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INVESTMENTS IN INDUSTRY 4.0

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Abstract. The paper examines the major factors influencing business decisions to invest in Industry 4.0 technologies and identifies the key barriers preventing businesses from entering this era. The article analyses various aspects of Industry 4.0, including its development, impact on sustainability, and approach to technology implementation. Particular attention is paid to the importance of investments in Industry 4.0 and the benefits and challenges examined in detail. The research aims to provide an overview of the status and trends in Industry 4.0 and identify important factors and barriers that affect the successful adoption and implementation of these technologies. The paper provides a new perspective on the transformation of manufacturing activities and suggests a basis for a deeper understanding of the role of Industry 4.0 in the current and future business environment. This analysis focuses on assessing previous investments in technology and innovation made by five selected Czech companies and their impact on the success or failure of their corporate strategies. The research focuses on the identification and detailed analysis of specific companies operating in the South Bohemia region of the Czech Republic. For this purpose, publicly available information on the costs and depreciation of these companies is used, as well as the collection of promotional materials, including brochures and documents available from the official websites of each company. Overall, the study provides a deeper understanding of the factors and barriers related to Industry 4.0 investments and their impact on corporate decision-making and strategies.

Keywords: Industry 4.0, investment; innovation; technology; digital transformation

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1. Introduction

Industry 4.0 represents a revolutionary change in how companies produce, manage, and optimise their products and services. New technologies are rapidly changing the structure of the economy and social life. This phenomenon requires continuous innovation and technological development in any company (Durana et al., 2019). Organisations can transform their business and create more value by adopting the initiatives of Industry 4.0 (Tostes & Azevedo, 2024). New technologies change the entire corporate value chains within Industry 4.0, Work 4.0, Education 4.0, and Thinking 4.0 (Dvořáková et al., 2021). Quality 4.0 is an emerging concept that is reconsidering the adoption of digital quality management (Saihi et al., 2021). Industry 4.0 is a technological framework and policy initiative that emerged in Germany in 2010 (Da Roit & Iannuzzi, 2022). According to Oláh et al. (2022), Industry 4.0 has become the most important tool companies can use to improve their business. From the first industrial revolution, which began with the invention of the steam engine to Industry 4.0, each industrial revolution resulted in a technological and economic paradigm shift (Chakraborty et al., 2023).

According to Bičo Čar et al. (2023), the pace at which new technologies emerge is unbelievable. Their findings indicate that the management of companies must assess the company's preparedness for adopting and

implementing these new technologies. Alper et al. (2023) distinguish four phases of industry development. The first industrial revolution, starting in the 18th century, used water and steam power for mechanisation. This was followed by the Second Industrial Revolution, during which electricity began to be used for mass production. The third industrial revolution was in the 1970s, characterised by introducing electronic and information technologies. The dawn of the 21st century saw the emergence of Industry 4.0, characterised by the implementation of various modern automation systems and digital software.

Each of these four industrial revolutions saw an increase in the productivity and efficiency of corporate production processes (Bueno et al., 2023). The new industrial paradigm, the fourth industrial revolution, brings about digital transformation, automation, and the interconnection of equipment and processes (Skare et al., 2024a). Investments in Industry 4.0 are thus becoming the critical factor for companies that want to remain competitive and bring innovative solutions to the market. The important thing is to incorporate sustainable practices to improve economic, social, and environmental sustainability (Nirmal & Reddy, 2024; Skare et al., 2024b,c). Papouskova et al. (2020) argue that increasing continuous safety and quality requirements primarily affects competitiveness. According to Shen et al. (2023), the primary goals of sustainability include reducing the consumption of non-renewable resources, minimising waste, and creating a healthy and productive environment. Butollo et al. (2023) state that the issue of investments in Industry 4.0 is highly topical today, becoming even a necessity. The shift towards Industry 4.0 was gradual. The extraordinary circumstances of the pandemic have led to significant investments widely interpreted as a digitalisation push (Olah et al. 2021; Skare et al. 2023).

According to Rawat et al. (2023), Industry 4.0 provides answers to such challenges through advanced technologies, such as the Internet, artificial intelligence, robotics, big data, etc. This evolving technology is expected to positively impact industry, economy, and society, which should lead to the development of a model innovation business and increased production. Ye et al. (2023) assume that digital investments will achieve mutually beneficial economic growth and environmental protection conditions. Cirillo et al. (2023) state that while some companies have already started to invest in modernising their production processes and infrastructure, some companies still need to be more confident. It shall be noted that investments in Industry 4.0 are not short-term but rather long-term future trends. This paper examines the importance of investments in Industry 4.0 and analyses the benefits and challenges it brings. A more detailed look at this issue shows that investments in Industry 4.0 can potentially change how production and industry development are perceived. New digital technologies are shaping the transformation of production activities. Fatima and Ali (2023) state that as the world moves towards optimised production strategies, third-world countries are also making efforts to contribute to this smart manufacturing approach.

This paper aims to analyse the major factors affecting corporate decision-making on investments in Industry 4.0 technologies and identify the key barriers preventing companies from entering this era. To this objective, the following research questions are formulated:

RQ1: What is the correlation between the development of personnel costs per employee and net income per employee of the selected companies in the years 2016 – 2022?

RQ2: What is the correlation between the depreciation of fixed assets per crown of net income and the development of sales-per-employees in the selected companies in the years 2016 – 2022?

2. Literature Review

According to Khlil et al. (2023), adopting new technologies may pose a challenge to organisations, including considerable investments in hardware, software, or human capital. The adoption of Industry 4.0 attracts manufacturing companies but also has barriers to its implementation, such as substantial investment costs or lack of qualified labour and infrastructure, causing many companies to hesitate to implement (Cornejo-Velazquez & Clavel-Maqueda, 2023). The RIL-INAPP survey collected information about the implementation of Industry 4.0 technologies. The issue of investments in new technologies in 2015–2017 was addressed with a specific question: "Did the company invest in the following new technologies in 2015–2017?" Respondents

were offered three options: robotics, big data analysis, augmented reality, cyber security, and Internet of Things. The Internet of Things (IoT) is a technology intended for the real-time processing of big data volumes with maximum effectiveness (Jarašūnienė et al., 2023). Within the survey, it was possible to choose multiple options. Cirillo et al. (2023) showed that all companies involved were eligible for the program, and they automatically received an incentive if they invested.

Figure 1 shows uneven distribution patterns of adoption, with less than 40 % of companies with at least 5 employees declaring that in the years 2015–2017, they made at least a single investment in Industry 4.0 technologies.

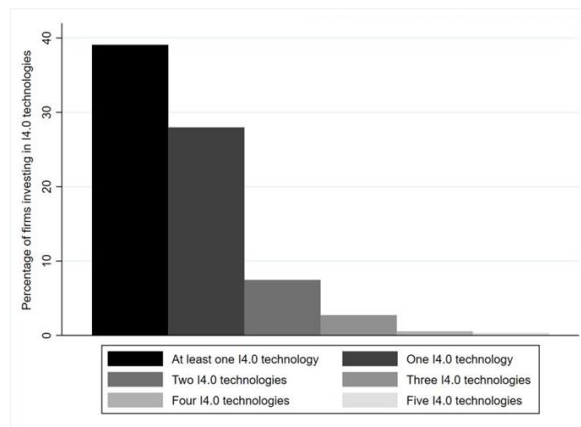


Figure 1. Italian companies investing in Industry 4.0 in the years 2015-2017

Source: The adoption of digital technologies: Investment, skills, work organisation, 2023

Another survey focused on developing the transition framework of Industry 4.0 in Tanzanian manufacturing industry. Maganga and Taifa, (2022) used a survey method to identify practitioners' perspectives. This method included open and closed structured questionnaires to assess the respondents' perception of Industry 4.0 and manufacturers' preparedness to transition to Industry 4.0. The study aims to adopt non-probability and purposive sampling strategies, focusing on fifteen Tanzanian manufacturing sectors. The data were subjected to quantitative and qualitative analysis using MAXQADA 2020 and Minitab 20. The findings confirmed a high awareness of Industry 4.0 among employees in the Tanzanian manufacturing sector, acquired, e.g., through work experience, quality training, the Internet, and reading. The results also showed that most manufacturing companies in Tanzania use Quality 3.0 or a lower approach to quality management but are prepared to adopt Quality 4.0 as practitioners see its advantages, including customer satisfaction, product and process improvement, etc. The obstacles hindering the adoption of Quality 4.0 in Tanzania include the requirement for reliable electricity supply and high-speed Internet, a qualified workforce, or insufficient infrastructure (Maganga & Taifa, 2022).

Industry 4.0 has great potential in manufacturing. Examples can be data-driven optimisation of individual machine production processes, driverless transport systems, and assistance systems. However, companies are still hesitating whether to invest in the implementation of Industry 4.0. Joppen et al. (2023) show that one of the causes might be its unclear financial benefits. Another study identifies the major challenges in adopting Industry 4.0 in the Indian construction industry. Several key challenges were identified based on available literature and personal interaction with construction management, IT experts, and academicians. The study shows that high investments and costs incurred for mobilisation with the support of the Internet of Things (IoT) in construction companies represent the main barriers to adopting Industry 4.0 methods. Another major obstacle in achieving this goal is recruiting experts for employee training, as among lower-level workers, there is a lack of basic understanding of computer use (Singh et al., 2023).

The study by Ferreira et al. (2023) aimed to analyse the benefits of the implementation of digital technologies to support environmental and social sustainability in European multinational corporations. A research model involving five digital technologies (artificial intelligence, cloud computing, robotics, big data analysis, and

blockchain) and sustainable environmental and social practices was created. The results show that the implementation of digital technologies in business models of European multinational corporations is still at a low level. Digital technologies also positively affect these companies' social and environmental sustainability (Ferreira et al., 2023; Simionescu et al. 2021, 2022). Digital technologies within Industry 4.0 in agribusiness enable traditional agricultural systems to move towards Agriculture 4.0. The study identified digital technologies that best relate to agribusiness, obstacles in implementing these technologies, and the effect of open innovations on improving agribusiness competitiveness. The results show that the Internet of Things (IoT) is the most pronounced technology of Industry 4.0. The main barrier is the lack of knowledge and advanced skills, which indicates the need for investment in operator training (Silva et al., 2023).

The study by Trianni et al. (2024) aims to examine various fields within Industry 4.0 and energy productivity in Australia. The study analyses the technologies and services of Industry 4.0, barriers within Industry 4.0 to energy productivity, regulatory framework, multiple benefits of Industry 4.0 technologies, relevant business models, and the roadmap to Industry 4.0. The findings showed that insufficient IT infrastructure, cybersecurity, complex supply chain and contracting, and uncertainty about Return on Investment (ROI) represent the major barriers. In terms of productivity benefits, the study highlighted the macroeconomic impact, impact on the industrial sector, the public budget, health, and welfare, as well as the impact on energy supply resulting from Industry 4.0 technologies (Trianni et al., 2024). The study by Cardoso et al. (2023) aimed to examine the relationship between Industry 4.0, AI (artificial intelligence), and sustainability by highlighting the direct and indirect links between these concepts. The study shows that adopting digital approaches can significantly improve the sustainability of production systems, provided the right balance is struck. This requires investments in technology and sustainability measures to achieve a holistic, globally sustainable production system. The study thus concludes that manufacturers must continue to invest in innovative technologies, including AI and Industry 4.0 while ensuring that these investments are aligned with their sustainability goals (Cardoso et al., 2023).

The aim of the research by Ocakci et al. (2023) was to provide insight into the impact of the unique capabilities of the fourth industrial revolution on the production and maintenance tasks in terms of providing support to existing manufacturing companies by recommending areas and tasks with high potential. The research methods include survey and literature research. The survey collected empirical data using a semi-structured questionnaire, which provided a broad overview of the company's current state in terms of production and maintenance. This led to more complex and specific information on the study topics. The study indicates that implementing Industry 4.0 technologies increases production, asset utilisation, quality improvement, and organisational competitiveness (Fasuludeen Kunju et al., 2021). For companies to operate competitively, efficiently, and cost-effectively, it is important to continuously optimise capacity planning. In this context, developments in the field of Industry 4.0 have become increasingly important in recent years (Ocakci et al., 2023; Skare et al. 2024d).

Another study analysed the barriers to adopting Industry 4.0 in Indonesian manufacturing supply chains. First, a qualitative study was conducted based on interviews. Next, companies were addressed using filter questions about the adoption of Industry 4.0 and its impact on the supply chain. The results indicate that five main barriers (unclear Industry 4.0 policy, higher risk investments, unsecured data sharing, lack of expertise, and lack of motivation) are considered barriers to adoption. Successful adoption of supply chain integration with the technology of Industry 4.0 can strengthen the manufacturing sector and competitiveness (Fernando et al., 2022). By leveraging the latest Industry 4.0 technologies, pharmaceutical companies can gain a real-time overview of their operations within their supply chain, enabling them to make data-driven decisions that improve performance, efficiency, resilience, and sustainability (Debnath et al., 2023). There is a growing need for companies and manufacturing systems to be flexible to adapt to rapid change and increasing uncertainty in society, markets, and supply chains. Several studies suggest that Industry 4.0 solutions support shorter innovation cycles, resource efficiency, faster decision-making, and higher flexibility in production (Höse et al., 2023). Sri Lanka's garment industry is trying to adopt Industry 4.0. Only a few developing countries have been able to take maximum advantage of the fourth industrial revolution. The study by Withanaarachchi and Silva (2023) aimed to identify the critical factors for the successful implementation of Industry 4.0. It was found that advances in digital technologies have a significant positive effect on financial investments and a negative effect

on organisational strategy and top management involvement in successfully implementing Industry 4.0 (Withanaarachchi & Silva, 2023). Another study aimed to examine the impact of knowledge-based technological pillars of Industry 4.0 to adopt the supply chain performance of Thai SMEs 4.0. The study identified four groups of Industry 4.0 technology pillars, specifically human support, automation, real-time, and security, which positively influence the performance of the supply chain (by increasing supply reliability, resource efficiency, reducing supply chain costs, and shortening lead times).

Another important finding is that supply chain performance positively influences the performance of an organisation in terms of profitability, Return on Investment (ROI), and sales growth (Sawangwong & Chaopaisarn, 2021). Nikolova (2023) performed an analysis of surveys in Bulgarian companies. Its results prove that, in the long run, the quantity and quality of human capital is the most decisive factor for the sustainable development of an organisation. More and more leaders and managers of companies are becoming aware of the need to invest in human capital and focus on creating value for their business by training their employees and building knowledge, skills, competencies, and motivational attitudes toward the changing work environment within Industry 4.0. There is a trend among businesses to apply continuously improving, technology-enabled processes (Nakandala et al., 2023). Despite the high investment costs of Industry 4.0, many developed countries and large enterprises are already using it (Dikhanbayeva et al., 2023).

3. Methodological Approach

3.1 Data

The methodology for the research is focused on the identification of specific companies operating in the Czech Republic, which are then subjected to a detailed analysis. For this purpose, publicly available information on the costs and depreciation of these companies will be used along with the collection of promotional materials, including brochures and documents from the official websites of each company. The collected information will then be studied in detail to identify and analyse the innovations and technological advances implemented by the selected companies. Data will be collected from the companies' annual reports for the years 2016–2022, which includes the period during which the companies published important information about their costs, investments, and earnings.

The data collected will be used as a basis for a detailed analysis of past investments and development of the selected companies. The analysis of the historical data on investments will be focused on assessing the company's past investments in technologies and innovations and the effect these investments had on the failure or success of corporate strategies. A total of five Czech companies will be selected (namely E-On, Robert Bosch, Madeta, Faurecia, and Mondi Bupak), which will be subjected to a detailed analysis in terms of their past investments and their impact on their position in the market and competitiveness. All the selected companies represent multinational companies operating in the South Bohemia region.

The data includes: Personnel Costs (PC): Total expenses incurred by the company for employee salaries, wages, and other compensation.

1. Number of Employees (E): The total number of employees within the company each year.
2. Fixed Asset Depreciation (D): The depreciation expense related to fixed assets as reported in the financial statements.
3. Net Income (NI): The total net income of the company after taxes and other deductions.
4. Total Revenues (TR): The total revenue generated by the company from its operations.

3.2 Methods

Data collected from the annual reports of the selected companies for the years 2016–2022 will be processed and subjected to analysis, entered into two tables, and then compared.

Table 1 will contain information about personnel costs of the selected companies in the years 2016–2022. This table will enable the comparison of the development of cost per employee in individual companies in the monitored period and identify their increase or decrease.

Table 2 will contain information on depreciation per crown of net income in the selected companies between 2016–2022. This table will be used to compare trends at the level of fixed asset depreciation and determine their development in the selected years.

In processing the data from the tables, it will be possible to follow the trends emerging during the monitored period, enabling a better understanding of the development of costs and depreciations of the selected companies and the possibility of identifying the relationship between these variables and other indicators of the financial health of the companies.

For the purposes of the research, special ratios will be created. The following formulas will be used for calculations:

$$K1 = \frac{\text{Personnel cost}}{\text{Number of employees}} \quad (1)$$

$$K2 = \frac{\text{Fixed asset depreciation}}{\text{Net income}} \quad (2)$$

$$K3 = \frac{\text{Total revenues}}{\text{Number of employees}} \quad (3)$$

$$K4 = \frac{\text{Net income}}{\text{Number of employees}} \quad (4)$$

Calculation of Pearson correlation is shown in the below equation 5.

$$r_{xy} = \frac{\frac{1}{n} \sum_{i=1}^n (x_i - \bar{x}) * (y_i - \bar{y})}{S_x * S_y} \quad (5)$$

Where:

x_i and y_i : are individual data points,
 $\bar{x}$ and $\bar{y}$: are the mean values of the datasets,
 S_x and S_y : are the standard deviations of the datasets.
 n : is the number of data points.

Next, a comparative analysis of case studies will be performed to compare the successful and unsuccessful implementation of Industry 4.0 technologies. The analysis focuses on identifying key differences between both cases regarding the implementation strategies, access to the technologies, and obstacles that have affected the result. The aim is to enable a deeper understanding of factors leading to success or failure in implementing modern technologies.

The analysis will be performed using a systematic approach, which includes the collection of relevant data, the structuring of information, and subsequent thorough evaluation aimed at the identification of key linkages and trends associated with a successful implementation of Industry 4.0 technologies. The calculated Pearson correlation coefficients will be interpreted to determine the strength and direction of the relationships between the variables. A positive correlation indicates that as one variable increases, the other also tends to increase. Conversely, a negative correlation suggests an inverse relationship. The strength of the correlation will be assessed based on the magnitude of the coefficient, with values closer to +1 or -1 indicating a stronger relationship. This study uses a statistical approach to analyse the relationship between important financial

variables such as personnel costs, net income, fixed asset depreciation, and sales in selected companies that follow Industry 4.0 standards. The analysis is based on data taken between 2016 and 2022 when Industry 4.0 technologies had an important effect on operational efficiency and cost structures in several industries.

4. Results and Discussion

4.1 Results: Presentation of selected companies

FRONIUS Česká republika s.r.o. – FRONIUS Česká republika s.r.o. is part of FRONIUS International GmbH, which specialises in welding technologies, battery charging, and renewable energy. Its products include welding equipment, solar inverters, and chargers for electric vehicles. The company is based in the Czech Republic and provides high-quality technical support and services for the industrial and energy sectors. The company focuses on innovation, quality, and sustainability of its products and services. The total sales for the last year (2022) amounted to CZK 2,110,382 thousand; income after tax was CZK 57,968 thousand. The company's taxable income was CZK 6,868 thousand.

Robert Bosch, spol. s. r. o. - Robert Bosch GmbH is an international company dealing with the manufacturing and distribution of technology solutions and services. The company specialises in automotive, industrial technology, consumer products, building technology, and technical systems. The total sales for the last year (2022) amounted to CZK 17,300,242 k; income after tax was CZK 307,334 k.

MADETA a. s. - Madeta a.s. is a Czech food company. It specialises in producing dairy products, such as cheese, processed cheese, butter, yogurt, and others. Madeta has a long history and is famous for its quality dairy products that are popular both in domestic markets and abroad. The total sales for the last year (2022) amounted to CZK 6,940,174 k; income after tax was CZK 212,952 k.

Faurecia Automotive Czech Republic s. r. o. - Faurecia Automotive Czech Republic s.r.o. is part of the international corporation Faurecia, which specialises in the manufacturing of automotive parts and components. The Czech branch of this company focuses on the development, production, and supply of automobile seats for the automotive industry. The total sales for the last year (2022), total sales amounted to CZK 17,899,054 k; income after tax was CZK 404,762 k.

Mondi Bupak s. r. o. - Mondi Bupak is in České Budějovice and currently employs about 220 people. It produces corrugated cardboard, which is then used for corrugated packaging solutions in an integrated production facility. It particularly focuses on the production of high-quality corrugated cardboard boxes used primarily in the main market segment of eCommerce. Its total sales for the last year (2022) amounted to CZK 2,038,898 k; income after tax was CZK 143,439 k.

Table 1 shows the development of personnel cost per employee in CZK thousands in the years 2016 - 2022 in five selected companies. FRONIUS Česká republika s.r.o., Robert Bosch, spol. s. r. o., MADETA a. s., Faurecia Automotive Czech Republic s. r. o., and Mondi Bupak s. r. o.

The values are interpreted as follows: First, From the FRONIUS Česká republika s.r.o. The cost per employee started at the level of CZK 441 thousand in 2016 and gradually reached CZK 665 thousand in 2022. There was a steady increase in costs with slight fluctuations until 2020. Then, the costs increased dramatically to CZK 623 thousand in 2020 and decreased to CZK 574 thousand in 2021. The year 2022 saw another significant growth to CZK 665 thousand. From the Robert Bosch, spol. s. r. o., the personnel costs per employee were significantly higher in the first year of the monitored period compared to the other companies, specifically, CZK 695 thousand. The costs grew gradually to CZK 981 thousand in 2022. A general trend with slight fluctuations can be seen; however, the year-on-year growth is not as pronounced as in other companies.

From the MADETA a. s. the costs per employee start at the level of CZK 380 thousand in 2016, gradually reaching CZK 593 thousand in 2022. The trend of increasing costs also shows slight fluctuations between individual years. Next in the Faurecia Automotive Czech Republic s. r. o. the cost per employee was at CZK

499 thousand in 2016 and rose to CZK 689 thousand in 2022. The company saw a relatively stable increase in costs, with minor fluctuations. From the Mondi Bupak s. r. o., the costs per employee were higher in the first year of the monitored period compared to MADETA and Faurecia, amounting to CZK 584 thousand, and gradually reached CZK 830 thousand in 2022. An increase with slight fluctuations can be seen, with a more pronounced increase in 2020, followed by a slight decrease and another growth in 2022.

Overall, it can be stated that the development of the cost per employee varied significantly in individual companies, with some companies experiencing stable growth with minor fluctuations. In contrast, others showed greater fluctuations, increases, and decreases in costs in specific years.

Table 1: Personnel cost per employee over the years in CZK thousands

Company	2016	2017	2018	2019	2020	2021	2022
FRONIUS Česká republika s.r.o.	441	494	500	541	623	574	665
Robert Bosch, spol. s. r. o.	695	727	794	799	810	890	981
MADETA a. s.	380	429	467	507	518	544	593
Faurecia Automotive Czech Republic s. r. o.	499	537	562	594	576	585	689
Mondi Bupak s. r. o.	584	597	603	713	762	792	830

Source: Author

Table 2 shows the development of fixed asset depreciation per CZK of net income in the years 2016 – 2022 for the same selected companies. The values in the table represent the ratio of fixed asset depreciation to net income. The units are not specified.

At first, from the FRONIUS Česká republika s.r.o., the fixed asset depreciation relative to the net income of this company shows low values throughout the monitored period. In 2016, the value was only 0.2, increasing to 0.5 in 2022. Overall, it can be seen that a major part of the net income was allocated to costs other than the depreciation of fixed assets. From the Robert Bosch, spol. s. r. o., in n 2020, fixed asset depreciation showed a negative value of -9.5, which might result from an extraordinary activity or accounting adjustment. Fixed asset depreciation relative to net income fluctuated between 1.6 and 3.0.

Next, from the MADETA a.s., the ratio of fixed asset depreciation to net income ranged between 0.3 and 0.8 in the monitored period. In 2022, the value grew to 0.8, which might indicate a higher allocation of income to fixed asset depreciation. From the Faurecia Automotive Czech Republic s. r. o., the depreciation of fixed assets relative to net income in this company showed values between 0.3 and 1.2. The highest jump was recorded between 2016 and 2017 (from 1.2 to 0.3). From the Mondi Bupak s. r. o., this company showed a ratio of net income and fixed asset depreciation between 0.7 and 1.9 in the monitored period. In 2017, the highest value of 1.9 was recorded, which was then followed by a gradual decrease, reaching 0.7 in 2022.

Overall, it can be stated that the ratio of fixed asset depreciation and net income in each company shows specific fluctuation over the years. In some cases, major changes were recorded, which could be caused by various factors, such as accounting adjustments, changes in corporate strategies, or investment plans.

Table 2. Depreciation of fixed asset per CZK of net income in the monitored period

Company	2016	2017	2018	2019	2020	2021	2022
FRONIUS Česká republika s.r.o.	0.2	0.3	0.2	0.1	0.4	0.2	0.5
Robert Bosch, spol. s. r. o.	2.8	1.6	2.3	1.6	-9.5	2.7	3.0
MADETA a. s.	0.3	0.4	0.7	0.6	0.4	0.7	0.8
Faurecia Automotive Czech Republic s. r. o.	1.2	0.3	0.6	0.3	0.5	0.5	0.3
Mondi Bupak s. r. o.	1.0	1.9	1.2	0.9	0.9	1.1	0.7

Source: Author

Table 3 shows sales per employee in CZK thousands for the selected companies in the years 2016 – 2022.

From the FRONIUS Česká republika s.r.o., in 2016, sales per employee amounted to CZK 3,576 thousand, gradually increasing and reaching CZK 4,221 thousand in 2022. A slight decrease to CZK 3,584 thousand was recorded in 2021, followed by significant growth in 2022. From the Robert Bosch, spol. s. r. o., the sales per employee amounted to CZK 6,112 thousand in 2016. This was followed by a gradual decrease to CZK 5,022 thousand in 2022. Within the monitored period, sales showed a gradual decrease with minor fluctuations. From the MADETA a. s., the sales per employee started at CZK 3,649 thousand in 2016. At the end of the monitored period, the value was CZK 5,389 thousand. The trend of sales per employee for this company showed stable growth with minor fluctuations.

Next from the Faurecia Automotive Czech Republic s. r. o., at the beginning of the monitored period, sales per employee were very high (CZK 30,110 thousand in 2016), increasing steadily and reaching CZK 54,078 in 2022. This indicator showed a consistent and pronounced trend, with an annual year-on-year increase. From the Mondi Bupak s. r. o., the sales per employee started at the level of CZK 4,373 thousand in 2016, gradually reaching CZK 8,784 thousand in 2022. The company also reported a continuous growth in sales, with a year-on-year increase.

Overall, it can be seen that the trend of sales per employee was different for each company. Some companies reported stable growth with minor fluctuations only, while others showed greater fluctuations and changes over the monitored years. Faurecia Automotive Czech Republic s. r. o. and Mondi Bupak s. r. o. showed a significant and continuous increase in sales per employee throughout the monitored period. In contrast, Robert Bosch, spol. s. r. o., showed a decreasing trend of sales per employee between 2016 and 2022.

Table 3. Company sales per employee in individual years in CZK thousands

Company	2016	2017	2018	2019	2020	2021	2022
FRONIUS Česká republika s.r.o.	3 576	3 744	3 513	3 957	3 680	3 584	4 221
Robert Bosch, spol. s. r. o.	6 112	5 515	5 736	5 620	4 763	4 925	5 022
MADETA a. s.	3 649	3 763	3 871	4 024	4 001	4 289	5 389
Faurecia Automotive Czech Republic s. r. o.	30 110	25 771	23 418	31 942	34 283	47 755	54 078
Mondi Bupak s. r. o.	4 373	4 904	4 984	5 011	5 968	6 655	8 784

Source: Author

Table 4 shows the net income generated by individual companies per employee in CZK thousand in 2016 – 2022.

From the FRONIUS Česká republika s.r.o., the net income per employee started at CZK 255 thousand in 2016. In 2022, it amounted to CZK 116 thousand. There were fluctuations between individual years. From the Robert Bosch, spol. s. r. o., in this company, net income per employee amounted to CZK 83 thousand in 2016, with a gradual increase to CZK 108 thousand in 2021, followed by a decline to CZK 89 thousand in 2022. The company showed a slight growth compared to the value in the first year of the monitored period.

Next from the MADETA a.s., in 2016, net income per employee amounted to CZK 241 thousand. In 2022, it declined to CZK 159 thousand, which means that the company reported an overall decline in net income per employee, with slight fluctuations over the years. From the Faurecia Automotive Czech Republic s. r. o., this company experienced considerable growth in net income per employee, starting from CZK 189 thousand in 2016 to CZK 1,223 thousand in 2022. The net income per employee in this company showed considerable and continuous growth throughout the monitored period. From the Mondi Bupak s. r. o., the net income per employee was CZK 198 thousand in 2016, reaching gradually CZK 610 thousand in 2022. The indicator shows stable and continuing growth throughout the whole monitored period.

Overall, it can be stated that individual companies show various trends in net income per employee, with some of them reporting stable growth while others experienced higher fluctuations and or a decrease. Faurecia Automotive Czech Republic s. r. o. and Mondi Bupak s. r. o. show considerable and stable growth in net income

per employee, while FRONIUS Česká republika s.r.o. and MADETA a. s. reported a decrease or a higher fluctuation over the years.

Table 4. Net income per employee in individual years in CZK thousand

Company	2016	2017	2018	2019	2020	2021	2022
FRONIUS Česká republika s.r.o.	255	149	177	325	121	209	116
Robert Bosch, spol. s. r. o.	83	133	107	169	-33	108	89
MADETA a. s.	241	198	114	151	222	179	159
Faurecia Automotive Czech Republic s. r. o.	189	761	448	1 234	737	756	1 223
Mondi Bupak s. r. o.	198	119	249	308	387	290	610

Source: Author

Figure 2 shows that in the FRONIUS Česká republika s.r.o, personnel cost per employee shows a relatively stable trend with slight fluctuations over the years. Between 2016 and 2022, there was a gradual increase in this indicator. In Robert Bosch, spol. s. r. o., the trend of personnel cost per employee experienced a gradual increase between 2016 and 2022. The indicator showed a year-on-year increase throughout the monitored period, with slight fluctuations. In the MADETA a.s., Personnel cost per employee grew gradually from 2016 to 2022, showing a relatively stable trend. In the Faurecia Automotive Czech Republic s. r. o., the company experienced a slight increase in personnel cost per employee in the monitored period, with certain fluctuations in individual years. In the Mondi Bupak s. r. o., the trend of personnel cost per employee shows a gradual increase between 2016 and 2022, with slight fluctuations in the monitored period.

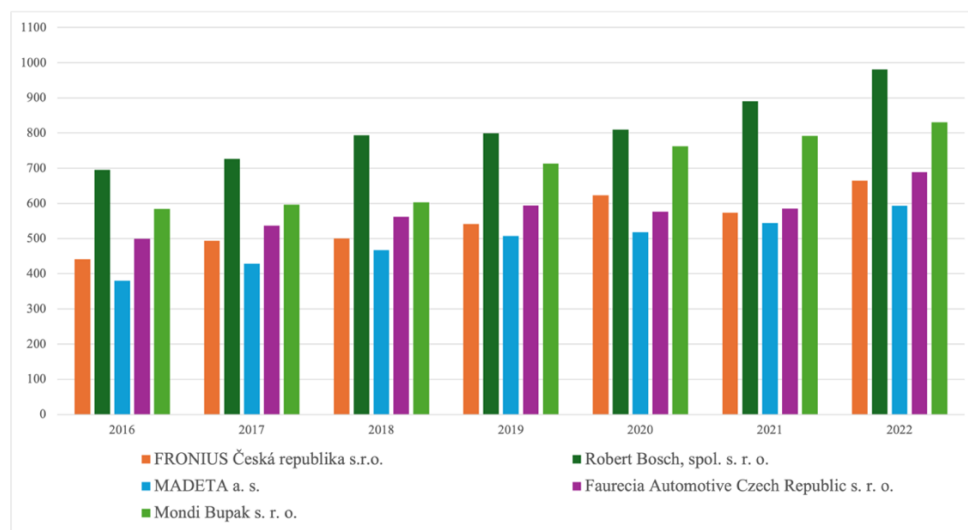


Figure 2. Personnel cost per employee in the monitored period in CZK thousand

Source: Author

Figure 3 shows a trend of personnel cost per employee in individual companies over the years. The trends might reflect changes in investment in human resources, wage growth, changes in the organisational structure, or other factors influencing employee-related costs. In the FRONIUS Česká republika s.r.o., the trend shows a slight increase and decrease in individual years, with the value ranging between 0.2 and 0.5. In Robert Bosch, spol. s. r. o., a significantly negative value was recorded in 2020, which may indicate an unusual situation or an exceptional year, as, in the following years, the value was positive again. In the MADETA a. s., the trend is relatively stable, with the values ranging from 0.3 to 0.8. In the Faurecia Automotive Czech Republic s. r. o., the value of fixed asset depreciation per CZK of net income remains relatively stable around the values of 0.3-0.6. The trend in Mondi Bupak s. r. o., ranges between 0.7 and 1.9, where in the last years of the monitored period, the value was stable, around 0.7. It also indicates different trends in the values of fixed asset depreciation

per CZK of income for individual companies. The data obtained might reflect variations in investment strategy, renewal of current assets, and asset management in individual companies within the monitored period.

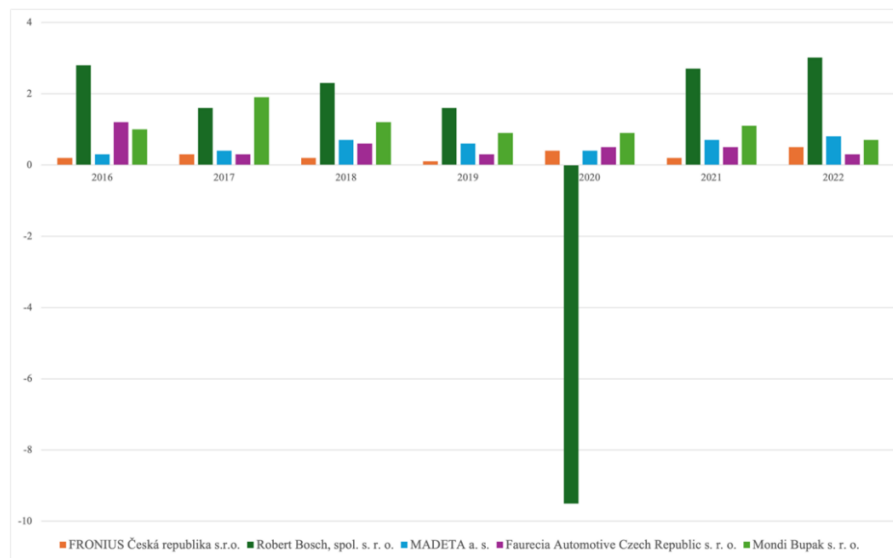


Figure 3. Trend of fixed asset depreciation relative to CZK of net income in CZK thousand

Source: Author

Figure 4 shows FRONIUS Česká republika s.r.o., the sales per employee show mild fluctuations within the monitored period, with a slightly upward trend between 2016 and 2022. In the Robert Bosch, spol. s. r. o., the trend of sales per employee showed a decrease between 2016 and 2022, with several fluctuations during this period. From the MADETA a.s., in this company, sales per employee show a gradual growth between 2016 and 2022, with minor fluctuations. The Faurecia Automotive Czech Republic s. r. o. reported a considerable increase in sales per employee in the years 2016 - 2022. The trend of Mondi Bupak s. r. o., in sales per employee shows a gradual increase in the monitored period, with several fluctuations recorded. It clearly shows different trends in sales per employee in individual companies. The differences might be due to different business growth strategies, changes in product portfolio, or changes in market conditions within the monitored period.

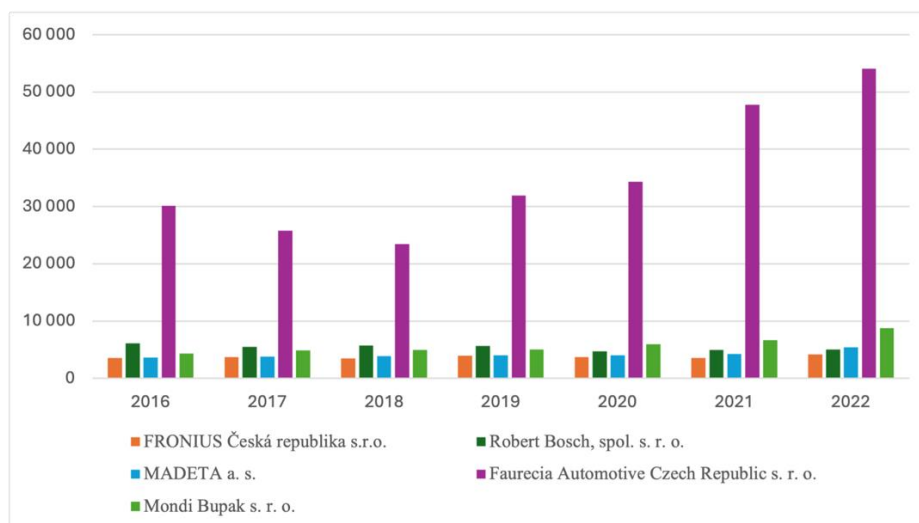


Figure 4. Sales per employee in individual years in CZK thousand

Source: Author

Figure 5 shows that in FRONIUS Česká republika s.r.o., the trend of net income per employee is variable, with fluctuations recorded throughout the monitored period and a decrease in the years 2017 and 2021. In Robert Bosch, spol. S. r. o., the company reports a variable trend of net income per employee, with a decrease in 2017 and 2020 followed by an increase in 2021. From MADETA a.s., the trend shows a slight decrease in net income per employee between 2016 and 2022, with several fluctuations in some years. In Faurecia Automotive Czech Republic s. r. o., net income per employee showed significant growth between 2016 and 2022, with a large jump recorded in 2019. The trend of net income per employee in Mondi Bupak s. r. o., shows a slight increase with several fluctuations recorded throughout the period. It clearly shows diverse trends of net income per employee in individual companies. The differences may be due to various factors, such as changes in business, effective use of resources, or business growth strategies in the monitored period.

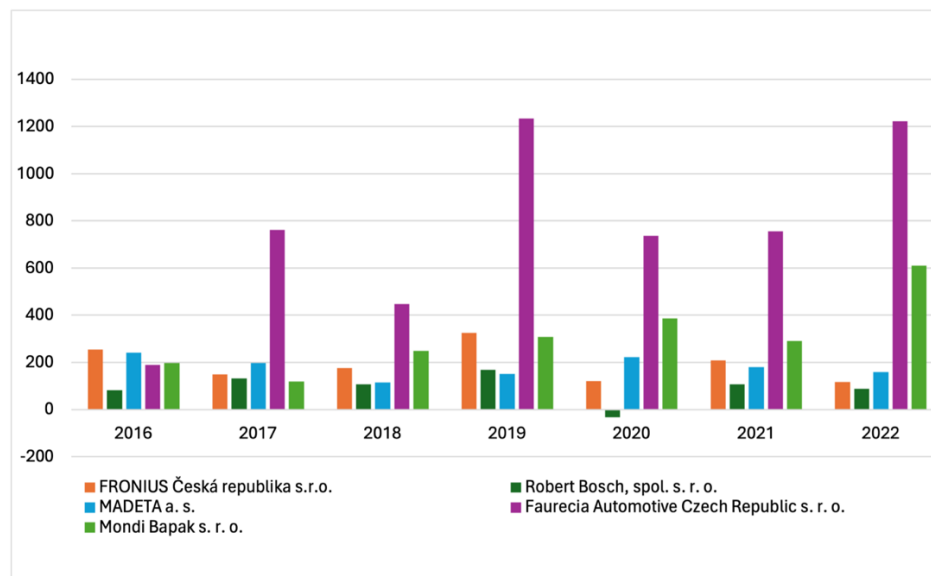


Figure 5. Net income per employee for individual years (in thousands CZK)

Source: Author

Pearson correlation between “Personnel cost per employee” and “Fixed asset depreciation to CZK of net income” for individual companies are as follows:

- | | |
|--|----------|
| 1. FRONIUS Česká republika s.r.o. | : 0.699 |
| 2. Robert Bosch, spol. s. r. o. | : 0.078 |
| 3. MADETA a. s. | : 0.776 |
| 4. Faurecia Automotive Czech Republic s. r. o. | : -0.654 |
| 5. Mondi Bupak s. r. o. | : -0.620 |

The correlation coefficient value for the company FRONIUS Česká republika s.r.o. is 0.699, indicating a strong positive correlation between personnel cost per employee and fixed asset depreciation. This means that the relation between both variables is directly proportional; the value of depreciation of fixed assets grows with increasing personnel cost and vice versa. In the Robert Bosch, spol. s. r. o., the value of the correlation coefficient is 0.078, which indicates a very weak or no correlation between personnel cost per employee and fixed asset depreciation. There is no clear relationship between these two variables, implying that an increase or decrease in one variable does not necessarily influence the second variable.

The correlation value (0.776) of the company MADETA a. s. confirms a strong positive correlation between personnel cost per employee and fixed asset depreciation. This means that an increase in personnel cost causes

a decrease in fixed asset depreciation and vice versa. The correlation coefficient value (-0.654) of the company Faurecia Automotive Czech Republic s. r. o., indicates a strong negative correlation between personnel cost per employee and fixed asset depreciation. This negative relationship shows that an increase in personnel cost may lead to a decrease in fixed asset depreciation and vice versa. The value of the correlation coefficient in Mondi Bupak s. r. o (-0.620) again indicates a strong negative correlation between personnel cost per employee and fixed asset depreciation, which means that an increase in personnel cost may cause a decrease in fixed asset depreciation and vice versa. Overall, Figure 6 shows the values of the correlation coefficient and provides important information on the relationship between personnel cost per employee and fixed asset depreciation. Negative correlations for Faurecia Automotive and Mondi Bupak suggest an inverse relationship between these variables, while in the case of FRONIUS and MADETA, it is a directly proportionate relationship. For U Robert Bosch s. r. o., the correlation is weak or non-existent.

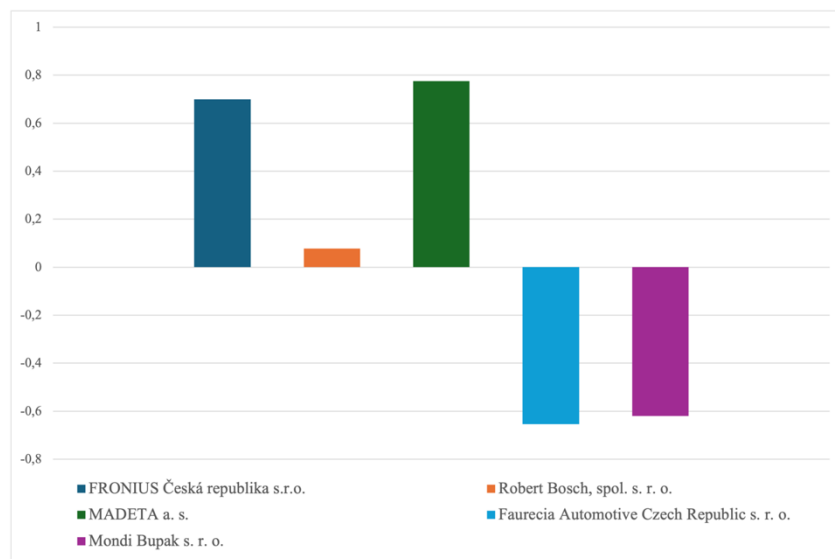


Figure 6. Values of correlation coefficients between personnel cost per employee and fixed asset depreciation per CZK of net income for individual companies.

Source: Author

4.2 Discussion of Results

RQ1: What is the correlation between the development of personnel costs per employee and net income per employee of the selected companies in the years 2016 – 2022?

The results of the analysis show variability in the relationship between the development of personnel cost per employee and net income per employee for individual companies under analysis in the period of 2016 – 2022. For some companies, such as FRONIUS Česká republika s.r.o. and MADETA a.s., a strong positive correlation between the development of personnel cost and fixed asset depreciation per CZK of income was identified, which indicates that an increase in personnel cost might be correlated with higher depreciation of fixed assets, hereby influencing net income per employee.

In contrast, companies such as Robert Bosch, Faurecia Automotive Czech Republic s.r.o. and Mondi Bupak s.r.o. show a weaker or even negative correlation. In the case of Robert Bosch, there is no clear indication of a relationship between the development of personnel cost and depreciation of fixed assets per CZK of income, while the negative correlation in the case of Faurecia Automotive Czech Republic s.r.o. and Mondi Bupak s.r.o. indicates that an increase in personnel cost can be related to a decrease in fixed asset depreciation, which may have a negative impact on net income per employee.

Such variability suggests the existence of various dynamics and factors influencing the relationship between cost per employee and income in individual companies. Moreover, it also confirms that an increase in cost per employee does not necessarily generate a higher income due to the influence of specific factors and strategies employed by the companies over time.

The results suggest that the relationship between the trend of personnel cost and fixed asset depreciation per CZK of net income differs in individual companies. For some companies, a strong and positive correlation was confirmed (FRONIUS, MADETA), while in other companies, it is weaker or even negative (Faurecia Automotive, Mondi Bupak). For Robert Bosch, the relationship between these two variables could not be clearly defined. The research results are in line with several studies mentioned by Jaafar et al. (2018) and Clemons et al. (2017).

Jaafar et al. (2018) point out that factors such as indebtedness and profitability might play an important role when analysing the relationship between personnel cost per employee and net income per employee, as well as in the case of examining the relationship between the impact of fixed asset depreciation on net income. The author's research findings support this concept, as there is variability in the relationship between the trend of personnel cost and net income per employee in individual companies.

Clemons et al. (2017) point to the usefulness of analysing the allocation of labour and cost while considering the development of personnel cost per employee and total sales per employee. The author's findings support this statement, as they suggest the existence of variability in the relationship between cost per employee and net income in individual companies, which may be due to various factors, including the allocation of funds and costs.

RQ2: What is the correlation between the depreciation of fixed assets per crown of net income and the development of sales-per-employees in the selected companies in the years 2016 – 2022?

To assess the effect of fixed asset depreciation on net income in comparison with the trend of sales per employee, it is necessary to compare the trend of fixed asset depreciation with the trend of sales per employee. Fixed asset depreciation in the FRONIUS Česká republika s.r.o., shows a relatively low trend, with the values ranging from 0.1 to 0.5. Sales per employee grew gradually from 3,576 in 2016 to 4,221 in 2022. Based on these findings, it is not possible to determine the direct relationship between fixed asset depreciation and the trend of sales per employee.

In 2020, the company Robert Bosch, spol. s. r. o., experienced a considerable decrease in fixed asset depreciation per CZK of net income (-9.5), followed by growth in the next years. Sales per employee decreased from 6,112 in 2016 to 5,022 in 2022. A certain relationship can be seen between a significant decrease in sales per employee and a subsequent decrease in fixed asset depreciation; however, a direct correlation cannot be determined. In the company MADETA a.s., the values of fixed asset depreciation fluctuated between 0.3 and 0.8. Sales per employee grew from 3,649 in 2016 to 5,389 in 2022. No clear relationship between the trend of fixed asset depreciation and sales per employee can be identified.

Fixed asset depreciation of the company Faurecia Automotive Czech Republic s. r. o. showed a relatively stable trend, with values ranging from 0.3 and 1.2. Sales per employee grew from 30,110 in 2016 to 54,078 in 2022. There is no clear direct relationship between the trend of fixed asset depreciation and sales per employee.

In the Mondi Bupak s. r. o., the trend of fixed asset depreciation fluctuated between 0.7 and 1.9. Sales per employee increased from 4,373 in 2016 to 8,784 in 2022. As in other companies, it is not possible to determine the relationship between the trend of fixed asset depreciation and sales per employee. Overall, it can be seen that for most companies, the relationship between the trend of fixed asset depreciation and total sales per employee cannot be determined. Both metrics seem to have developed independently in the monitored period, with no consistent pattern or relationship between these two factors. Jaafar et al. (2018) confirm that the financial stability and performance of the company can positively affect the development of sales per employee and fixed

asset depreciation. Especially in the context of the effect of depreciation on net income, it is necessary to consider the interaction of these factors with other indicators of a company's financial health.

5. Conclusions

The paper's objective was to analyse the major factors affecting corporate decision-making on investing in the technologies of Industry 4.0 and identify the key barriers that hinder companies from entering this era. The objective of the paper was achieved. However, there are certain limitations and a need for further research. The paper provides valuable information and outlines the relationship between the observed variables. Nevertheless, due to the diversity of the results, further research and in-depth analysis are needed to understand the relationship between these factors better. Therefore, it is necessary to consider other aspects when interpreting and applying the findings in practice.

In the context of examining the correlation between the trend of personnel cost per employee and net income for the selected companies in the period of 2016-2022, different levels of correlation were found. For some companies (e.g., FRONIUS and MADETA), a stronger and positive correlation was identified between the development of these variables, while in other companies (Faurecia Automotive and Mondi Bupak), a weaker or even negative correlation was determined. In the case of Robert Bosch, the relationship between personnel cost and net income could not be clearly defined.

As regards the effect of fixed asset depreciation per CZK of net income in comparison with the trend of sales per employee, no clear relationship was confirmed for most of the companies under study. The relationship between the development of these factors seems to be inconsistent, with no single pattern. The impact of factors such as financial stability and performance of the company might be important when examining these relationships and their effect on the company's financial health.

Overall, it can be stated that the relationship between the development of personnel cost per employee and fixed asset depreciation represents a comprehensive financial indicator and can be influenced by various factors important for the company's overall performance.

Let's look into some of the benefits of this research. First, the comprehensive analysis of the relationship between personnel cost, fixed asset depreciation, and key financial indicators, such as net income and sales per employee for selected companies in the monitored period. Statistical tools and correlation analysis were used to identify differences in interaction between the observed variables for individual companies. The information and findings from the research can provide a context for managerial decision-making and strategic planning in finance and human resources.

Now, we have to look into the drawbacks of this research. First, the lack of detailed information on the data collection method and the limited period (2016-2022) can limit the scope of the analysis and generalisations of conclusions made. Secondly, the limitation of the research only to companies operating in the South Bohemia region can distort the results obtained since economic and industrial conditions, regulations, and market behaviour can differ in different regions or countries. Given the diversity of the results, further research and in-depth analysis are needed to understand the relationship between the observed factors better. Overall, the paper provides valuable information and outlines the relationship between the observed variables. However, due to the limitations identified and the need for further research in this field, other aspects shall be considered when interpreting and applying the findings in practice.

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