood as a process consisting of two parts: (1) acquiring and (2) selecting employees. Individual aspects of recruitment are subsequently composed of several activities (Koubek, 2007).

#### Acquisition of employees

Several authors (Blašková, 2003; Hittmár, Parnell et al., 2021) agree that acquiring employees consists of the following activities:

- Identification of resources;
- Selection of methods of acquiring employees;
- Selection of documents required from applicants;
- Formulation and publication of a job opportunity offer;
- Preliminary selection and classification of successful applicants.

**The acquisition is** attracting the attention of applicants who are suitable for a given job. At the same time, they should be sufficiently motivated to become part of the given business and perform the required work duties (Holcner et al., 2021). When acquiring employees, several options relate to the internal and external environment (Hitka, 2018).

When acquiring employees from the business's internal environment, it can be, for example, advertising job offers on its intranet pages, in magazines, employee rotation, and similar methods. On the other hand, from the external environment, it is the recommendations by colleagues, the employment of direct applicants, using head hunters, and with the help of their career page or online career portals (Walas-Trebacz, 2022). It does not matter which acquisition method the business uses, but it is always necessary to present the job position honestly and

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objectively to the applicants (Buckley et al., 1998). The process ends with sorting applicants into successful and unsuccessful ones (Dvořáková et al., 2012).

## **Selection of employees**

The second activity of employee recruitment is **the selection of employees**. This is related to the previous step, which was acquiring employees. The authors define employee selection (Čihovská et al., 2007; Zhao et al., 2019; Ghani et al., 2022; Kisi, 2022) as a process during which the company makes decisions based on specific criteria for the most suitable potential employee for a specific position. Just like acquiring employees, this process also consists of other activities (Vaverčáková and Hromková, 2018):

- Detailed analysis of applicants' written documents;
- Preliminary (courtesy) interview;
- Testing the work capacity and potential of applicants;
- Selection interview;
- Summarising the results, deciding on applicants' selection, and informing them about the result.

In selecting employees, the decisive activity is **the testing of applicants**. It can be, for example, (1) intelligence tests, (2) ability tests, or (3) personality tests (Šikýř, 2012). However, there are other ways of verifying abilities (Potocnik et al., 2021), such as tests of verbal maturity, administrative tasks, control process, numerical intelligence, spatial thinking and imagination, reasoning of applicants, or physical testing.

Another important activity is **the admission interview**. The purpose of such an interview is to obtain and evaluate various information about the applicants, based on which it is possible to predict their performance in the given job (Sands et al., 2022). The final selection of the applicant means that the given applicant best meets the predefined criteria from the pool of all applicants. His/her knowledge and skills are sufficient to perform the given job. At the same time, the business sees the candidate's potential for maximising knowledge, which can contribute to the development of the entire business.

#### **Risks in the recruitment process**

The process of recruiting employees is also associated with **risks** that have an impact not only on the personnel department but also on the entire business. Since people are the most crucial element of any business, the failure of an individual can sometimes mean the collapse of the whole company.

The business could risk becoming non-innovative without hiring new employees from the external environment. As a result, the company would not generate new ideas or expertise, and the rate of innovation would stay the same. Other possible risks associated with the recruitment of employees can be, for example, the need for more interest of qualified applicants in a job offer, the employee not identifying with the business culture, the employee not taking a job, etc. (Sobocka-Szczapa, 2021).

#### Human resources information system

Human resources information system (HRIS) can be defined as an information system that ensures effective work in human resources (HR). Such a system's essence is providing information for the implementation of personnel processes in sufficient content, scope, quality, and time (Vrabcová, Urbancová, 2021; Staffenova, Kucharcikova, 2022). **HRIS** aims to support personnel department employees with effective HR management. (Hittmár et al., 2013). Koubek (2007) lists the four basic HRIS modules: (1) information about employees, (2) information about jobs, (3) information about personnel processes, and (4) information about the external conditions of the business in relation to the personnel department. Each of these modules is unique and contains specific information (Lambert et al., 2000):

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**1. The employee information module** manages all information about people in the business. These are, for example, personal identification numbers, work function, the nature of the employment relationship, education and qualifications or career-related data, remuneration, employee benefits, attendance and the like;

**2. The job information module** provides information regarding the work activities of the given employee. This includes, for example, information about the place of work; job position characteristics; requirements for the employee who holds this job position; organisational classification and relationships within the organisational structure and the like;

**3. The module of information on personnel processes** describes the operations of all personnel processes of the business. This includes, for example, job analysis, planning, recruitment, evaluation, training, compensation, employee care and the like. In addition, it also provides information on labour standards, whether it is a work order, a collective agreement, records of conflicts, etc.;

**4. The information module on external conditions** focuses on the situation in the labour market. Information is kept on the minimum and average wages, the state and development of the population, or competition on the market and the like.

Nowadays, more and more processes, including personnel processes, are performed with the help of ICT. In such a case, we talk about the e-personalistics. **E-personalistics** can, therefore, be defined as an application of electronic personalistics which helps in the effective management of personnel processes. Hittmár (2013) lists several types of e-personalistics: e-reporting, e-attendance, e-learning, e-benefits, e-assessment, and e-recruiting. One of the most important types for supporting personnel management in a business is e-recruitment.

The essence of **e-recruitment** is that it involves recruiting employees in the online space (Sirkemaa, 2017; Gilch, Sieweke, 2021). In this case, the employees of the HR department use the online space for some recruitment process activities. For example, they post job offers on social networks (Spahrkas et al., 2021), conduct a job interview using a video call (Sands, Arnold, 2022; Wolff, Burrows, 2021), or introduce various chatbots to communicate with the applicants (Koivunen et al., 2022), etc.

#### Business sustainability achieved via an optimally set employee recruitment process

Views on corporate sustainability vary. Some authors look at it via an environmental and financial prism, while others look at it via a technological prism. However, this article focuses on **personnel sustainability**.

The sustainability of the business can also be described regarding HR and the processes of working with people that take place in the company. It is possible to implement a sustainable strategy by understanding the role of human resources (HR) and the correct setting of activities (Sode, Chenji, 2022). Research of 513 companies from Greece confirms that the development of human resources with a focus on strategic flexibility and innovation contributes to achieving the sustainability of the business (Kafetzopoulos, 2022). The results show that the development of human resources affects environmental dynamics, thereby supporting sustainability. Other findings point to the critical positive impact of HR practices and theories on achieving business sustainability (Dwivedi, Chaturvedi, Vashist, 2021).

Using digitisation elements in HR management reflects globalisation and a turbulent environment (Melnychenko, Lositska, Bieliaieva, 2022). This aspect also contributes to setting the personnel sustainability of the business. To achieve personnel sustainability, and thus the sustainability of human resource management (HRM), it is necessary to focus on the motivation of employees and their willingness to commit to long-term progress (Lubis, Pratama, Safrida, 2023). Only if employees and managers are convinced of the positive impact of development, understand the meaning of HRM activities, and are willing to take risks associated with implementing new solutions can the sustainability of the business be achieved. The theme of personnel sustainability is also connected with the use of HR in helping to set up socially responsible business management. As part of further research, HR policies and procedures in 46 multinational companies were analysed. The analysis resulted in

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several recommendations for supporting responsible management to achieve the company's sustainability (Baek, Kim, 2021).

**The gap** in the current literature, addressed by the article's authors, is characterised by the interconnectedness of the areas described in this chapter. These are the areas of recruitment and selection of employees, risk management, implementation of information systems in HR, and support of business sustainability. The gap can be described as the impact of information systems and ICT tools on the efficiency of the business's employee recruitment process. This relationship ensures that the sustainability of the business, as well as the sustainability of the process of recruiting employees, are supported. When controlling the recruitment process using an ICT tool, it is necessary to identify and manage the potential risks associated with implementing the selected technical solution. For the business to be sustainable in the long term, it needs regular addition of new employees to its personnel structure. Regularly adding the required employees will be effective via applying ICT in HR.

## 3. Methodology

The article consists of two parts. The first part evaluates the longitudinal research conducted between September 1, 2020, and November 30, 2021. Several methods of data acquisition were used in this research. Both primary and secondary data were collected. Observation, questionnaire survey, and semi-structured interviews were used to obtain primary data. Three in-depth interviews were conducted. The first two were related to staff recruitment and took place with two branch managers. The third interview was conducted with the company manager, who presented his perspective on the analysed issue. These methods were implemented in the environment of one specific company. For the article, the company will be called ABC, because it requested anonymity (so that the results of the analyses do not give a competitive advantage to other companies in the same market). Since it is a detailed analysis of the conditions of one company, our case study was created based on the results.

On the other hand, secondary data was obtained using case studies, that is, by analysing other case studies. In this case, qualitative case studies of two businesses were evaluated. The companies were selected based on the following criteria: 1) the companies must have implemented ICT-enabled recruitment, and 2) the companies must be perceived, at least in Slovakia (preferably internationally), as solid employer brands.

The second part of the article focuses on identifying risks associated with implementing the proposed solution. A necessary step was selecting a method for risk mapping and visualisation. The critical path method (CPM) has been used as a valuable tool to assess time-related risks (Olivieri et al., 2019; Kusumadarma et al., 2020; Ramani et al., 2022). Several authors also use CPM in risk management (Nguyen et al., 2018; Mohamed et al., 2022). The method mentioned above was also used by Song et al., who used the critical path as an entry point for managing and coordinating individual project activities (2021). The results of their research show that the presented method is significantly better than the breadth-first search algorithm. The above testifies to the appropriate use of CPM for this article.

CPM is a project management technique used to determine the longest sequence of activities required to complete a project. It helps identify time-critical activities, meaning that any delay in these activities will directly impact the overall project schedule. The critical path method identifies potential timing risks and bottlenecks, allowing better planning and risk mitigation strategy preparation (Armstrong-Wright, 1969). Project management is considered a key element in many service and productivity projects. The results are particularly noticeable in large projects limited by the schedule (Ahmad, 2020). CPM includes the following steps:

• **Defining the project's scope:** Establishing the project's goals, tasks, and outputs. This provides a basis for determining the actions that need to be taken;

• Identification of all project activities: Dividing the project into individual activities that need to be performed;

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• **Determining dependencies between activities:** Determining relationships between individual activities. Some actions may need to be completed before others can begin, creating dependencies;

• Estimating the duration of activities: Assigning a time plan for each activity based on historical data, expert opinions, or other reliable sources. It is essential to consider factors such as resource availability, dependencies and potential risks;

• **Building a network diagram:** Creating a visual representation of project activities and their dependencies using nodes (representing activities) and arrows (representing dependencies);

• Calculating the earliest start and end times: It is necessary to start by assigning the earliest start time of the initial activity (t = 0). Based on the duration of the activity, the earliest start and end times for each subsequent action are then calculated;

• Calculating the latest start and end times: In this case, on the contrary, it is necessary to start with the endpoint of the last activity or the entire project and work backwards, determining the latest start and end times for each activity. This helps determine flexibility within the project timeline;

• **Determining the critical path:** The critical path is the longest sequence of activities that must be performed to complete the project on time. It consists of activities with zero margin or flexibility, which means that any delay in these activities will cause a delay in the completion of the whole project;

• Analysing the critical path: By focusing on the critical path, potential risks and bottlenecks can be identified. Delay or disruption of any activity on the critical path poses the greatest threat to the project schedule.

By applying the critical path method in assessing the time risks associated with the implementation of the proposed solution, this article aims to provide insight into potential problem areas and help develop strategies to minimise or mitigate the negative impact of these risks.

#### Observation

The observation in the ABC company lasted for about a year. The authorised researcher was part of a team within the ABC company focusing on examining the performance of personnel activities, primarily recruiting new employees. The observation aimed to gain an overview of the company's employee recruitment procedures, identify possible areas for improvement and provide recommendations based on the findings. Observation and analysis of personnel activities have to focus on the hiring process in the analysed business. Therefore, the the following sub-objectives were set:

- Gain a comprehensive knowledge of existing employee recruitment procedures;
- Identify strengths and weaknesses within the recruitment process;
- Evaluate the effectiveness of recruitment strategies in obtaining and selecting qualified candidates;
- Assess the level of compliance with fair employment practices and legal requirements.

The research design of this observation was predominantly qualitative, with an emphasis on direct observation of recruitment-related personnel activities. The researcher worked closely with the HR department and other relevant teams involved in the recruitment process. The following methods were used in data collection:

• **Direct observation:** The researcher actively observed and recorded recruitment activities, including applicant screening, selection, interviewing and selection procedures. This included shadowing HR staff, attending recruitment meetings, and watching various stages of the process;

• Document analysis: Various recruitment-related documents such as job offers, application forms, interview guides, and assessment criteria were collected and analysed to gain insight into the business's recruitment practices;

• **Interviews:** Structured interviews were conducted with key personnel involved in the recruitment process, including HR managers, recruiters, hiring managers, and selected applicants. These interviews aimed to obtain additional information, insights and feedback about the recruitment process.

The obtained data were subsequently analysed in two ways:

• Thematic analysis: identified and categorised vital themes and patterns related to the recruitment process;

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• **Quantitative analysis:** quantitative data such as recruitment indicators (e.g., time to fill a position, applicant diversity, etc.) were also analysed to provide complementary insights and support the qualitative findings.

A vital element of the observation was the ethical aspects, such as the prior consent of the participants involved in the interviews and the anonymised identity of the participants to maintain the confidentiality of the information provided.

### Questionnaire survey

The questionnaire survey aimed to supplement the study's qualitative aspect by obtaining data from a sample of employees. 128 employees of the ABC company were involved in the questionnaire survey. With the total population size (185), the error rate was 4.82% for the collected 128 answers. The questionnaire survey was designed in such a way that it was possible to:

• Obtain quantitative data to supplement qualitative findings obtained from direct observation and interviews;

• Assess the perception and experience of employees regarding personnel activities with a focus on the recruitment process;

• Measure employee satisfaction and feedback on various aspects of recruitment, such as communication, fairness and applicant experience;

• Identify potential areas for improvement and gather suggestions for improving the recruitment process.

The questionnaire was designed to obtain information related to the research objectives. At the same time, the questions were formulated to reflect various aspects of the recruitment process (including communication, fairness, and satisfaction). The questionnaire consisted of a combination of closed and open questions. Closed questions used Likert scales, multiple-choice formats, and rank ordering to facilitate quantitative data collection. Open questions allowed respondents to provide detailed explanations, suggestions, and comments. This is how quantitative data has been collected by several authors of peer-reviewed articles (Buchelt et al., 2020; Moreno-Garcia et al., 2022; Boari, Ruscone, 2015; Feijo et al., 2020).

A pilot survey was conducted with four employees to test the questionnaire's comprehensibility, validity, and reliability. Feedback from the pilot testing was used to refine the questionnaire. Respondents were given a tablet to fill out the electronic questionnaire anonymously. The collected survey data were analysed using statistical techniques appropriate to the research objectives—basic statistics such as relative and absolute frequencies were calculated to summarise responses. The collected data were analysed using appropriate statistical methods such as independence tests. Other authors frequently use these in their studies (e.g., Varmus et al., 2022).

## Case study method

The companies Jysk and Lidl were selected for the case study based on the following criteria: (1) award of the best employer in Slovakia, but also abroad, (2) transparency of general information, (3) willingness to cooperate with the research team, and provision of internal documents for inspection. Data collection was performed at two levels:

• Review publicly available information, including annual reports, company websites, industry publications, and news articles. This helped to understand the history of companies, their organisational structures, and strategies, but mainly helped with an in-depth analysis of recruitment issues, whether it is communication with applicants, posting job offers, applying online channels, etc.

• Analysis of internal documents provided by selected companies and addition of information based on unstructured interviews.

The obtained data were subjected to a thematic analysis. Key themes and processes were identified, categorised and compared between Lidl and Jysk. This analysis helped reveal the similarities, differences, and unique characteristics of the recruitment process of both businesses.

#### **Research Questions and Hypotheses**

Specific research questions were defined in relation to the analysed area, which the researchers followed up on. During the application of the methods, answers were sought, and subsequently, the research hypotheses were verified during the data evaluation. The defined questions include the following ones:

- Q1: How is the recruitment process for new applicants performed?
- Q<sub>2</sub>: Are online platforms used in the recruitment process?
- Q<sub>3</sub>: What are the methods of informing applicants about job offers?
- Q<sub>4</sub>: Do applicants look for job offers on social networks?

As mentioned above, for the need for a structured examination of the context, two research hypotheses were defined. The first  $(H_1)$  is related to the length of employment and the recruitment method; the specific wording is: There is a relationship between the length of employment of employees in the business and how they were approached in the recruitment process.

The second hypothesis  $(H_2)$  is related to the use of social networks and the efficiency of the job search process. The specific wording is: There is a relationship between whether employees regularly use social media to search for work and whether they consider this process effective.

#### 4. Results

The research was focused on the field of human resources. In this area, a problem was defined in the ABC company, which consisted of the high turnover of employees. In the past, the company tried to reduce turnover by increasing employee motivation. Although the implemented solution ensured a specific decrease in the turnover rate, it was not to such an extent that it was possible to claim that the given problem was fully eliminated. Therefore, it was necessary to propose a solution that would increase the motivation of employees right from the beginning of their work for the business. The recruitment process's professionalism has the most significant impact during this period. **The recruitment process** was thus determined as a problem area of the research part.

#### Analysis of secondary data

Secondary data was linked to two case studies related to staff recruitment. These were explicitly chosen cases of two multinational companies, namely JYSK s. r. o. and Lidl Slovak Republic v. o. s. As recruiting employees may differ in individual countries, it is necessary to point out that these case studies focus on the territory of the Slovak Republic. This was the main reason for the deliberate selection of the mentioned companies. The JYSK company appears on the market as a retailer with Scandinavian roots, which offers its customers solutions focused on two fundamental areas of life. The company's very motto represents these areas: "Scandinavian Sleeping & Living" (Jysk website, 2023). The second company is Lidl. It is one of Slovakia's largest retail chains and abroad. Together with the Kaufland chain, they belong to the German Schwarz-Gruppe group (Lidl website, 2023).

#### Case study: JYSK s. r. o.

In addition to a commercial website, the company also operates a career website that is focused directly on the recruitment process (webpage – Kariéra Jysk, 2023). The domain of this website is kariera.jysk.sk in Slovakia. The main menu of the career page is divided into several sub-pages: (1) stores, (2) customer service department, (3) about the JYSK company, (4) JYSK headquarters for the Czech and Slovak Republics. This way, the company communicates with potential applicants and builds its name as a TOP employer. Job offers are also published on this page. These are available on web career portals (Profesia, 2023; Kariéra – zoznam, 2023) and social networks (LinkedIn – Jysk, 2023; Facebook – Jysk, 2023).

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However, the company does not only use the online space and ICT for communication with potential applicants. A more significant part of the employee recruitment process takes place with the help of their own HRIS, which supports the management of this process. Due to this information system, some activities take place online, thus reducing the costs of their implementation. In Figure 1, employee recruitment processes in the JYSK company online can be seen (green colour).



Figure 1. The use of ICT in the process of recruiting employees in the JYSK company

JYSK conducts most of its recruitment activities online using various ICTs. They contribute to the faster implementation of this process and to the improvement of the selection of employees.

#### Case study: Lidl Slovak Republic v. o. s.

Like the company JYSK s. r. o. also, Lidl Slovak Republic v.o.s. publishes job offers online. It also operates its career website, available to the public under the domain kariera.lidl.sk (webpage – Lidl Career, 2023). The website consists of six main parts, further divided into sub-pages. Information for potential applicants is also published here. The difference from the JYSK website is that potential applicants can create their accounts on this website. People can upload, for example, a CV to the account, a cover letter and other documents.

With the help of this page, applicants can also apply directly for a published job vacancy. Even the testing of applicants takes place directly on this page. Two types of tests are completed here: (1) cognitive tests and (2) tests of numerical intelligence. Based on the mentioned tests, the employee of the HR department decides whether to advance the applicant to the next round of recruitment or reject him/her.

The entire process of recruiting employees in Lidl Slovak Republic is shown in the following image. In this case, it concerns recruiting an employee for the job position of shop director. The individual steps of this process may differ for every recruitment; it depends on the job position for which the applicant applied.

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Figure 2. The use of ICT in the recruitment process in Lidl Slovak Republic v. o. s.

In Figure 2, after passing the testing, a job interview with an employee of the HR department follows. Subsequently, another round of testing takes place, Assessment Centre (AC). This type of testing takes place in the form of role-playing games. The last step is a job interview with the company's operations manager. As can be seen, all the mentioned steps of recruiting employees are performed **strictly online**.

#### Analysis of primary data – ABC company

The primary data was tied to the chosen ABC company, for which the authors subsequently proposed a career website. (This company will not be explicitly named for anonymity. They have particular know-how of business activities that ensures they are unrivalled in the market.) The company in question focuses primarily on the goods inventory (hereinafter referred to as "INV") in various retail chains. The company's headquarters is in Nitra; other branches are in Banská Bystrica – Zvolen, Žilina and Rimavská Sobota. The ABC mainly employs students based on an agreement on part-time student work, which is why it ranks among small businesses. The business provides part-time work to 185 employees, mainly students, mothers on maternity leave, and working citizens. The ABC employs only 10 to 19 employees on a permanent employment contract.

#### **Observation results**

During the observation, it was possible to see that recruiting employees is approached differently in individual branches of the ABC company. While in the Banská Bystrica – Zvolen branch, the recruitment of employees is carried out primarily via the recommendation by colleagues, in the Rimavská Sobota branch, recruitment of employees takes place almost exclusively via advertisements on social networks. It is also different at the branch in Nitra. Career websites such as *profesia.sk* (2023) or *kariera.zoznam.sk* (2023) are also coming to the fore there.

The individual parts of the recruitment process are different too. While in Nitra, every employee goes through a job interview, in Banská Bystrica and Zvolen, the job interview is an exception. It is, therefore, challenging to talk about a uniform recruitment process.

Table 1 shows the individual parts of employee recruitment defined by Blašková (2003). These parts have been supplemented with information on whether the ABC company carries out the given activities and, if so, to what extent and in which branches.

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Table 1. Identification of the im	plemented activities of the recruitmen	t process in the business
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Activity	Implementation	Form of implementation
Identification of sources of human potential	yes	Computing technology based on the forecast of employment of orders by the business's employees.
Choice of methods of recruiting employees and management staff	yes	The activity is entirely in the hands of the recruiter, and there is no directive for this activity.
Choice of documents required from applicants	no	-
Formulation and publication of a job offer	yes	The activity is entirely in the hands of the recruiter, and there is no directive for this activity.
Ongoing selection and classification of applicants' success	no	_
Evaluation of the effectiveness and feedback of the acquisition process	no	-
Detailed analysis of applicants' written documents	no	_
Preliminary courtesy call	no	_
Testing the work capacity and potential of applicants	no	_
Selection interview	partly yes	The activity is entirely in the hands of the recruiter, and there is no directive for this activity. However, the admission interview is not carried out to a large extent.
Summarising the results, deciding on the selection, and informing the applicants based on personal feeling	no	The recruiter makes the decision alone.
Evaluation of effectiveness and feedback of the selection process	no	_

The ABC company does not implement several steps in the recruitment of employees (Table 4). It is also evident that even in the parts that individual recruiters implement, they have their activities and do not follow any standard directive or template. Another conclusion is that none of the employee recruitment steps in the company are examined online.

#### **Results of a questionnaire survey**

One of the questionnaire survey questions focused on **how the respondent learned about a possible job in the ABC company**. Up to 65% of respondents answered that they learned about the job from a friend or acquaintance who works or has worked for the business. The most common method of recruiting employees is, therefore, the recommendation by a colleague. Only 35% of respondents chose the option of online recruitment. In comparison, 30% stated that they found out about the given business due to advertising on social networks, and only 5% of the respondents used a career web portal (see Figure 3).



Figure 3. Methods of informing applicants about job offers in the selected business

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Another question dealt with **the frequency of searching for job offers on social networks**. Only 30% of the total number of respondents who selected the social network option in the previous question were involved in this question. There were 38 respondents out of 128. Up to 87% of respondents answered positively, while 61% answered that they often seek work via social networks. 18% only look at job offers posted on social networks occasionally. And 8% of respondents are even part of groups focused on these advertisements. Only 13% of respondents do not search for job offers on social networks (see Figure 4).



Figure 4. Searching for job offers on social networks

Based on this information, it is possible to evaluate that applicants for job offers have a habit of searching for job offers on social networks. However, since the recruitment rate of such applicants is meagre, it is possible to assume with significant probability that the ABC company needs to make more efforts for e-recruitment. Another essential piece of information emerged from the questionnaire survey: the respondents consider introducing a career website to support the recruitment of employees an excellent idea.

Statistical evaluation of the analysed relationships

The conducted Chi-square test aimed to examine two hypotheses regarding the relationship between different variables in the recruitment process. The results showed that the first hypothesis H1 was confirmed, according to which there is a relationship between the length of employment of employees in the company and how they are approached in the recruitment process (Table 2). The test result is  $X^2 = 7.273$ , with a P-value of 0.026. All respondents involved in the questionnaire survey (n = 128) were included in evaluating the subject hypothesis.

	Hypothesis H <sub>1</sub>	Hypothesis H <sub>2</sub>				
Test statistic:	$X^2 = 7.273$	$X^2 = 18.153$				
Critical value @ 5%:	C = 5.991	C = 21.026				
Significant*	yes	no				
P-value:	0.026	0.111				
$*X^2 > C = yes; X^2 < C = no$						

Table 2.	Chi-square	test results
I abic 2.	CIII-square	test results

The findings show that how the employee was approached during the recruitment process has a statistically significant effect on the length of employment in the ABC company. This means that the length of their tenure in the company is related to how the employees were addressed. But it also shows that this aspect affects the sustainable setting of the recruitment process. When setting the company's sustainability in relation to employees and their loyalty, it is necessary to emphasise the recruitment method.

Subsequently, a pivot table was also created, where the specific frequencies of the individual options, which the respondents marked for the questions, are listed (Table 3). The option with the highest frequency of marking: *"A friend who also works/worked at the company"* is highlighted in orange. It is possible to state that the respondents use the referral program the most, while it is one of the most expensive forms of employee

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recruitment. It is also possible to state that, even though the ABC company uses a career website, its benefit can only be identified in relation to 5% of hired employees (green colour in Table 3).

	1-3 months		Over 3	8 months	Together	
	Freq.	[%]	Freq.	[%]	Freq.	[%]
Social networks	19	22	19	45	38	30
A friend who also works/worked	62	72	21	50	83	65
at the company						
Career web portal	5	6	2	5	7	5
Total sum	86	67	42	33	128	100

#### Table 3. Chi-square test results

On the other hand, the second hypothesis  $H_2$ , which examined whether there is a relationship between the respondents' regular use of social media when looking for a job and their perception of the effectiveness of this process, **was not confirmed** (Table 2). Those respondents who were approached via social networks in the recruitment process (n = 38) were included in the evaluation of the second hypothesis.

The study found no significant relationship between the respondents' regular use of social media in their job search and their perception of the effectiveness of this process. The assumption that individuals who frequently use social media for job search tend to perceive the process as more effective than those who do not rely on social media for job search activities was not confirmed. This finding does not support the potential benefits of incorporating social media platforms into the recruitment process. Businesses should combine these platforms with a career website to attract and engage potential candidates effectively.

#### 5. Recommendations and discussion

Based on the research (specifically, primary data analysis), creating a career website supporting **the recruitment process** management at ABC company was recommended. This and similar methods of streamlining the staff recruitment process are also supported by Mhamdi et al. (2022). The secondary data analysis also confirms the importance of using different ICTs in recruitment. The example of the JYSK company confirms that the selection of employees is more effective with such technologies. From a long-term point of view, effective recruitment of suitable applicants impacts the support of sustainable business. Fluctuation is reduced, employees share their ideas and thoughts, bringing value to the company, etc.

Based on the findings from the analysis of primary data (the current situation of the company ABC) and secondary data (examples of best practices), recommendations for the creation of the website were created. The website should primarily communicate with potential job applicants in the business, i.e., creating a mutual relationship. Top management should also support this (Liu, Chua, Hu, 2021). The proposal is for the website to be split into two parts. In the first part, it would be about publicly available pages. These include *Home, About Us, Work, Q&A, Login, Blog.* All these sub-pages should deal with informing site visitors about the company, job offers, subject of activity, and the like. This will likely attract potential applicants with the skills and abilities necessary to fill open positions, contributing to a sustainable recruitment process.

The second part of the website should be the pages that are not visible to the public. These are sites where the recruitment process would take place directly. The applicant reaches them via email, which he/she receives automatically after sending a job application to the company. These pages include *Welcome to Us, CV, Test, and Video questionnaire*. All these non-public pages should support the individual steps of the recruitment process, whether it is collecting documents, testing applicants, or a job interview. At the same time, it is suggested that a chatbot is available on all pages, in which it is recommended to install artificial intelligence. Due to this solution,

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communication with site visitors will be simplified and more effective. It is artificial intelligence that can answer almost all questions and thus reduce the burden on recruitment staff, which leads to the support of the company's sustainability.

As part of a project solution, such as **implementing a website to support the staff recruitment process**, it would be necessary to define sub-phases. Within them, it is also essential to identify individual activities that must be performed to achieve the project's goal, like how the steps were placed in the analysis of the Lidl example (Figure 2). Individual phases, as well as activities, are shown in Figure 5.



Figure 5. The process of implementing the proposed solution and identifying possible risks

As shown in Figure 5, certain risks (indicated by red triangles) are associated with implementing such a project in the company. These can occur in several phases of implementation, such as:

- Defining the problem and goals of the project;
- Evaluation of the weaknesses of the staff recruitment process;
- Defining the requirements of the solution by the company;
- Evaluation and definition of the main activities of the recruitment process;
- Creation of a website;
- Connection with the system for recruiting employees;
- Implementation of the website;
- Initial training of company employees.

One of the most significant risks is **non-compliance with the project schedule** (Acebes et al., 2022). As a result, financial costs for the entire project may increase. Risks must be identified and managed (Buganova et al., 2023). As part of management-related activities, risks can be measured using several methods and indices (Jia, Li, 2022). The necessity of risk management is highlighted by Trzeciak (2021).

To minimise the identified risk, it is necessary to clearly define the project's critical path (Li et al., 2022). The critical path consists of activities that are bottlenecks in implementing the website to support the selected

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company's employee recruitment process. These implementation steps are risky, and if they are not completed by the set date, the total time of project implementation will be extended.

To identify the critical path, it is first necessary to define the individual activities that will be carried out during the implementation of the project. Table 4 shows the chronologically arranged activities. Individual activities are also assigned their duration and previous activities (predecessors) or subsequent activities (successors).

ID	Activity	Duration	Predecessor	Successor
Α	Determination of the solved problem and the goal of the project	2	-	B, C
В	Collection of secondary data	20	А	D
С	Collection of primary data	40	А	D, I
D	Comparison of collected data and definition of bottlenecks	10	B, C	E, G
E	Presentation of the problem to the representative of the company	1	D	F
F	Definition of solution criteria by the company	2	Е	J
G	Creation and submission of three variants of solving the company's problem	2	D	Н
Н	Choice of solutions to the problem by the company	2	G	Ι
Ι	Evaluation of the recruitment process	1	H, C	J
J	Creating a demo version of the website	20	F, I	K
K	Presentation of the final proposal of the solution	1	J	L
L	Incorporation of company comments into the demo version	5	K	М
М	Creating a website	60	L	N, P
Ν	Website testing	10	М	0
0	Elimination of shortcomings	5	Ν	S
Р	Linking the website with the system for recruiting employees	20	М	Q
Q	Testing the connection between the website and the employee recruitment system	10	Р	R
R	Elimination of shortcomings	5	Q	S
S	Final check of the solution	10	O, R	T, V
Т	Compatibility setting with other software and ISs	10	S	U
U	Integration of the recruitment process	10	Т	W
V	Database integration	15	S	W
W	Website testing	5	U, V	X
X	Initial training of employees	3	W	-

 Table 4. Defining the activities of the recruitment process via the website

Based on the succession of individual activities of the recruitment process, the project's time distribution plan is also evident. For clarity, the individual activities were plotted in a project network, captured in Figure 6.

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Figure 6. Project network showing the critical path of the implementation of the design solution

The total timeframe for implementing the recruitment website is provisionally estimated at 216 days, i.e., approximately 7 months. Figure 6 shows **the critical path of the process** (highlighted in red). The critical path consists of activities where the time margin is zero. Each activity is assigned an earliest date (start = top left and end = top right), the latest permissible date (start = both bottom left and end = bottom right), a time margin (bottom centre) and, of course, the duration of the activity (top centre). An explanatory view can be seen in the bottom right corner of the figure. The critical path shows the possible occurrence and magnitude of the time risk of the project's implementation phase. When implementing it, it is necessary to keep the set deadlines of the activities that are part of the critical path as a priority so as not to prolong the whole project and, therefore, not increase the implementation costs.

Suppose the enterprise wants to avoid the risk of failing to meet the project schedule while implementing the proposed solution. In that case, meeting all the deadlines of the activities that make up the project's critical path is necessary. Care must be taken during these activities to adhere to the time limit (Goman, 2021). Any time slippage will be reflected in the overall duration of the project and thus, for example, in an increase in the total cost associated with the implementation of the proposed solution, the business wants to avoid the risk of non-compliance with the project schedule, it is necessary to comply with all the dates of the activities that make up the project's critical path. In these activities, it is essential to pay attention to the observance of the time limit (Goman, 2021). Any time slippage will be reflected in the project's total duration and, thus, in the increase of the total costs associated with implementing the solution (Zou, Zhang, Zhang, 2021; Catalao, Cruz, Sarmento, 2021).

#### Conclusions

As can already be seen from the analysis of the theoretical starting points, the main goal of employee recruitment is to attract the best applicants for the given job. It is necessary to do it in a way that will be effective for the company. Recruitment can also be understood as a process consisting of two sub-processes: recruitment and selection of employees. When planning and preparing recruitment, it is necessary to focus on both sub-processes separately and regarding their immediate connection.

Many authors also deal with the issue of risk identification and management. The analysis showed that there are several risks associated with the process of recruiting employees. These can have an impact not only on the personnel department but also on the entire company. Therefore, managers must address the risks associated with the recruitment process. Then, new and current employees will be able to generate new ideas, the acquisition of expertise will be supported, and the rate of innovation may increase.

Overall, ICT support for staff recruitment can be included under HRIS. HRIS aims to support personnel department employees by effectively managing human resources. The use of ICTs also affects the sustainability of business. This can be achieved if employees and managers understand the meaning of HRM activities and are willing to take risks associated with implementing new solutions.

The article described the analysis of cases from practice at two selected companies (JYSK s. r. o.; Lidl Slovak Republic v. o. s.). This was the phase of the secondary data analysis. Based on the primary data analysis, an authors' case study was subsequently created, which was carried out in one selected Slovak company (ABC company). The purpose of creating this study was to point out the fact that the recruitment of employees significantly affects the subsequent motivation of employees (motivation to achieve high work performance, incentive to stay in the company, motivation to submit new ideas, etc.).

The main findings led to the design of a solution: to create a career website that provides information for the public and potential job seekers. The website also supports the management of the recruitment process, as several employee recruitment activities are carried out exclusively by this method. The second part of the article identified potential risks associated with implementing the proposed solution in the selected enterprise. Above all, the need for clearly defined project schedules and adherence to time limits is emphasised.

**A limitation** of this article is the focus on one selected company in the case of primary analysis. Within this company, the field of human resources is dealt with, explicitly recruiting employees. Two examples of best practices from Slovakia were chosen as part of the secondary data analysis. Their number can be expanded, as well as the market in which the analysed companies operate (not only Slovakia). Only the critical path method was used when identifying risks, representing a limitation in a specific aspect.

**In the future**, risk analysis can be expanded via other methods such as Pareto analysis of risk areas, BIA analysis of the proposed solution, or risk matrix for determining the importance and impact of the risk on the company. In the future, it is also possible to expand the research to several other companies and, due to this, develop recommendations in the form of a model solution to the issue of e-recruitment. It is also recommended that future research focus more deeply on the specific factors and mechanisms underlying the confirmed relationship between social media applications and perceived effectiveness in the recruitment process. In addition, conducting qualitative studies to capture individuals' experiences and perspectives regarding using social media in the job search can provide valuable insights into the underlying reasons for this relationship.

In their future projects, the authors of this article will focus on other Slovak companies, where they will apply the same methodological procedure. It will be small and medium-sized companies since large companies implement

e-recruitment themselves. They have entire IT departments (corresponding activities will be provided in-house). We will compare the new results with the previous ones to identify similarities or differences in this area within Slovakia. These will be beneficial for creating further recommendations. We encourage foreign authors to focus on SMEs in their environment so that they can compare results across countries.

The originality and **novelty** of the results presented in this article are linked to the emphasis on the necessity of identifying and managing risks associated with implementing ICT in HR. Business managers must focus on detecting threats as early as possible while planning to use any ICT tool in personnel management. In a narrower sense, the novelty can be seen in the crucial online support of the recruitment process. These technologies support the overall innovativeness of businesses and their approach to employee recruitment. The results presented and the recommendations defined have implications for firms aiming to optimise their recruitment strategies. While employees may be fine with their recruiting experience, businesses should recognise the importance of social media as a valuable tool for reaching and engaging job seekers. By effectively using social media platforms, companies can strengthen their recruitment efforts and reach a wider pool of candidates actively using these channels for job search.

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**Gabriel KOMAN** is an Associate Professor at the Department of Managerial Theories, Faculty of Management Science and Informatics, University of Žilina in Žilina. Research interests: enterprise information systems, management information systems, digital marketing, ERP systems (SAP), big data, industry 4.0. **ORCID ID:** https://orcid.org/0000-0001-7562-5476

**Dominika TOMAN (TUMOVÁ)** is an assistant professor at the Department of Managerial Theories, Faculty of Management Science and Informatics, University of Žilina in Žilina. Research interests: organisational behaviour, motivation and creativity, management of sports organisations, ICT decision support. **ORCID ID:** https://orcid.org/0000-0003-2393-2946

**Radoslav JANKAL** is an Associate Professor at the Department of Managerial Theories, Faculty of Management Science and Informatics, University of Žilina in Žilina. Research interests: quality in services, business excellence, ethics, CSR. **ORCID ID:** <u>https://orcid.org/0000-0001-6447-1651</u>

**Patrik BORŠOŠ** is a doctoral student at the Department of Managerial Theories, Faculty of Management Science and Informatics, University of Žilina in Žilina. Research interests: Enterprise decision-making supported by modern enterprise information systems.

ORCID ID: https://orcid.org/0009-0009-6024-5337

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## ANALYTICAL VIEW OF THE PROFITABILITY OF COMMERCIAL COMPANIES\*

## Agneša Víghová 1\*, Iveta Košovská 2, Monika Hudáková 3

<sup>1,3</sup> Bratislava University of Economics and Management, Department of Small and Medium Business, Furdekova 16, 851 04 Bratislava 5, Slovakia

<sup>2</sup> Slovak University of Agriculture in Nitra, Faculty of Economics and Management, Trieda Andreja Hlinku 2, 949 76 Nitra, Slovakia

*E-mails:* <sup>1\*</sup>agnesa.vighova@vsemba.sk (Corresponding autor); <sup>2</sup>iveta.kosovska@uniag.sk; <sup>3</sup>monika.hudakova@vsemba.sk

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**Abstract:** A reliable report on the company's financial situation can be obtained by analyzing costs, revenues, profit margin and the development of net profit. To study this information, we use a range of indicators from the financial analysis environment. The financial analysis results are interpreted and put into business practice by the accounting units. The basic information sources used in financial analysis are the financial statements of business companies. The article aims to point out the development of revenues, the total net profit of grain growers in the time horizon 2014-2022, as well as the profit margin of the industry for the period 2014-2022. The subject of the analysis was agricultural enterprises, from which we selected one accounting unit that operates in the agriculture sector. Within the industry, they focused our attention on the segment of cereal growers in Slovakia in the time horizon 2014-2022; the mentioned period is interesting because the COVID-19 pandemic and the war in Ukraine marked it. We presented the analysis results in the final part of the article.

Keywords: financial analysis; information sources; balance sheet; profit and loss statement; notes; profitability indicators; Slovakia

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#### 1. Introduction

Effective management of costs, revenues, net profit and commercial margin in companies is critical in every accounting unit, as they are also related to profitability indicators. Profitability indicators express the performance of business efforts. The level and development of liquidity, activity and indebtedness are reflected in their level and growth. Profitability indicators have different forms, for example, profitability of assets, equity, and sales.

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Some of the profitability indicators are very systematic and comprehensively express the essential characteristics of the company's performance. We also call profitability indicators indicators that describe and analyze the efficiency of business activity. Profitability indicators depend on other financial indicators, such as net profit and profit margin, which we use in business practice to assess the company's financial health and recommend effective management conclusions in financial decision-making.

## 2. Literature review

Costs and revenues represent the essential information when determining the result of the management of commercial companies. The financial statement in the profit and loss section contains information on costs, revenues, profit before tax and profit after tax of commercial companies. The balance sheet conveys information about the profit after tax through the line of the economic result; at the same time, this line is a connecting line between the balance sheet and the profit and loss statement. In the Slovak Republic, the financial statements include notes in addition to the balance sheet and profit and loss statement. The notes also include a cash flow statement. Financial statements are the primary information source for carrying out companies' financial analysis. The authors present these and other findings in their publications: Oreský & Rehák, 2019; Farkaš, 2020; Štangová et al 2012; Šuranová & Škoda, 2007; Šlosárová & Blahušiaková, 2020; Alex, 2005; Kajanová, 2014; Vlachynský et al 2009; Zalai, 2016; Štangová & Hajduchová, 2010; Pevná, 2017; Jeleníková & Procházková, 2018; Suhányiová & Fabian, 2010; Suhányiová et al., 2016; Suhányiová, 2009; Suhányiová, 2011.

Through financial analysis, business companies can calculate financial indicators to identify the company's financial health. The category of most used financial indicators includes profitability indicators; in practice, we often use the form of ROA, ROE, ROS, which provide information on the profitability of assets, equity and sales. The development of these indicators tells about profitability and will help predict the future development of profitability, which will help management make effective decisions. The authors provide information about these facts: Grünwald & Holečková, 2007; Nita, & Oleksyk, 2020; Tawiah & Gyapong, 2021; Stewart & Connolly, 2021; Sacer & Zyznarska-Dworczak, 2020; Henrique et al. 2020; Frintrup, 2020; Gernon, 2001; Hellmann & Patel, 2021; Kubíčková & indřichovská, 2015; Kotulič et al., 2018; Hillebrandt & Leino-Sandberg, 2021; Pavic, 2020; Silva et al., 2021a, 2021b.

In addition to profitability, the net profit and profit margin indicators provide valuable information. The amount of net profit is affected by corporate income tax in individual states, as profit before taxation is taxed by accounting units with corporate income tax. The corporate income tax rate is different in individual states. The general assembly of commercial companies decides on the use of net profit. Profit after tax represents the ratio of total profit to revenues, expressed as a percentage. The authors of the following publications wrote about it: Kieso & Weygandt, 2007; Riahi-Belkaoui, 2000; Jenčová & Rákoš, 2010; Jakubec & Kardoš, 2016; Miah, 2021; Natalizi, 2020; Roca, 2021; Wijekoon et al. 2021; Lombardi et al 2020; Miah et al 2021, Savina et al 2021; Kainth & Wahlstrom, 2021.

## 3. Basic characteristics and information sources of financial analysis

The financial situation of the company may be of interest to a large number of business entities. This fact is reflected in the different purposes, tasks, and methods used to process financial analysis (Grünwald et al. 2007). We divide the financial analysis into internal and external. External financial analysis is processed based on publicly available data; internal financial analysis is processed by analysts of the given business company based on internal data (Jenčová & Rákoš, 2010). The basic task of financial analysis is to identify the company's weaknesses, which could lead to problems in the future, and strengths, which the company can rely on in the future (Šuranova et al. 2007). It follows from the above that the financial analysis is the starting point for making the right decisions about the company's future.

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One of the sources of information for the company's financial analysis is the financial statements. In the Slovak Republic, this area is regulated by Act No. 431/2002 Coll. on accounting as amended (Zalai, 2016). Financial statements are a structured presentation of facts that are the subject of accounting, provided to persons who use this information (users). The financial statements form a single unit and have the requirements prescribed by law. The most common sources of information for financial analysis in the double-entry bookkeeping system are the following components of the financial statements:

- balance sheet,
- profit and loss,
- notes to the financial statements, which include an overview of cash flows and other information that explains and supplements the data in the balance sheet and the profit and loss statement (Kotulič et al., 2007).

**The balance sheet** is a basic accounting statement that captures the state of assets (property) and liabilities (resources of property coverage) in monetary terms on a specific date. When drawing up a balance sheet, the basic balance principle applies - assets are equal to liabilities.

From the point of view of the formal arrangement of the balance sheet, the balance sheet may take the form of:

- horizontal form the balance sheet has the form of a double-sided table that expresses the basic balance equation,
- vertical form balance sheet items are arranged in columns. Liabilities are listed after assets.

The profit and loss statement for users of information from the financial statements is a source of information about the financial results of the activity of the accounting unit. It captures the total movements of revenues and costs of individual activities carried out by the company, which participate in the management of the current accounting period (Růčková, 2019). According to the Accounting Act, income means an increase in the economic benefits of the accounting unit in the accounting period, which can be reliably estimated (Farkaš, 2020). The Accounting Act defines costs as a reduction in the economic benefits of the accounting unit in the accounting period that can be reliably estimated. The task of the profit and loss statement is to explain the creation of the economic result in the company for a precisely defined accounting period. The result of management practically represents the difference between revenues and costs. If the value of the economic result is positive, it is a profit (Alex, 2005). On the contrary, if the value of the economic result is negative, i.e., costs are more significant than revenues, it is a loss. We define the operating result in the context of the pre-tax operating result, which represents the accounting operating result and the after-tax operating result, the so-called net profit.

#### Notes to the financial statements

The notes also include a cash flow statement. The cash flow statement provides information about cash receipts (positive cash flows) and cash expenditures (negative cash flows) that occurred in the accounting unit during the accounting period and caused the balance of cash and cash equivalents at the end of the accounting period to change in comparison with the state of cash and cash equivalents at the beginning of the accounting period (Šlosárová, 2006).

The cash flow statement is usually structured into the following areas:

- operational area,
- investment area,
- financial area (Štangová et al 2012).

The individual parts of the accounting statements, which are the balance sheet, profit and loss statement and cash flow (part of the notes), form the so-called three-balance sheet system, which expresses the connection of these statements (Table 1).

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Table 1. Three-balance system

CASH	I FLOW		BALANCI	E SHEET		PROFIT AND LOSS	
			Assets	Liabilities			
Initial cash balance	expenses		Assets excluding cash	Total capital excluding profits		Costs	Revenues
Incomes	Final balance of funds	=	Cash resources	Profit after tax	=	Profit after tax	

Source: Financial analysis of the company (Kotulič, Király, Rajčáníová, 2018)

#### 4. Analytical view of profitability indicators

Among the basic indicators of the company's financial health, we primarily include profitability. In the professional literature, profitability is the ability of the company to evaluate the invested funds in the form of profit. Profitability indicators are also often referred to as profitability indicators or return indicators. Based on this fact, profitability is the ability of the entity to make a profit through invested capital. It follows from the above that profitability can be analyzed in connection with the profitability of assets, equity, and sales. In the case of profitability analysis, it is necessary to characterize the terms that we use under the abbreviations EAT, EBT, EBIT, EBITDA:

- **EAT represents profit after tax.** The amount of this profit depends primarily on the profit before tax and on the amount of the tax rate. In our conditions, we can talk about the so-called result of business management (Pevná, 2017).
- **EBT profit before tax is defined as the so-called gross profit of the company**. This form of profit is suitable for comparing management results within individual tax rates.
- **EBIT** the company's profit before deducting income tax and interest costs. However, it is generally referred to as the so-called operating profit. It is primarily used to analyze a company's main activities without capital structure costs and tax costs affecting income (Kieso & Weygandt, 2007).
- **EBITDA** is translated as profit before interest, taxation, depreciation and amortization. This indicator determines the company's gross profit without the company's overhead costs.

Among the most common profitability indicators, we include:

- return on assets,
- return on equity,
- return on sales.

#### Return on assets (ROA)

It compares the company's profit and total assets regardless of their financing sources. This indicator is primarily considered vital for this reason, as the result tells us how many cents of profit per euro of invested capital (Jeléníková et al. 2018).

#### $ROA = \_EBIT\_$

assets

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#### **Return on equity (ROE)**

It reflects the total return on equity. This information is essential for business owners. The calculated figure shows how many cents of profit per euro of retained equity. An increase in this indicator can create a higher profit, a reduction in the interest rate of foreign capital, a decrease in the share of equity in the company's total capital, and a combination of the above (Jeléníková et al. 2018).

# $ROE = \underline{EAT}$ own capital

#### **Return on sales (ROS)**

Through the profitability of sales, the profitability of profit in relation to sales is determined. We can replace profit with EBIT, EBT, and EAT values in the calculation at the reader's place. Sales for own services and goods, or total revenues, can represent sales in the denominator. The obtained data tells us how many cents of profit are generated in the company for one euro of sales (Kubíčková & indřichovská, 2015).

## ROS = <u>profit</u> revenues

## 4.1 Analysis of the development of profitability in a selected agricultural company in the Slovak Republic and the agricultural sector

We solved the research project in the framework of several agricultural enterprises. Still, in the mentioned article, we numerically present the selected company, representing the problems occurring in the profitability field and its management in most of them. In addition to the chosen company, we also present data from the agriculture sector (Table 2).

		2	0	1 2	
YEAR	2018	2019	2020	2021	2022
Return on Assets (ROA)	3,78 %	14,67 %	8,7%	6,93 %	10,52 %
Return on Equity(ROE)	6,56 %	25,56 %	18,76 %	10,28 %	18,72 %
Return on Sales (ROS)	5,69 %	15,42 %	11,15 %	8,59 %	1,25 %

Table 2. Profitability indicators of the analyzed agricultural company

Source: Own processing based on the accounting statements of the agricultural company

**Return on assets (ROA)** is one of the fundamental indicators, as it expresses how much profit falls on all the capital used in the company. The origin of this capital plays almost no role in this case. In this case, it is both own capital and foreign capital. To eliminate the influence of different financial structures of the company in the industry and the analyzed company, the EBIT numerator was used to calculate ROA (EBIT = profit of the company before deduction of income tax and interest costs). The analyzed company showed the highest return on assets in 2019, more than double the industry's value. In 2020, it is possible to observe a decline in the company and the industry. In this case, the company recorded more than three times the ROA value compared to the industry. In 2021, the values stabilized below 7 percent, and in 2022, the company reported the second-highest result.

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As for the calculation of return on equity (ROE), net profit was used. If you look at the values in the table, it is clear that the company achieved much better than the industry in 2019. Investors and company owners will most appreciate this information, as their capital is effectively valued. Only in 2021 did the industry slightly outperform the company's values, caused by a rare dip in the company's profit.

**Return on sales (ROS)** is then calculated through EBIT. In this case, it is an indicator that represents the company's margin. In this case, too, the trend will be the same as for the previous indicators. Values of 11 to 18 percent can be rated as good. Figures of 15 to 14 percent are excellent, especially for industry figures less than half for 2019 and 2020.

YEAR	2018	2019	2020	2021
Return on Assets (ROA)	7,4 %	7,23 %	2,34 %	6,4 %
Return on Equity (ROE)	11,05 %	13,25 %	0,85 %	10,67 %
Return on Sales (ROS)	7,15 %	6,45 %	2,52 %	6,73 %

#### Table 3 Profitability indicators of the industry

Source: Own processing based on accounting statements published at www.finstat.sk

#### 4.2 Analysis of the development of sales, total net profit and profit margin for grain growers in Slovakia

The primary function of agriculture is the production of food and industrial food raw materials. In agriculture, the most significant uncertainty is the weather and its influence on vegetation development, which is largely conditioned primarily by the amount and distribution of precipitation. Agricultural enterprises cannot influence the mentioned uncertainty, but they must try to use its positive effects and soften the negative ones. Of course, all business risks are also reflected in financial indicators.

In addition to one selected company, we provide summary information on the profitability indicators of the agriculture industry and the total sales of cereal growers in the period 2014-2022, the total net profit of cereal growers in the period 2014-2022, the profit margin of the industry for the period 2014-2022.

#### 4.2.1 Revenue development of grain growers in the Slovak Republic in the period 2014 - 2022

The subject of the research was 1,200 enterprises that are engaged in the cultivation of grain in Slovakia. Graph 1 shows the increase in revenues in 2022.

Revenues are an important indicator that is also the basis for calculating profit before tax and net profit. As part of the analysis, we analyzed the development of revenues in the given segment. The analysis shows a significant increase in the revenues of the researched companies from 2014 to 2022. A trading company based in the Nitra Region reported the most significant revenues in the given segment, which is 42.000.000 Euros.

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Graph 1. Total revenues of grain growers in the period 2014 – 2022 Source: www.finstat.sk

#### 4.2.2 development of the net profit of grain growers in the period 2014 - 2022

The financial indicator net profit, which in practice represents profit after tax, is related to revenues. The research shows that the highest after-tax profit in the industry was achieved by a trading company based in the Nitra Region, which in 2022 reached a net profit of more than 10 million Euros. The reason for reporting a higher net profit is that the prices of agricultural commodities grew at the highest rate in the last decade, mainly contributed by the high prices of industrial fertilizers and plant protection products. To maintain the rentability of production, the analyzed company applied rationalization measures, which consisted of increasing the scale of production, modernizing the production process, introducing new energy-saving technologies and reducing commodity stocks.



Note: the data are in Euros



#### 4.2.3 Profit margin of the industry in the period 2014-2022

Another indicator related to revenues and net profit is the profit margin. The profit margin is a percentage of the company's net profit after deducting costs.



Note: the data are in %

Graph 3. Profit margin of the industry in the period 2014 - 2022 Source: <u>www.finstat.sk</u>

The research results prove the connection between revenues and net profit with the rising tendency of the profit margin in the analyzed company. In 2022, the profit margin had an excessive upward trend. The reason was an excessive increase in revenues and net profit.

#### 5. Final evaluation and recommendations

As part of the research project, based on the performed analysis, we found the following facts:

## 5.1. Analyzed agricultural society and the agriculture sector

It reported recommended results in the case of profitability analysis, which showed that, except for the unfavorable year 2018, which the company experienced, it consistently achieved higher values than the industry except for one result. The value of the ROA indicator doubled in 2019 and even more than tripled in 2020. As for the following year, there was a decrease, and the values almost leveled off. ROA values were calculated using EBIT to remove the influence of different financial structures. The company achieved the highest ROE in 2019, reaching 25.56%; the ROS indicator was subsequently the highest in 2019 at 15.42%. In the case of the profitability of payable capital, there was a similar development trend. From the results in this case, we can notice a downward trend in 2020 and 2021, when all indicators of the analyzed company decreased. Also, for this reason, the year 2022 was more than important when the values came closest to the values from 2019.

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The following recommendation for the analyzed company follows from the above results. It is a reduction in the total volume of inventory that the company had on average in the years we examined. Their amount was reflected in a negative way in several analyzed areas, which significantly burdened the financial stability and performance of the company we examined. The effects of holding a large amount of inventory undoubtedly had a significant impact on the company's liquidity.

#### 5.2. Grain growers in Slovakia

According to statistical data, approximately 1,300 legal entities are engaged in the cultivation of cereals in the Slovak Republic. In 2022, the total revenues of cereal growers rose above one billion euros. In 2021, the revenues of these legal entities amounted to EUR 877 million, which means an increase of 21%. These businesses also saw a rise in net profit. Companies in this sector reported a net profit of 154 million euros in total, resulting in a profit margin of 14%. Compared to last year, this is a 10% increase.

Our recommendation, which results from the performed analysis, is to maintain the upward trend of net profit and the profit margin in the analyzed industry despite risks such as the weather and the development of market prices of agricultural inputs and commodities.

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Agneša VÍGHOVÁ, Assoc prof. PhD. is head of Bratislava University of Economics and Management, Department of Small and Medium Business, Furdekova 16, 851 04 Bratislava 5, Slovakia. Scientific field: Accounting, Taxation, Statutory audit. **ORCID ID:** <u>https://orcid.org/0000-0001-8094-0067</u>

**Iveta KOŠOVSKÁ**, Ing. PhD., Vice-dean for Education, Faculty of Economics and Management, Institute of Accounting and Informatics, Trieda Andreja Hlinku 2, 949 76 Nitra, Slovakia. Scientific field: Accounting, Taxation. **ORCID ID:** <u>https://orcid.org/0000-0001-6131-7405</u>

Monika HUDÁKOVÁ, prof.h.c. prof. Ing. PhD. MBA, Vice Chancellor for science and research is head of Bratislava University of Economics and Management, Department of Economics and Finance, Furdekova 16, 851 04 Bratislava 5, Slovakia. Scientific field: economy and business management, crisis management, management. ORCID ID: <u>https://orcid.org/0000-0003-0454-9626</u>

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