Analysis of Technological Competencies from an Economic Perspective

Leticia Pekk[1], Andras Hary[2] and Zoltan Kovacs[1]
[1]University of Pannonia, Veszprém, Hungary
[2]ZalaZONE Science Park Ltd., Zalaegerszeg Hungary

leticia.pekk@tc.org.hu
andras.hary@apnb.hu
kovacs.zoltan@gtk.uni-pannon.hu

Abstract: The research examines technological competencies from the perspectives of both human and technical components, emphasizing their significance in responding to corporate management challenges. Recent global changes have triggered significant technological transformations, presenting new challenges for corporate management. In this context, technological competence – encompassing both qualified human resources and technical innovations – plays a crucial role in the success of the responses provided by companies. The objective of the study is to demonstrate how technological competencies affect a company's economic performance and strategic adaptation capabilities. Data collected within the research framework included economic information provided by companies, such as revenue and staff numbers, as well as specific data related to technological forecasting methods. The analytical methods employed enabled the creation of a comprehensive understanding of the role technological competencies play in the economic context. The research underscores how the development of technological competencies can assist companies in successfully navigating through the challenges posed by technological changes. The findings indicate that the development of human resources and the integration of technological innovations are indispensable for strengthening corporate success and market position. Expert-type companies, which facilitate knowledge-based development and the introduction or marketing of new technologies, particularly benefit. In these companies, not just the technical equipment, but also human capabilities are decisive in successfully responding to technological challenges. This supports the importance of combining human resource development and technological innovations. The application of technological forecasting methods enables companies to better anticipate and manage market and technological trends, further strengthening their adaptive and innovative capacity. In summary, the research concludes that the harmony between technological competencies, knowledge, and corporate strategy enhances organizational competitiveness, highlighting the importance of knowledge-based development and the expansion of qualified human resources. To successfully adapt to the dynamics of technological changes, companies need to integrate technological competencies at a strategic level, thereby promoting knowledge-based economic growth and long-term success.

Keywords: Technological Competencies, Economic Performance, Corporate Management, New Technologies

1. Introduction

In recent years, the business landscape has undergone significant transformations due to rapid technological advancements and shifting global dynamics. These changes have not only redefined the market conditions but also reshaped the way companies operate and compete. Central to navigating this evolving environment is the development of technological competencies which encompass a blend of qualified human resources and advanced technical innovations.

Understanding and harnessing these competencies have become pivotal for companies aiming to maintain a competitive edge and respond effectively to management challenges. While it may seem intuitive that technical competency positively influences economic performance, empirical evidence is mixed. Some studies, such as Oztemel and Ozel (2019), highlight the substantial role of technological infrastructure in enhancing company performance, whereas others, like Ainin et al. (2010), emphasize the importance of technical capability, firm innovativeness, and e-business practices. These mixed findings indicate the need for further research to gain a deeper understanding of how technological competencies affect business performance across different contexts. This study seeks to explore the intricate relationship between technological competencies and corporate management, emphasizing how these elements contribute to a company's economic performance and strategic adaptation. Through a comprehensive analysis of various data sources, including company-provided economic information and technological forecasting methods, this research aims to provide insights into how organizations can leverage these competencies to foster sustainable growth and long-term success in a dynamic global market.

Wolff (2021) discusses the complexities and interconnectivity of modern technologies, such as artificial intelligence and the Internet of Things, emphasizing the challenges they pose for governance and social control.

She highlights the increasing difficulty of understanding and managing these technologies due to their sophisticated nature. Wolff (2021) argues for a more nuanced understanding of technological impact, stressing the need for scholars to explore both the positive and negative effects of technological advancements on society. Also, underlines the importance of developing social, political, and legal tools to guide the evolution of technology in beneficial directions.

The analysis by Ellingrud et. al (2020) highlights the significant impact of automation and digitization on the workforce in operationally intensive sectors. As technologies advance, up to 58% of operational tasks could be automated using existing technologies, dramatically shifting skill requirements. The future demand will focus increasingly on technological skills, with a projected rise of over 50%, and a similar increase for complex cognitive skills. However, many leaders are unprepared for these changes, hindered by a lack of clarity on future skill impacts and insufficient tools to manage the transition effectively.

Considering these global changes and technological advancements, it becomes clear that companies must not only focus on developing human resource competencies but also pay close attention to their strategy formulation processes to successfully adapt and thrive in the rapidly changing business environment.

Hunger and Wheelen (2020) outline that strategic management typically evolves through four phases: from basic financial planning and forecast-based planning to externally oriented strategic planning, and ultimately to strategic management, which incorporates implementation, evaluation, and control into strategy formulation. This evolution reflects the need for organizations to adapt to dynamic environments and transition from rigid, bureaucratic structures to flexible, learning organizations. Such adaptability is crucial as it enables organizations to maintain competitiveness by continually reassessing their strategies and responding quickly to environmental changes.

The novelty of the study lies in its comprehensive examination of how structured technology management and forecasting practices influence a company's technological competence, particularly focusing on both economic performance and strategic adaptability. Additionally, the authors introduce a specific approach to defining and measuring technological competencies using two key indicators: knowledge intensity and technical intensity. Through a comprehensive analysis of various data sources, including company-provided economic information and technological forecasting methods, this research aims to provide insights into how organizations can leverage these competencies to foster sustainable growth and long-term success in a dynamic global market.

Given the significant shifts in the business landscape, it is essential to investigate this area further. The study is based on interviews with representatives from 62 companies to gain deeper insights into their strategic practices and viewpoints. Publicly available business data were also analysed to assess the economic performance of these organizations, comparing them with their systematic approach to developing technological competencies. This comprehensive method enables an examination of how effectively organizations are using their technological competencies to improve their strategic and operational effectiveness amidst ongoing global and technological transformations.

2. Literature Review

Nowadays in the business landscape, the influence of new technologies on organizational strategy, management methods, and corporate performance is profound. The literature review synthesizes findings from various studies that explore these dynamics, offering insights into how businesses are adapting to the technological era.

Marinkovic et al. (2022) stress the critical role of corporate foresight in enabling organizations to anticipate and adapt to rapid technological changes and market dynamics. Their study highlights how effective foresight activities help companies maintain competitiveness by preparing for future scenarios and mitigating potential risks. Also, advocate to integrate corporate foresight into strategic management to enhance responsiveness and strategic flexibility. Zhao et al. (2022) discuss the distinction between corporate foresight and technology foresight in the context of strategic planning and technology management. The authors highlight that while both concepts involve anticipatory functions, they serve different strategic roles within organizations. Corporate foresight is identified as a broader process that encompasses not only technological insights but also environmental scanning, societal changes, and economic shifts, making it integral to overall strategic management. In contrast, technology foresight is more narrowly focused on emerging technologies and their potential impacts on sectors and markets, specifically aiding in technological planning and innovation management.

Ilyina et al. (2020) emphasize the necessity for organizations, particularly within scientific sectors, to adapt rapidly to market changes. They propose a unified digital platform that integrates scientometric indicators and Technology Project Readiness Levels to enhance the management and visualization of scientific and technological competencies, fostering collaboration and innovation across industries. Tronina et al. (2020) suggest a methodological approach to mapping key technological competencies within regions, advocating for "smart specialization" to leverage regional strengths and drive innovation. This strategy aims to align regional capabilities with emerging opportunities, enhancing strategic planning and promoting sustainable economic growth. Oztemel and Ozel (2019) discuss the importance of technological competency assessments in SMEs, particularly in the manufacturing sector. They introduce a model that evaluates essential technological capabilities, providing a roadmap for SMEs to enhance their competitive advantage by aligning their technological infrastructure with contemporary standards. Zoia et al. (2018) examine factors influencing the technological status of Italian firms, finding that firm size, internationalization, and cooperation significantly impact innovation capabilities. The study points to the importance of geographic location and the propensity of technologically capable firms to engage in innovative cooperation. Fuertes et al. (2020) analyse the strategic management literature, noting a lack of theoretical frameworks to guide the formulation and evaluation of strategies in the context of technological advancements. They advocate for a balance between systematic planning and adapting to the organic, often chaotic nature of strategic processes. Belas et al. (2020) investigate management practices within SMEs, noting the critical role of human resources and participative management styles in adapting to changing business environments. Their findings suggest that a strategic integration of human resources is essential for corporate adaptability and performance. Toborek-Mazur and Partacz (2023) delve into how technological development impacts corporate management methods, highlighting the increasing significance of knowledge and technology management as critical components of modern business practices. Hamdani et al. (2018) discuss the impacts of AI, blockchain, and data analytics on corporate structures, predicting a future where traditional hierarchical structures may become obsolete due to the decentralizing power of these technologies. Tanushev (2022) focuses on the strategic adaptation required for businesses to thrive in the digital age, using Kaplan and Norton's strategy maps to outline the influence of digital processes on enhancing customer value and developing sustainable business models. Agolla (2018) presents a model aligning innovation, strategy, and strategic human resource management, positing that integrating these elements enhances organizational competitiveness by fostering an innovative capacity through strategic HR practices. Singla et al. (2018) analyse the transition between technology push and demand-pull strategies in manufacturing, supporting the view that market needs are crucial drivers of innovation. Fettig et al. (2018) explore the impact of Industry 4.0 on organizational structures, showing how the integration of Cyber-Physical Systems necessitates a re-evaluation of corporate strategies to maintain competitiveness in a digitally transformed economy.

The significance of technological competencies has increased substantially in recent years, as demonstrated by numerous studies showing that technological innovations and the associated development of human resources directly impact the economic performance of companies.

This review underscores the importance of technology foresight in equipping organizations to navigate and adapt to rapid technological and market changes. It highlights how integrating foresight into strategic planning and management is crucial for anticipating future challenges and seizing opportunities, thereby enhancing organizational agility and competitive edge in the global marketplace.

3. Research Question

The main research question of the paper seeks to examine the link between management approaches in technology and a firm's ability to develop and maintain technological competencies as a critical factor in today's fast-paced business environment:

- How do structured technology management practices and the use of technology forecasting impact the technological competence of the companies?

Technological competence: The ability of a company to effectively utilize technological resources to achieve competitive advantage. This includes the capacity to integrate, build, and reconfigure internal and external competencies to address rapidly changing environments. (Teece et al., 1997)

Technology management practices: These refer to the systematic approaches and processes that companies use to manage their technological resources and capabilities. This includes planning, implementation, and control of technological activities within the firm. (Gregory, 1995)

Technology forecasting: The process of predicting future technological developments and trends. This involves using various methods and tools to anticipate changes in technology that could impact the company's strategic planning and innovation efforts. (Watts and Porter, 1997)

Emerging from the identified need in the literature to understand the strategic integration of technological advancements, this study aims to:

- Assess the extent to which technology management practices are adopteded by companies.
- Analyse the relationship between the application of technology forecasting methods and technological competence levels.
- Determine the impact of these practices on a companies' capacities to innovate and compete.

Given the rapid evolution of technology and its disruptive impact on markets, the study is bounded by the examination of current technology management and forecasting practices, focusing on their direct correlation with measures of technological competence. It intends to contribute to the strategic management literature by offering empirical insights into the effectiveness of these practices, potentially guiding corporate leaders in optimizing their strategic responses to technological challenges.

4. Methodology

Data were gathered through structured interviews with representatives from 62 technology-intensive companies of varying sizes, including small, medium, and large enterprises. The selection of companies was based on identifying technology-intensive sectors. According to the research findings of Pekk et al. (2021), the telecommunications and electronics industries, as well as the machinery and automotive sectors, were selected for their high technology intensity. As a result of the interviews, two main areas were highlighted:

1. Technology Forecasting Application: Companies were asked about their use of technology forecasting methods, evaluated on a scale of 1 to 4, where:

- 1- indicates no use of technology forecasting,
- 2- acknowledges the importance of forecasting and its integration into decision-making,
- 3- signifies the use of simplified forecasting methods,
- 4- reflects the employment of comprehensive technology forecasting methods.

2. Technological Management Methodology: Companies were also rated on their systematic approach to technology management on a scale of 1 to 4, where:

- 1- Represents a non-systematic approach, where companies that apply technological forecasting and management methods on an ad-hoc or irregular basis.
- 2- Shows little evidence of a structured application of these methods.
- 3- Indicates that companies apply these methods consistently and moderately systematic approach.
- 4- Denotes a highly systematic and integrated technological management systems.

The evaluation of the Technological Management Methodology for the companies is based on several key factors: the systematic application of forecasting methods, the integration of strategy with new technologies, and the presence of systematic management practices. The Technological Management Methodology was classified and assessed accordingly by the authors.

Based on these assessments, a 4x4 matrix was constructed to classify companies according to their methodology in both areas, allowing for the identification of organizations with their systematic approaches in technology forecasting and management.

3. Technological competence was evaluated based on calculated values derived from public financial reports between 2012 and 2022. The calculation encompassed two components:

- Knowledge intensity: added value, derived from the average gross salary can reflect the skill level and knowledge of the workforce),
- Technical intensity: determined by the ratio of technology asset value to total revenue.

Knowledge intensity refers to the degree to which a company's operations and competitive advantage rely on specialized knowledge and skills. Higher knowledge intensity is linked to better innovation outcomes and higher productivity. For example, research by Ainin et al. (2010) demonstrates that companies with a more knowledgeable workforce are better positioned to implement advanced technologies and processes, leading to

sustained competitive advantages. Additionally, studies by Doloreux and Melançon (2008) emphasize the importance of knowledge-intensive industries in driving economic growth and innovation.

Technical intensity can also include other metrics such as the proportion of R&D expenditure to sales, the number of patents per employee, or the extent of technological equipment and infrastructure investments. This indicator measures the extent to which a company invests in technology relative to its overall size and is a key metric for understanding a company's commitment to maintaining and advancing its technological infrastructure. For example, studies like those by Hollenstein (1996) and Falk (2004) use similar measures to assess technical intensity in their respective analyses of innovation activities.

A 62x62 matrix was prepared, ranking companies according to these calculated values to position them based on their level of the two components of technological competence.

The final stage of the methodology involved a comparative analysis between the two matrices to investigate potential relationships or patterns between the companies' structured technology management practices, use of technology forecasting methods, and their overall technological competence. Figure 1 presents the interpretation of the two matrices and the way of examination of the correlations between them.

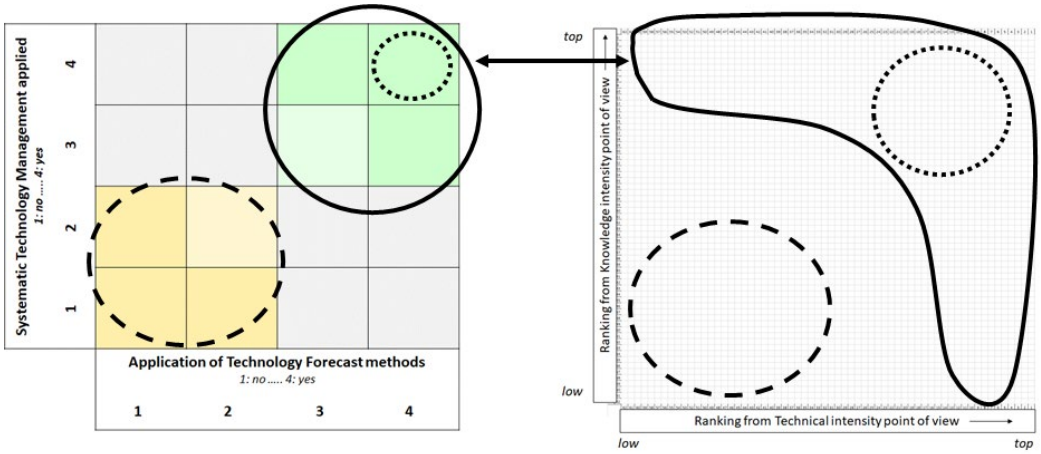

Figure 1: Display and expected relations of 4x4 and 62x62 matrices

This analysis aims to identify whether a systematic approach in these domains is indicative of higher technological competence, thereby providing valuable insights into effective management strategies for adapting to technological advancements.

5. Results and findings

This section highlights the findings derived from the analysis of the 4x4 and 61x61 matrices, which collectively represent the systematic application of technology management and forecasting alongside the calculated technological competence within the sample of the interviewed companies. The analysis aimed to explore how technological competencies - both human and technical - contribute to corporate success. Key observations include:

A. Contribution to corporate success: The study underscores that nearly 80% of the more systematic companies excel in either knowledge intensity or technical intensity, indicating that strong technological competencies in either dimension significantly contribute to corporate success.
B. Distinction in competence: Among the firms with more systematic approach, 3 out of every 7 exhibit strong competencies in both knowledge and technical intensity. This dual strength indicates that these companies, which excel in both dimensions of technological competence, are likely to achieve superior performance and adaptability in their respective industries.
C. Variability in approaches: Conversely, companies with less systematic approaches to technology management and forecasting tend to rank lower in both dimensions of technological competence. This suggests a correlation between the systematic application of technology strategies and higher levels of technological competence.

Figure 2 depicts the distribution of 62 companies based on the application of technology forecasting methods and the systematic nature of their technology management. The lower left quadrant, where both aspects score

low, is the most populated, indicating that majority of the companies do not employ systematic methods in either domain. Contrary, the upper right quadrant represents companies that score high in both, signifying a systematic approach in both technology forecasting and management. For the quadrants where companies have low technology forecasting but high technology management scores, it suggests these firms might prioritize internal processes and day-to-day operations over strategic foresight. This could imply a focus on current operational efficiencies rather than future-oriented planning, which may impact their long-term adaptability and innovation potential.

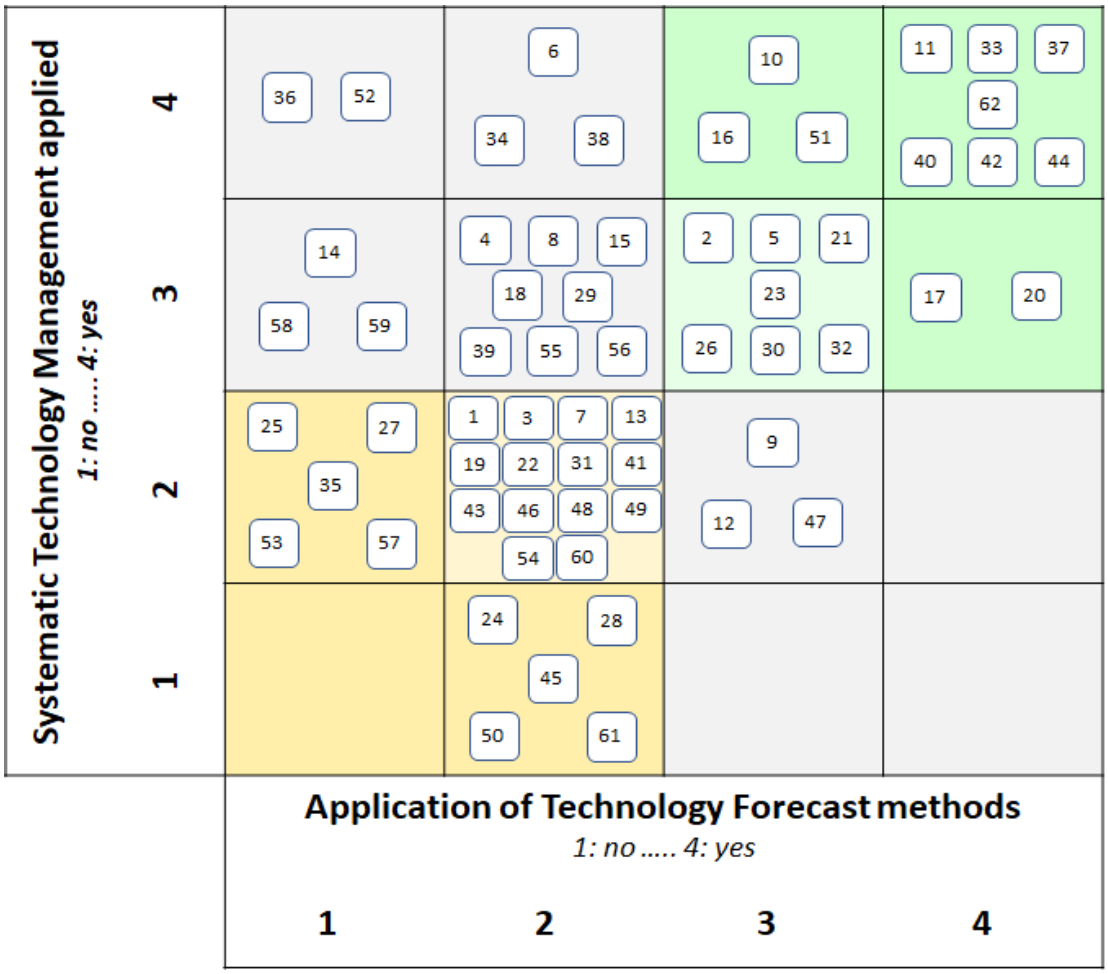

Figure 2: 4x4 matrix in the light of systematic Technology Management and Technology Forecasting methods across the analysed companies

Figure 3 illustrates a 62x62 matrix plotting the Knowledge Intensity and Technical Intensity of 62 companies, calculated from their business data. The marked 'L-shaped' area encloses companies that are strong in either or both dimensions, with those in the upper right quadrant excelling in both areas, indicating robust competencies. The green squares denote companies that were identified as methodical in both technology management and technology forecasting methods in the 4x4 matrix. Notably, three companies highlighted within the greens demonstrate high technical and knowledge intensities, pointing to their substantial capabilities in both domains.

The red squares indicate companies ranked as less methodical in the 4x4 matrix; these generally show weaker intensities in this matrix as well.

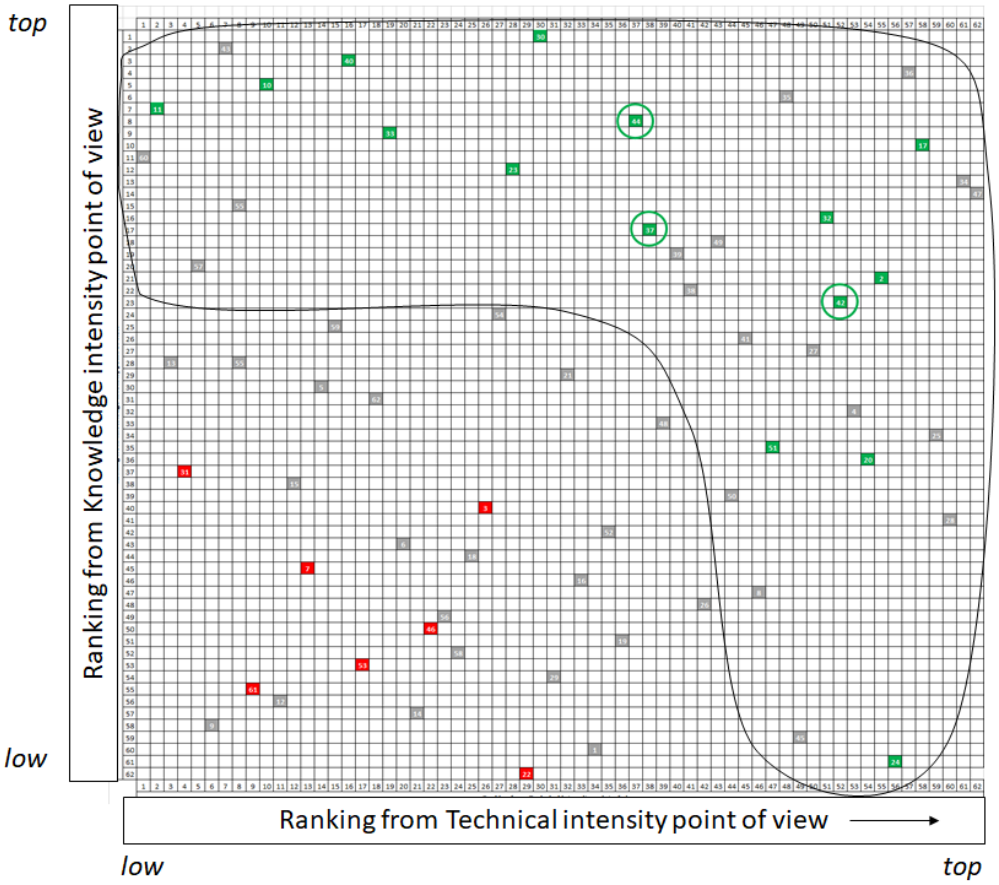

Figure 3: 62x62 matrix in the light of Knowledge intensity and Technical intensity across the analysed companies

The analysed companies do not necessarily show high scores in both dimensions to be successful. High Knowledge Intensity, derived from the added value or average gross wages, suggests that a higher wage is associated with higher-skilled personnel. On the other hand, Technical Intensity, calculated as the ratio of technological costs to revenue percentage, indicates investment in technology. There are successful companies that do not rely on expensive technology for added value, demonstrating that high performance can be achieved through various paths of technological competence.

The analysis of interview data and collected information has led to the following additional conclusions, providing deeper insights into specific trends and correlations observed among the companies:

- Profitability trends: The collected data indicates significant variability in the profitability of companies over the years. For example, "Company 17" experienced exceptionally high profitability in certain years, while in other years, it did not show significant profits. This suggests that some companies achieve periodic or project-based success, driven by specific technological developments or large-scale projects.
- Technology management systematic nature: Following the comprehensive evaluation of the companies' technology management practices, it was found that companies such as "Company 10" and "Company 11" both of which received a high rating (4), generally exhibit better technological intensity and profitability.
- Correlation between systematic technology management and profitability: The analysis reveals that the systematic application of technology management practices is positively correlated with profitability. Companies that more consistently apply these methods, such as "Company 11" (rated 4), generally achieve higher profitability compared to those that are less systematic in their approach, such as "Company 1" (rated 2).
- Impact of human/tech cost index: The analysis shows that companies with a higher human/tech cost index, such as "Company 5" (rated 3), generally achieve higher technological intensity and better long-term performance. This suggests that investments in technology tend to pay off in the long run.

- Sector-specific trends: The differences between sectors are also notable. For example, companies operating in the manufacturing sector, such as "Company 3" and "Company 4", generally exhibit higher technological intensity and productivity. However, their technology forecasting methods are rated lower (2), and their technology management systematic nature scores are (2) and (3), respectively. This suggests that while these sectors benefit from technology management and forecasting, there is still space for improvement in their systematic application to achieve even better performance.

6. Limitations and Future Research

While the study reveals insights into the relationship between technological management practices and corporate success, its scope is limited by several factors. The sample, consisting of 62 companies, provides a focused glimpse but may not reflect the broader industry landscape. Moreover, the research's cross-sectional design captures a single moment in time, which might not encompass the evolving nature of technological competencies and forecasting practices. Self-reported data from interviews could also introduce a degree of bias, as companies may present themselves in a more favourable light.

Further research could delve into how companies with high technical intensity approach innovation versus optimization. This research could explore the strategic decisions that lead companies to prioritize one over the other and how this affects their competitive advantage in the market. It would be insightful to examine if companies with both high knowledge and technical intensities are more innovation-oriented compared to those with high technical intensity but lower knowledge scores, which may focus on optimizing current processes. A more granular analysis of industry-specific trends could provide a detailed understanding of how different sectors adopt methodical technology management and forecasting practices. Investigating sectoral distributions of companies in the matrix may identify patterns that suggest certain industries are inherently more inclined towards systematic technological strategies. This line of research could uncover industry benchmarks and best practices that drive technological competence.

7. Conclusion and Discussion

This research has undertaken a comprehensive examination of how structured technology management and forecasting practices influence a company's technological competence. The findings from the analyses of both the 4x4 and 62x62 matrices provide insightful answers. Nearly 80% of companies with methodical orientations demonstrate excellence in either knowledge or technical intensity, indicating that a strong presence in at least one of these dimensions is pivotal to corporate success. Moreover, a significant portion of the - companies with systematic management show strength in both dimensions, underscoring the dual significance of robust knowledge and technical capabilities for superior industry performance and adaptability.

Contrary, companies with less structured approaches tend to exhibit lower levels of technological competence, as indicated by their positions in the lower left quadrant of the matrices. This alignment suggests that systematic practices in technology management and forecasting are correlated with enhanced technological capabilities.

The examination of the distribution of companies with systematic and less systematic approach within the 62x62 matrix has yielded additional insights. The green squares, representing the companies identified as methodical in the 4x4 matrix, are predominantly positioned within the 'L-shaped' area, reinforcing the notion that methodical practices correlate with higher technological competencies. Notably, the three companies that excel in both knowledge and technical intensities affirm that excellence in both areas can coexist within highly systematic frameworks.

The novelty of this research lies not only in examining the structured practices of technology management and forecasting but also in defining and measuring technological competencies using specific indicators: knowledge intensity and technical intensity. This approach provides a deeper understanding of how these competencies are developed and maintained within companies.

Practically, these findings suggest that companies should consider investing in systematic technology management and forecasting as part of their strategic planning. This does not negate the effectiveness of high technical intensity or the value of skilled personnel; rather, it emphasizes the additional competitive edge that structured foresight can provide.

In conclusion, as businesses continue to navigate the ever-changing technological landscape, it is evident that those who adopt structured and well-established strategies in their management and forecasting efforts are better positioned to exploit their technological competencies for economic and strategic gains.

The research highlights the importance of structured technological practices in enhancing both economic performance and strategic adaptability, providing insights for companies aiming to achieve long-term success in a dynamic global market. Furthermore, it contributes to the existing body of knowledge by providing empirical observations on the effectiveness of these practices, thus contributing to the understanding of the strategic integration of technological advancements.

Acknowledgements

Prepared with the professional support of the doctoral student scholarship program of the co-operative doctoral program of the ministry of innovation and technology financed from the national research, development and innovation fund.

References

Agolla, J. E. (2018) Modelling the relationship between innovation, strategy, strategic human resource management and organisation competitiveness, *African Journal of Business Management*, 12(14), pp. 428–438.

Ainin, S. et al., (2010) An Assessment of Technological Competencies on Professional Service Firms Business Performance*, World Academy of Science, Engineering and Technology*, 66, pp. 599-605.

Belas, J. et al. (2020) Selected Factors Of Corporate Management In Smes Sector, *Polish Journal of Management Studies*, 21(1), pp. 119–134, Poland.

Tanushev, C. (2022) Digital Transformation: The Impact on Corporate Strategy*, Economic Alternatives*, 28(3), pp. 383–404.

Doloreux, D. and Melançon, Y. (2008) On the Dynamics of Innovation in Quebec's Coastal Maritime Industry. *Technovation*, 28(4), 231-243.

Ellingrud, K., Gupta, R. and Salguero, J. (2020) *Building the vital skills for the future of work in operations,* McKinsey & Company.

Falk, M. (2004) What drives business R&D intensity across OECD countries? *Applied Economics*, 36(8), 937-946.

Fettig, K. et al. (2018) Impact of Industry 4.0 on Organizational Structures, *in 2018 IEEE International Conference on Engineering, Technology and Innovation (ICE/ITMC)*, pp. 1–8, Stuttgart.

Fuertes, G. et al. (2020) Conceptual Framework for the Strategic Management: A Literature Review—Descriptive, *Journal of Engineering*, pp. 1–21.

Gregory, M. J. (1995) Technology management: A process approach. Proceedings of the Institution of Mechanical Engineers, Part B: *Journal of Engineering Manufacture*, 209(5), 347-356.

Hamdani, A. et al. (2018) Technological progress and the future of the corporation, *Journal of the British Academy*, 6(s1), pp. 215–245.

Hunger, J. D. and Wheeler, T. L. (2020) *Essentials of strategic management (5th ed.)*, Pearson Education, USA.

Ilyina, E.A. *et al.* (2020) Digital platform of scientific and technological competencies, *Journal of Physics: Conference Series*, 1475 (012010).

Hollenstein, H. (1996) A composite indicator of a firm's innovativeness. An empirical analysis based on survey data for Swiss manufacturing. *Research Policy*, 25(4), 633-645.

Marinkovic, M. *et al.* (2022) Corporate foresight: A systematic literature review and future research trajectories, *Journal of Business Research*, 144, pp. 289–311, UK.

Minghui, Z. *et al.* (2022) Literature Review and Practice Comparison of Technology Foresight, *Procedia Computer Science*, 199, pp. 837–844.

Oztemel, E. and Ozel, S. (2019) Technological competency assessment, *International Journal of Services Technology and Management,* Vol. 25, No. 2, pp.138–159.

Pekk, L., Háry, A. and Tóth, C. (2021) Technology Features of the Differenct Sectors, *Conference Proceedings Of The 3rd International Conference On The Economics Of Decoupling, pp. 513-526.*

Singla, A., Sethi, A. and Ahuja, I. S. (2018) A study of transitions between technology push and demand pull strategies for accomplishing sustainable development in manufacturing industries, *World Journal of Science, Technology and Sustainable Development*, 15(4), pp. 302–312.

Teece, D. J., Pisano, G. and Shuen, A. (1997).Dynamic capabilities and strategic management. *Strategic Management Journal*, 18(7), 509-533.

Toborek-Mazur, J. and Partacz K. (2023) The impact of technological development on changes for corporate management, *Scientific Papers of Silesian University of Technology, Organization and Management Series*, No. 184.

Tronina, I. A. et al. (2021) Methodological Approach To Building A Map Of The Region Key Technological Competencies, *European Proceedings of Social and Behavioural Sciences*, pp. 1043–1050, Russia.

Watts, R. J. and Porter, A. L. (1997) Innovation forecasting. *Technological Forecasting and Social Change*, 56(1), 25-47.

Wolff, J. (2021) *How Is Technology Changing the World, and How Should the World Change Technology?, Global Perspectives*, 2(1), California.

Zoia, M. G. *et al.* (2018) The determinants of Italian firms' technological competencies and capabilities, *Eurasian Business Review*, 8, pp. 453–476.