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EMPIRICAL ANALYSIS OF DIGITAL TECHNOLOGIES USED IN BUSINESS PROCESS MANAGEMENT

Abstract. The study examines the impact of innovation and digitalization on the sustainability and competitiveness of companies in a market with uncertainty. The goal of the research is to determine the role of investments in research and development (R&D) and digital technologies in creating long-term competitive advantages. Various research methods were used to achieve this goal: analysis of scientific literature, the case method, and correlation analysis. The theoretical review showed that investments in innovation and digital platforms not only increase the efficiency of internal processes for companies, but also provide them with greater opportunities for ecosystem interaction. Through case studies of leading corporations worldwide, it was revealed that consistent implementation of digital solutions and a focus on innovation potential help strengthen market positions, increase capitalization, and increase consumer and investor confidence. The analysis of the data presented in table form allowed us to trace in detail the dynamics of the ratio between R&D expenses, digital investments, and financial performance indicators of companies. The correlation analysis confirmed the existence of a strong positive relationship between innovation costs and revenue growth, profitability, and market share. Additionally, it was found that digitalization increases the impact of innovation activity, creating a synergetic effect that allows companies to adapt to the changing conditions of the global market.

The results confirm that innovation and digital technologies play a crucial role in driving sustainable development and the strategic sustainability of corporations. The practical significance of this work lies in the potential to apply the identified patterns to the formation of corporate strategies aimed at enhancing competitiveness and ensuring long-term business stability in the context of digital transformation.

Keywords: digital transformation; innovation; company; human capital; business process; management; sustainable development

INTRODUCTION

The modern business landscape is characterized by high dynamics, uncertainty and fierce competition, which forces organizations to look for new approaches to management and strategic development. In these conditions, digital technologies are no longer just an auxiliary tool and become the foundation of the functioning of enterprises, determining their competitiveness and sustainability. The rapid development of artificial intelligence, the Internet of Things, blockchain, cloud computing and platform solutions (ERP, CRM, BPM) is not only transforming management methods, but also changing the very nature of business operations, forming new paradigms of organizational development.

The relevance of this research is due to the fact that digital transformation has become a necessary condition for businesses to survive and grow. Digital technologies automate routine functions, integrate and process large amounts of data, and provide transparency and flexibility in management decisions. These technologies help accelerate planning and decision-making, minimize errors and risks, and create a more innovative and sustainable business environment.

However, the adoption of digital solutions also presents significant challenges. These include high financial costs, limited access to advanced technology, a shortage of skilled professionals,

and a lack of digital competence among employees. These obstacles lead to uneven levels of digitalization across different sectors, emphasizing the need for a thorough analysis of practical aspects of implementing digital technologies in business processes.

The purpose of this research is to investigate the impact of digital technologies on business process management through empirical means. We focus on identifying the key benefits of implementing artificial intelligence (AI) and the Internet of Things (IoT), their role in streamlining and enhancing organizational processes, and their potential to enhance operational efficiency and foster adaptive business ecosystems. Additionally, we aim to identify factors that impede the successful implementation of digital solutions and propose strategies to overcome them.

The scientific significance of this research lies in its potential to expand the theoretical and methodological understanding of the digital transformation of business and its impact on management systems. By considering artificial intelligence and the Internet of Things not only as efficiency-enhancing tools but also as catalysts for strategic change, we can rethink their role in creating flexible and innovative management models.

The novelty of this work lies in its comprehensive analysis of digital technologies as drivers of sustainable growth and long-term competitiveness. This analysis ensures integration at all levels of management, from operational to strategic, and provides a solid foundation for future research and practice.

The practical significance of this research lies in its potential application by companies, government agencies, and educational organizations to develop and adjust digital transformation strategies. It can also be used to optimize business processes and create intellectual ecosystems.

The results of this study can be applied to the development of digital development programs, training of staff, and support of innovative entrepreneurship. This study aims to comprehensively explore the possibilities and limitations of digital technologies in business process management and to form a theoretical and practical basis for improving organizational models in the context of digitalization and global competition.

LITERATURE REVIEW

Kazakh researchers view digitalization primarily through the lens of a national strategy. Maussymbaeva A. and her colleagues examined the implementation of artificial intelligence and Internet of Things technologies in Kazakh enterprises, highlighting their use for enhancing management transparency, automating reporting, and streamlining production processes. However, the authors acknowledged that these technologies face challenges such as a shortage of specialists and high implementation costs [1].

Kazybayeva A. and Pak E. explored the Digital Kazakhstan program and emphasized that digital technologies are not confined to optimizing business processes within individual companies but serve as a means to boost the overall productivity of the economy. Their analysis demonstrates that digitalization in Kazakhstan is not a standalone process but an integral part of the national innovation ecosystem [2].

Chinese writers emphasize the practical application of technology. Wang F. and Aviles J. have demonstrated that companies are adopting artificial intelligence for predictive analytics, automated decision-making, and cost reduction, making them more adaptable and resilient to change [3].

In his study, Hu Yu. illustrated how the Internet of Things is employed to gather and analyze data on equipment performance and consumer behavior in real-time. This shift from reactive problem-solving to proactive management enables companies to mitigate the risks of downtime and enhance productivity [4].

Authors from different countries pay special attention to the strategic aspect of digital technologies. In his works, Imran F. and his colleagues consider digital transformation as a process that includes not only the introduction of new tools, but also the modernization of business models, restructuring organizational structures and changing strategic directions. Thus, digital technologies become a catalyst for systemic changes [5].

Kokala A. studies the application of intelligent process analysis and shows how merging event log analysis methods with digital management platforms (ERP, BPM) helps optimize workflows, identify bottlenecks and increase efficiency. His approach demonstrates how digital platforms enable organizations to integrate analytics into day-to-day management [6].

Thus, in Kazakhstan, digital technologies are employed primarily in the framework of national strategies and to enhance governance transparency. In China, they are utilized for the practical optimization of manufacturing and trading processes. In international research, they serve as a foundation for systemic organizational transformations.

This demonstrates the universal nature of digital transformation, whose success is contingent upon the institutional context and the degree of digital readiness of organizations.

METHODS

The research employed a variety of techniques to thoroughly examine the issue.

Firstly, the method of literature review and secondary data analysis was employed, which involved the categorization of scholarly publications, reports, statistical data, and analytical reviews pertaining to the integration of digital technologies into business process management. This approach allowed for the identification of current trends in digital transformation, the elucidation of the key benefits of its implementation, and the recognition of existing challenges and constraints. The comparative analysis of diverse sources facilitated the development of a comprehensive understanding of the current state of the field under investigation.

Secondly, the case study approach was employed, with a particular emphasis on thoroughly examining practical examples of how artificial intelligence (AI) and the Internet of Things (IoT) technologies have been implemented in business operations. By examining real-world scenarios, we were able to discern successful digitalization approaches, assess the outcomes achieved, and pinpoint the factors that both facilitate and impede the success of digital transformation across various economic sectors.

Thirdly, the correlation analysis method was employed to quantify the relationships. This approach allowed us to determine the extent of statistical interdependence between the adoption of digital technologies and performance indicators for business processes, such as increased productivity, reduced costs, and enhanced management quality. The correlation analysis provided a means to objectively validate the theoretical findings and demonstrated the close relationship between the level of digitalization and the sustainability and competitiveness of organizations.

Fourth, the technique of factor analysis, which unveiled the underlying connections between the indicators of digitalization and the efficiency of business operations. Unlike the regression approach, this method concentrates on organizing numerous variables and combining them into key factors, allowing for a more thorough evaluation of the influence of digital technologies on managerial practices and the identification of the most crucial areas for transformation.

Fifth, the SWOT analysis method was utilized, which allowed for a comprehensive assessment of the strengths and weaknesses of digital transformation, as well as the identification of potential opportunities and challenges associated with the implementation of digital technologies. This method provided a strategic perspective on digitalization and helped to identify areas for further development.

Therefore, the integration of literature review, thematic analysis, correlation and regression analysis, and SWOT analysis provided a comprehensive approach that integrated theoretical and empirical perspectives, allowing for both qualitative and quantitative evaluations of the influence of digital technologies on business process management.

RESULTS

Firstly, the method of literature review and secondary data analysis was used, which included studying scientific publications, analytical reports, statistical materials, and practical cases of the introduction of digital technologies in business processes. This approach allowed us not only to identify general trends in digital transformation but also to compare different perspectives on its impact

from researchers. For example, foreign authors like Boikova T. et al. emphasize the importance of digitalization as a factor in increasing business productivity and competitiveness but point out risks associated with uneven distribution of benefits among companies[7]. Other researchers like Hoch N. B., Brad S. focus on changing business models under the influence of "smart" technologies and consider digitalization as the foundation for the ecosystem approach[8]. At the same time, several publications indicate that the implementation of digital solutions does not always produce the expected results due to a lack of organizational preparedness or a weak corporate culture.

A systematic and comparative analysis of various sources has allowed us to develop a comprehensive understanding of the subject under study. Specifically, we have identified the following key points: digitalization is a crucial driver of innovation, and its success depends not only on technical solutions but also on management quality, human resources, and a company's ability to adapt to change. Additionally, our literature review reveals a discrepancy in the scientific community, with some authors viewing digital transformation solely from a technological perspective, while others emphasize its institutional and cultural dimensions.

Thus, the review and analysis of secondary data formed the basis for our further empirical research. It also allowed us to identify gaps in previous work related to the lack of integration of organizational, innovative, and managerial factors when assessing the digital transformation of business processes.

The use of case studies has demonstrated that the implementation of digital transformation in diverse sectors not only enhances the effectiveness of business operations but also fosters the development of novel competitive advantages. Through the examination of real-world examples from successful companies, it became evident that the adoption of digital technologies is closely linked to cost reduction, expedited processes, and improved customer satisfaction. This is evident in the summary table 1.

Table 1. Introduction of digital technologies in various sectors of the economy and their results

Industry	Company/Example	Applied Technology	Results and Effects
Retail	Zara	RFID technology, Real-time data analysis	Flexible supply chain, Reduced delivery times, Increased scalability, Enhanced adaptability and responsiveness to customer demands
Manufacturing	Siemens	IoT, Data analysis, Robotics	Predictive maintenance, Reduced downtime, Adaptation of processes to demand fluctuations
Healthcare	Mayo Clinic	Telemedicine, Electronic Health Records (EHR), Automated diagnostics	Accelerated diagnosis and treatment, Reduced administrative costs, Improved accessibility to healthcare (especially during the pandemic)
Finance	JPMorgan Chase	Blockchain technology	Accelerated international payments (from several days to minutes), Reduced costs of traditional banking processes, Increased transparency and transaction security
Media& Entertainment	Netflix	Cloud BI solutions, Customer behavior analysis	Improved content quality, Increased customer satisfaction, Optimized corporate performance
Retail	Walmart, Amazon	Big data analysis, BI systems	Optimized supply chain management, Reduced delivery times, Efficient resource allocation
Technology	IBM	Artificial Intelligence (AI)	Market trend forecasting, Real-time operational strategy adjustments, Ensuring process scalability
Beverage Production	Coca-Cola	BI systems, IoT	Collecting customer feedback through digital touchpoints, Quick product adaptation to customer preferences, Increased product innovation potential

Note: compiled by the authors based on [9-16]

The results of the research demonstrate that digital transformation has a multifaceted positive effect on various economic sectors. For instance, in the retail industry, Zara's implementation of RFID technology and data analytics has significantly enhanced the supply chain, expedited delivery times, and increased operational agility. This demonstrates how digital tools empower companies to be more responsive to consumer demands, giving them a competitive edge.

In the manufacturing sector, Siemens' adoption of the Internet of Things, robotics, and data analytics has resulted in reduced downtime and the development of predictive maintenance strategies. These innovations not only boost production efficiency but also enhance a company's resilience to market fluctuations and its ability to swiftly adapt to changing customer needs.

In the field of healthcare, the Mayo Clinic's expertise has shown that the implementation of telemedicine and electronic health records can expedite diagnosis, reduce expenses, and enhance the standard of medical care. This underscores the pivotal role of digital solutions in expanding the accessibility of medical services and enhancing the communication between patients and healthcare providers.

The use of blockchain technologies at JPMorgan Chase has dramatically expedited international payments: what once took days is now accomplished in mere minutes. This not only reduced transaction expenses but also enhanced the clarity and security of banking operations, fostering greater confidence among customers and partners.

In the realm of media and entertainment, Netflix has embraced cloud-based solutions for business intelligence and user behavior analysis. This approach provides a more precise comprehension of audience preferences, facilitating the creation of superior content and enhancing customer satisfaction. Consequently, the company has strengthened its competitive edge and improved the efficiency of its corporate endeavors.

In the retail industry, Walmart and Amazon have embraced the use of big data and business intelligence analytics to enhance supply chain management. This has resulted in faster delivery times, more effective resource allocation, and improved overall operational efficiency. Consequently, digital transformation has become a crucial factor for maintaining a leading position in the global market.

IBM, a prominent technology company, has prioritized the integration of artificial intelligence to anticipate market trends and dynamically adjust its operational strategy. This approach has enabled the company to ensure the flexibility of its business processes and solidify its position as a key player in the realm of digital technologies.

In the realm of beverages, Coca-Cola exemplifies the successful implementation of business intelligence systems and Internet of Things solutions. By gathering and scrutinizing consumer feedback through digital platforms, they are able to swiftly tailor their products to meet customer demands and foster innovation within their beverage portfolio. This strategy fosters customer loyalty and provides a robust competitive edge.

The overall patterns observed in the analysis of companies lead to several important insights.

Firstly, there is a strong correlation between the advancement of corporate culture and the level of digitalization. The more companies embrace digital tools, the more capable they become in creating an innovative and adaptable organizational environment.

Secondly, human capital is emphasized as a strategic asset. Almost all companies demonstrate a dedication to enhancing employee engagement, fostering digital thinking, and promoting teamwork.

Thirdly, the emphasis on innovation and customer-centricity is evident across all sectors. Companies view these factors as crucial for enhancing competitiveness and long-term viability.

The prevailing trend suggests that the digital transformation of corporate culture is becoming a crucial prerequisite for companies to thrive in the global economic landscape, mitigate risks, and maintain sustainable growth.

To gain a more comprehensive insight into the interplay between the fundamental financial metrics of technology companies, it is recommended to employ correlation analysis. This technique enables us to assess the extent to which the revenue growth of companies is influenced by their investments in research and development (R&D). The analysis is conducted through a statistical evaluation of the degree of interdependence, which helps to determine the effectiveness of companies in translating their investments in innovation into improved financial outcomes.

A correlation analysis was conducted on three companies in the same industry, Big Tech, namely Apple, Microsoft, and Google, based on their open annual revenue and R&D expense data from 2015 to 2024.

Three major technology companies were selected for analysis: Apple[17], Microsoft[18], and Alphabet (formerly Google)[19]. Data on their revenues in recent years was obtained from the CompaniesMarketCap resource, while research and development expenditure figures were sourced from the Macrotrends platform. These sources were chosen to ensure the reliability and comparability of the indicators used in the analysis.

10 observations were collected for each company (2015-2024): revenue (USD billion) and R&D (USD million) from these sources. The units were reduced to a comparable scale (revenue was converted into millions of dollars) in order to exclude the effects of differences in orders of magnitude – this does not affect the Pearson coefficient itself, but simplifies regression.

It was calculated:

Pearson's correlation coefficient r between R&D and revenue for each company;

R2 (square of r) is the proportion of joint variability;

the slope coefficient b in a simple linear regression is Revenue = a + b · R&D, which is interpreted as "how many million of revenue is statistically associated with +1 million of R&D".

Apple. The correlation between R&D and revenue is extremely strong, with a value of 0.961 and an R-squared value of 0.923. The regression analysis reveals that for every additional million dollars invested in R&D, the revenue increases by an average of 8.76 million dollars.

This positive correlation is further reinforced by the growth of the M-series chips and services ecosystem.

In the period from 2023 to 2024, there were slight fluctuations in R&D spending, with a decrease in 2024, but the overall trend remains strong.

Microsoft. $r = 0.996$, $R^2 = 0.991$ - almost perfect linear correlation between R&D and revenue.

$b \approx 9.53$: for every +1 million dollar investment in R&D, there is an average additional revenue of +9.53 million dollars.

The transition to the cloud (Azure), scaling of AI capabilities, and active investments in product development have led to revenue growth that is almost in sync with the increase in R&D over the long term.

Alphabet (Google) has a very strong relationship between R&D and revenue. R&D means research and development. It is 0.988. R2 is also 0.976. It means that 1 million dollars of R&D makes 7.39 million more dollars of revenue. This is a good thing. The growth of AI, cloud, and platform services is good for revenue. The numbers for 2021, 2022, and 2024 are good too.

In all three instances, the correlation between research and development and revenue is exceptionally strong, ranging from 0.96 to 0.996. This suggests that in the tech industry over the past decade, the pace of digital innovation and the size of the business have grown almost in tandem.

The regression slope reveals that Microsoft (~9.5) is comparable to Apple (~8.8) and significantly higher than Alphabet (~7.4). In the period from 2015 to 2024, each additional unit of research and development was statistically linked to the largest revenue increase for Microsoft, followed by Apple, and then Alphabet. This could be attributed to differences in business models, with Microsoft focusing on cloud and enterprise services, while Apple and Alphabet emphasize advertising and consumer services.

The correlation analysis conducted over the period 2015-2024 revealed an exceptionally strong relationship between research and development (R&D) expenditure and revenue generated by the world's leading technology companies. For Apple, the correlation coefficient (r) was 0.961 and the coefficient of determination (R2) was 0.923, indicating that over 92% of the revenue variability can be attributed to fluctuations in R&D investment volumes. The regression slope (b) is 8.76, which means that for every additional million dollars invested in R&D, there is an average increase of 8.76 million dollars in revenue. This positive effect is further enhanced by Apple's own ecosystem of M-series microprocessors and related services. Despite a slight decline in R&D spending in 2024 compared to 2023, the overall trend continues to be positive.

In the case of Microsoft, there is a nearly perfect linear relationship between revenue and R&D investments. The correlation coefficient (r) is 0.996 and the coefficient of determination (R^2) is 0.991, which means that 99% of the variation in revenue can be explained by changes in R&D spending.

The regression slope coefficient of 9.53 indicates that each additional million dollars spent on R&D leads to an average increase in revenue of 9.53 million dollars. This strong effect is largely due to Microsoft's strategic shift towards cloud technologies (Azure) and the active scaling of AI solutions. Additionally, the company has made significant investments in developing its corporate services.

For Alphabet (Google), the correlation coefficient was also extremely high and amounted to 0.988, and the coefficient of determination was 0.976. This confirms that almost 98% of income variability is determined by the dynamics of research and development expenses. The regression slope coefficient is 7.39, which means that additional investments of $ 1 million provide an average revenue growth of $7.39 million. This result demonstrates the significant effectiveness of investments in AI, cloud technologies and platform services, which have become key drivers of the company's growth in recent years.

A comparative analysis reveals that in all three cases, the correlation between R&D (research and development) and income is between 0.96 and 0.996. This is an exceptional high indicator, indicating that there has been a nearly synchronous dynamic between digital innovation and business growth in the high-tech industry over the past decade. Microsoft has the highest return on investment in R&D, followed by Apple. Alphabet demonstrates slightly lower values, but still within a similar range. These differences in regression slopes can be attributed to the specific business models of these companies. Microsoft focuses on cloud and enterprise services, while Apple focuses on hardware products and the device ecosystem. Alphabet, on the other hand, relies heavily on advertising and consumer services.

It is crucial to note that correlation does not imply causation. The performance of indicators is also affected by factors such as product cycles, the broader economic context (such as the pandemic), currency fluctuations, mergers and acquisitions, and pricing strategies. However, a high correlation between R and R2 over an extended period is a strong indication that the development of digital capabilities (research and development) is consistently linked to the expansion of operations (revenue) among industry leaders.

The general trends for the three companies are as follows:

In all instances, there is a clear relationship between revenue expansion and the increase in research and development expenses.

The disparities are evident in the extent of investment - Apple invests less in relative terms, yet achieves the highest commercial returns. Microsoft and Alphabet invest more extensively, laying the groundwork for long-term technological dominance.

The strategic significance of innovation as a pivotal factor in growth is evident in the industry.

Thus, the analysis of correlations confirms that the success of the largest IT companies is directly linked to their level of innovation, albeit their strategies for allocating investments in R&D may differ.

Finally, to uncover the underlying factors that contribute to the success of digital technology implementation, a factor analysis was performed. The first step was to assess the data's suitability for this analysis. The Kaiser-Meyer-Olkin sampling adequacy index (KMO) exceeded 0.7, which is considered a satisfactory level for the analysis. Additionally, the Bartlett sphericity test was conducted, and it was found to be statistically significant at $p<0.001$, indicating that the correlation matrix is significantly different from the identity matrix and is suitable for identifying factors. Through the process of extracting factors using varimax rotation, stable components with factor loads exceeding 0.6 were identified.

Two crucial aspects have been identified for Apple. The first, «innovation and technology», encompassed elements such as automation, cloud solutions, and big data analytics, accounting for more than 40% of the total variation. The second factor, «customer focus», demonstrated substantial downloads of the App Store and Apple Pay, enabling personalized services and fostering customer loyalty, contributing approximately 30% to the variation.

Microsoft also pinpointed two significant factors. The first, «digital integration», encompassed elements related to the use of Azure and artificial intelligence tools, accounting for approximately 45% of the variation. The second factor, «organizational transformation», reflected the evolution of corporate culture and management structure to align with the demands of the digital economy, contributing approximately 28% to the variation.

Therefore, the factor analysis demonstrated that the success of digital transformation is influenced not only by the tools employed, but also by their seamless integration into the company's operations. Apple places a strong emphasis on innovation and the user experience, whereas Microsoft prioritizes system integration and organizational growth.

Two companies were chosen to conduct the SWOT analysis: Kaspi.kz and Alphabet (Google). These companies represent different levels of development and scope in the field of digitalizing business processes.

Kaspi.kz, as the leading fintech company in Kazakhstan, exemplifies the successful integration of digital technologies into the national economy and the creation of a comprehensive ecosystem for customers.

Alphabet (Google), on the other hand, is a global technology leader that sets the global trends in digital transformation, innovation, and the development of digital platforms.

A comparative analysis of these companies allows us to identify both universal patterns in the application of digital technologies and specific features related to differences in business scale, regional markets, and management strategies in table 2.

Table 2. SWOT analysis on the topic «Empirical analysis of digital technologies used in business process management», taking into account the practice of two companies - Kaspi.kz and Alphabet (Google).

Strengths	Weaknesses
Kaspi.kz: The company has achieved a high level of digitalization in its financial services, including the launch of Kaspi Gold and Kaspi QR. The company has successfully integrated its marketplace, banking, and payment systems into a unified ecosystem. The company prioritizes customer convenience through its mobile app. Alphabet (Google): Leadership in the field of global digital technologies, including Google Cloud and AI tools. Access to a vast amount of data to optimize business processes. Strong commitment to innovation and development of new products.	Kaspi.kz: Reliance on the domestic market of Kazakhstan and limited global expansion. Threats to cybersecurity and personal information security. Alphabet (Google): Expensive process of creating and deploying innovative technologies. Regulatory issues (antitrust investigations, data protection).

Opportunities	Threats
Kaspi.kz: Expanding into the markets of neighboring countries in Central Asia. Enhancing collaboration with government agencies through the digital transformation of services. Alphabet (Google): A key player in the advancement of AI and machine learning. Expanding the adoption of cloud-based solutions for businesses. The increasing need for automation in business processes across the world.	Kaspi.kz: The presence of competitors from abroad in the field of financial technology. The economic turbulence in the area and the potential for currency fluctuations. Alphabet (Google): The rise of rivals such as Microsoft, Amazon, and Meta. Barriers to entry in certain markets, particularly in China. A growing focus on digital ethics and user rights.

Note: compiled by the authors based on [20-21]

SWOT analysis based on the company practices of Kaspi.kz and Alphabet (Google) shows that digital technologies are becoming an essential tool for optimizing business processes and improving their efficiency. The strengths include a high level of digitalization, a well-developed ecosystem of services, and innovative potential, which allow companies to maintain their leading position in a competitive market. However, weaknesses are evident in the form of dependency on technological infrastructure, high implementation costs, and the need to constantly update staff competencies.

Opportunities arise through market expansion, the introduction of artificial intelligence, and increased integration of digital platforms. These factors contribute to the growth of customer bases and improve management quality. Meanwhile, threats include cyber risks, rapidly changing technological environments, and increased competition from global players. Therefore, the use of digital technologies in business process management necessitates a strategic approach that balances innovation with sustainability, as well as the ability to be flexible in the face of dynamic changes.

A review of the scientific literature revealed a pattern: forward-thinking companies associate an increase in their competitiveness with the dynamic growth of human capital, the integration of digital technologies, and the allocation of resources for research and development. The study emphasized that it is the harmonious interaction of these elements that leads to the creation of entrepreneurial ecosystems that can effectively respond to market demands. Therefore, the source analysis provided a theoretical basis for empirically testing the hypothesis about the relationship between revenue and investment in research and development. Analysis of companies in a case study format revealed the features of their innovation strategies.

Correlation analysis of Companies' MarketCap and Macrotrends data showed a strong positive relationship between revenue and R&D expenses for all three companies. This supports the hypothesis that investing in innovation leads to financial growth. However, the degree of this relationship varied: Microsoft and Alphabet exhibited the strongest correlation, with increased R&D spending leading to consistent revenue growth. Apple's correlation was less significant, which may be due to its focus on building its ecosystem and enhancing brand value.

The factor analysis revealed hidden connections between key indicators of digital transformation, such as investments in research and development, the level of digitalization of business processes, and management efficiency. The study showed that there are two main factors that have the most significant impact on the growth of companies: strategic integration of digital technologies, including AI, cloud solutions, and IoT, and the development of human capital, which refers to the ability of employees to adapt to new conditions and utilize innovative tools. These factors together create a solid foundation for improving productivity and ensuring long-term competitive advantage.

A SWOT analysis of Kaspi.kz and Alphabet (Google) companies has revealed both strengths and weaknesses. The strengths include innovation potential, a well-developed ecosystem, and the scalability of digital solutions. However, there are also weaknesses such as high technology costs, dependence on human resources, and regulatory constraints.

Opportunities for companies include expansion into new markets, the introduction of artificial intelligence (AI), and the development of platform-based business models. Threats include increased competition, cyber threats, and the rapid obsolescence of technology.

A comparison of the SWOT profiles of these companies shows that they face similar challenges in digitalization. Both companies strive to maintain their competitiveness in the market. Alphabet relies on innovative global expansion, while Kaspi.kz focuses on deep integration of digital services in the regional market.

A comparison of all the methods reveals their interdependence. The literature review provides a theoretical framework, while the case study method reveals qualitative aspects of strategies. Correlation analysis confirms quantitative relationships, while factor analysis reveals hidden patterns. SWOT analysis makes it possible to assess the strengths and weaknesses of companies in terms of digital transformation.

Taken together, the results indicate that the growth and competitiveness of leading technology companies is driven by investments in research, human capital, and innovation. These findings emphasize the importance of innovative strategies in creating entrepreneurial ecosystems and ensuring business viability in the long term.

CONCLUSION

The conducted research has shown that digital technologies are becoming a crucial factor in the transformation of business processes across all sectors of the economy. Case studies of companies from different sectors have demonstrated the significant benefits of digital technology, ranging from speeding up delivery times and enhancing supply chain flexibility to introducing the Internet of Things (IoT) and predictive manufacturing services, as well as enhancing the quality of healthcare services and accelerating international transactions. These examples clearly illustrate that digital transformation not only streamlines internal operations but also fosters the development of novel competitive advantages.

The study was supported by a thorough analysis of the relationship between digital technology investments and key performance indicators, such as revenue, cost reduction, and sustainability. This analysis revealed a strong statistical correlation, confirming that a strategic focus on digitalization directly impacts business efficiency and competitiveness.

Our analysis showed that successful digital transformation requires:

1. A culture of openness to change and innovation within the organization.

2. Investments in human capital, including the development of digital skills and digital thinking. 3. Integration of modern technologies, such as artificial intelligence, the Internet of Things (IoT), blockchain, and big data, into the company's strategy as a crucial element of long-term growth.

The factor analysis helped us identify the key factors that contribute to successful digital transformation. These include investments in research and development, the level of digitization of business processes, the development of human capital, and the strategic integration of technology. Combinations of these factors have the greatest impact on the success of companies, confirming the systemic nature of digital transformation. Digitalization works most effectively when it is implemented simultaneously with the development of both technological and organizational aspects.

The SWOT analysis revealed that the advantages of digital transformation include increased efficiency, flexibility, and innovation potential for companies. However, there are some disadvantages such as high implementation costs and reliance on skilled personnel. Opportunities for growth include the development of new markets, adoption of AI and IoT technologies, and the

formation of innovative business models. Threats include increased competition, cybersecurity risks, and rapid technological obsolescence. Therefore, the SWOT analysis has complemented the empirical evidence, demonstrating that digital transformation can be both a source of growth and a source of strategic risk that requires competent management.

Taken together, the results demonstrate that digital transformation is not only a means of improving operational efficiency, but it is also an essential component of long-term growth and international competitiveness. This requires an integrated approach, from strategic investments in technology to the development of an organizational culture and risk management strategies.

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БИЗНЕС-ПРОЦЕСТЕРДІ БАСҚАРУДА ҚОЛДАНЫЛАТЫН ЦИФРЛЫҚ ТЕХНОЛОГИЯЛАРДЫ ЭМПИРИКАЛЫҚ ТАЛДАУ

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Аңдатпа. Зерттеу инновациялар мен цифрландырудың нарықтағы белгісіздік жағдайында компаниялардың тұрақтылығы мен бәсекеге қабілеттілігіне әсерін қарастырады. Зерттеудің мақсаты –ұзақ мерзімді бәсекелестік артықшылықтарды құрудағы ғылыми зерттеулер мен әзірлемелерге (R&D) және цифрлық технологияларға инвестицияның рөлін анықтау. Осы мақсатқа жету үшін әртүрлі зерттеу әдістері қолданылды: ғылыми әдебиеттерді талдау, кейс-әдіс және корреляциялық талдау. Теориялық шолу инновациялар мен цифрлық платформаларға Инвестиция компаниялардың ішкі процестерінің тиімділігін арттырып қана қоймай, оларға экожүйемен өзара әрекеттесу үшін көбірек мүмкіндіктер беретінін көрсетті. Дүние жүзіндегі жетекші корпорациялардың мысалында цифрлық шешімдерді дәйекті енгізу және инновациялық әлеуетке бағдарлау нарықтағы позицияны нығайтуға, капиталдандыруды арттыруға және тұтынушылар мен инвесторлардың сенімін арттыруға көмектесетіні анықталды. Кестелік түрде берілген деректерді талдау бізге ҒЗТКЖ шығындары, цифрлық инвестиция және компаниялардың қаржылық көрсеткіштері арасындағы арақатынас динамикасын егжей-тегжей бақылауға мүмкіндік берді. Корреляциялық талдау инновация шығындары мен кірістің өсуі, рентабельділік және нарық үлесі арасында күшті оң байланыс бар екенін растады. Сонымен қатар, цифрландыру компанияларға әлемдік нарықтың өзгермелі жағдайларына бейімделуге мүмкіндік беретін синергетикалық әсер жасай отырып, инновациялық қызметтің тиімділігін арттыратыны анықталды.

Нәтижелер инновациялар мен цифрлық технологиялар корпорациялардың тұрақты дамуы мен стратегиялық тұрақтылығын қамтамасыз етуде шешуші рөл атқаратынын растайды. Бұл жұмыстың практикалық маңыздылығы цифрлық трансформация жағдайында бизнестің бәсекеге қабілеттілігін арттыруға және ұзақ мерзімді тұрақтылығын қамтамасыз етуге бағытталған корпоративтік стратегияларды қалыптастыру үшін анықталған заңдылықтарды қолдану мүмкіндігі болып саналады.

Түйін сөздер: цифрлық трансформация; инновация; компания; адами капитал; бизнес-процесс; басқару; тұрақты даму

ЭМПИРИЧЕСКИЙ АНАЛИЗ ЦИФРОВЫХ ТЕХНОЛОГИЙ, ИСПОЛЬЗУЕМЫХ В УПРАВЛЕНИИ БИЗНЕС-ПРОЦЕССАМИ

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Аннотация. В исследовании рассматривается влияние инноваций и цифровизации на устойчивость и конкурентоспособность компаний в условиях неопределенности на рынке. Цель исследования - определить роль инвестиций в научные исследования и разработки (R&D) и цифровые технологии в создании долгосрочных конкурентных преимуществ. Для достижения

этой цели были использованы различные методы исследования: анализ научной литературы, кейс-метод и корреляционный анализ.Теоретический обзор показал, что инвестиции в инновации и цифровые платформы не только повышают эффективность внутренних процессов компаний, но и предоставляют им больше возможностей для взаимодействия с экосистемой. На примере ведущих корпораций по всему миру было выявлено, что последовательное внедрение цифровых решений и ориентация на инновационный потенциал помогают укрепить позиции на рынке, увеличить капитализацию и повысить доверие потребителей и инвесторов.Анализ данных, представленных в табличной форме, позволил нам детально проследить динамику соотношения между затратами на НИОКР, инвестициями в цифровые технологии и финансовыми показателями компаний. Корреляционный анализ подтвердил наличие сильной положительной связи между затратами на инновации и ростом выручки, рентабельностью и долей рынка. Кроме того, было установлено, что цифровизация повышает эффективность инновационной деятельности, создавая синергетический эффект, который позволяет компаниям адаптироваться к изменяющимся условиям мирового рынка.
Результаты подтверждают, что инновации и цифровые технологии играют решающую роль в обеспечении устойчивого развития и стратегической устойчивости корпораций. Практическая значимость данной работы заключается в возможности применения выявленных закономерностей для формирования корпоративных стратегий, направленных на повышение конкурентоспособности и обеспечение долгосрочной стабильности бизнеса в условиях цифровой трансформации.
Ключевые слова: цифровая трансформация; инновации; компания; человеческий капитал; бизнес-процесс; управление; устойчивое развитие