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DEVELOPING METHODS FOR ASSESSING THE IMPACT OF DIGITAL INNOVATIONS ON THE ECONOMIC EFFICIENCY OF ENTERPRISES: METHODOLOGY FOR MEASURING ROI OF DIGITAL PROJECTS

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РАЗРАБОТКА МЕТОДОВ ОЦЕНКИ ВЛИЯНИЯ ЦИФРОВЫХ ИННОВАЦИЙ НА ЭКОНОМИЧЕСКУЮ ЭФФЕКТИВНОСТЬ ПРЕДПРИЯТИЙ: МЕТОДОЛОГИЯ ИЗМЕРЕНИЯ ROI ЦИФРОВЫХ ПРОЕКТОВ

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Abstract. This study aims to develop methodologies for assessing the return on investment (ROI) of digital projects, crucial for understanding the economic impact of digital innovations on enterprises. Traditional ROI metrics often fail to capture the comprehensive value generated by digital projects. The proposed integrative framework employs advanced analytical methods, including cost-benefit analysis, real options analysis, and predictive analytics, to evaluate both tangible and intangible benefits. It incorporates dynamic risk management and scenario planning to address uncertainties and future challenges. Continuous feedback and iterative improvements ensure the framework's accuracy and relevance, enabling enterprises to optimize economic efficiency and strategic decision-making. This holistic approach offers an understanding of the multifaceted value of digital innovations.

Аннотация. Целью данного исследования является разработка методологий оценки возврата на инвестиции (ROI) цифровых проектов, что является ключевым аспектом для понимания экономического влияния цифровых инноваций на предприятия. Традиционные метрики ROI часто не способны охватить полную ценность, создаваемую цифровыми проектами. Предлагаемая интегративная структура использует передовые аналитические методы, включая анализ затрат и выгод, анализ реальных опционов и предиктивную аналитику, для оценки как материальных, так и нематериальных выгод. В нее включены динамическое управление рисками и сценарное планирование для учета неопределенностей и будущих вызовов. Непрерывная обратная связь и итерационные улучшения обеспечивают точность и актуальность структуры, позволяя предприятиям оптимизировать экономическую эффективность и стратегическое принятие решений. Этот целостный подход предоставляет понимание многоаспектной ценности цифровых инноваций.

Keywords: digital innovation, return on investment, economic efficiency, advanced analytics, risk management, scenario planning, integrative framework.

Т. 10. №10 2024
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Ключевые слова: цифровая инновация, возврат на инвестиции, экономическая эффективность, передовая аналитика, управление рисками, сценарное планирование, интегративная структура.

The rapid advancement of digital technologies has significantly transformed the operational landscape of modern enterprises. Digital innovations, encompassing a wide array of tools and platforms such as artificial intelligence (AI), blockchain, and the Internet of Things (IoT), are increasingly being integrated into business processes to enhance productivity, optimize resource allocation, and drive economic growth. These technologies have reshaped traditional business models, enabling firms to achieve higher levels of efficiency and competitiveness.

Despite the evident benefits, the adoption and implementation of digital innovations pose substantial challenges, particularly in measuring their economic impact. Traditional metrics of economic efficiency often fall short in capturing the multifaceted value generated by digital projects. As enterprises allocate substantial resources towards digital transformations, there is a pressing need for robust methodologies to assess the return on investment (ROI) of these initiatives accurately.

The objective of this theoretical study is to develop methodologies for evaluating the impact of digital innovations on the economic efficiency of enterprises, with a specific focus on ROI measurement. This involves an examination of existing ROI assessment techniques, identification of key factors influencing ROI in digital projects, and the formulation of integrative frameworks that address the complexities of digital transformation.

Foundations of digital innovations

Digital innovations represent a transformative force that has reshaped various sectors by integrating advanced technologies into business operations. These innovations encompass a wide spectrum of technological advancements, including but not limited to AI, blockchain, the IoT, big data analytics, and cloud computing. Each of these technologies contributes uniquely to the digital transformation landscape, enabling enterprises to enhance operational efficiency, innovate products and services, and create new business models. In 2023, global spending on digital transformation reached $2,49 trillion USD (https://lyl.su/j0Nz). The United States was recognized as the country with the highest digital competitiveness in the world, which means the ability to adopt digital technologies in enterprises and governmental organizations.

Digital innovations can be defined as the application of digital technology to create new or improved processes, products, or services that deliver significant value to enterprises and their stakeholders. This broad definition includes both incremental improvements and radical innovations that fundamentally alter the way businesses operate [1].

The scope of digital innovations is extensive, encompassing various domains such as manufacturing, logistics, marketing, finance, and customer service. By leveraging digital tools, enterprises can streamline operations, reduce costs, and enhance customer experiences, thereby achieving greater economic efficiency.

The evolution of digital innovations has been marked by several key phases. The initial phase, characterized by the advent of computers and basic automation, laid the groundwork for more sophisticated technological developments. The introduction of the internet and the subsequent rise of e-commerce marked a significant shift, enabling businesses to reach global markets and operate with unprecedented agility. In recent years, the proliferation of mobile technology, social media, and cloud computing has further accelerated digital transformation.

Т. 10. №10 2024
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As of 2023, nearly 92% of digital leaders globally stated that their companies had adopted cloud technology on some scale. Big data and analytics were the second most adopted technology, followed closely by AI and ML (Figure).

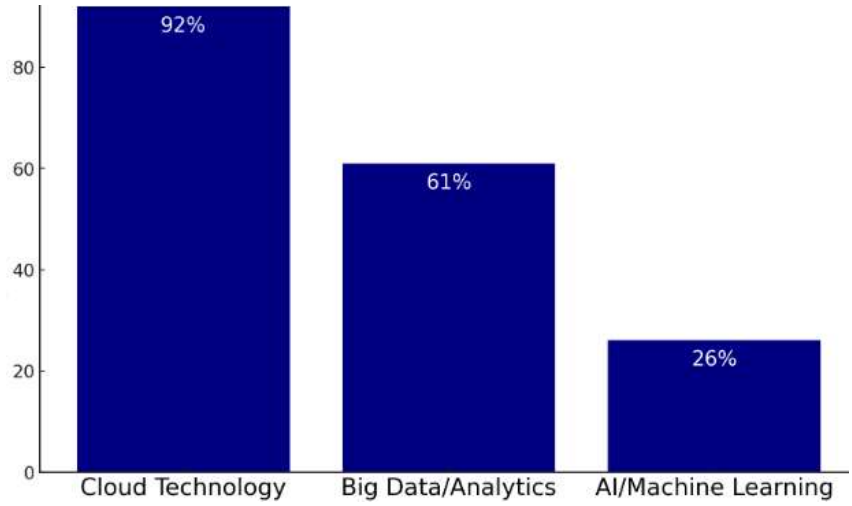

Figure. Adoption of new technologies in companies worldwide in 2023 (https://lyl.su/QzbA)

These data were obtained from a survey of over 2,000 respondents from 86 countries. The integration of AI and machine learning into business processes has enabled predictive analytics, automation of routine tasks, and enhanced decision-making capabilities. These technologies have facilitated real-time communication, data sharing, and collaboration across geographically dispersed teams. Currently, the digital innovation landscape is being shaped by emerging technologies such as blockchain and IoT. Blockchain technology offers decentralized and secure transaction systems, which are particularly valuable in finance, supply chain management, and contract enforcement [2]. IoT connects physical devices to the digital world, enabling real-time monitoring and control of various assets, thus enhancing operational efficiency and creating new business opportunities.

Digital innovations have not only improved existing business processes but have also led to the creation of entirely new business models. For example, the subscription-based model, popularized by software-as-a-service (SaaS) companies, relies heavily on cloud computing and internet connectivity. Similarly, platform-based models, such as those employed by Uber and Airbnb, leverage digital networks to connect service providers with consumers directly.

Digital innovations facilitate the emergence of data-driven business models. Enterprises can collect and analyze vast amounts of data to gain insights into consumer behavior, optimize supply chains, and develop personalized marketing strategies. This shift towards data-centric operations underscores the importance of digital literacy and the capability to manage and interpret complex data sets.

Despite the numerous advantages, the adoption of digital innovations presents several challenges. These include the high initial costs of implementation, the need for continuous updates and maintenance, and the requirement for specialized skills and knowledge. Issues related to data privacy, cybersecurity, and regulatory compliance must be carefully managed to protect both the enterprise and its customers [3].

The success of digital innovation initiatives depends on a holistic approach that integrates technology with strategic vision, organizational culture, and process optimization. Enterprises must foster an environment that encourages experimentation and agile adaptation to rapidly changing technological landscapes.

Т. 10. №10 2024
https://doi.org/10.33619/2414-2948/107

Economic efficiency and ROI: theoretical perspectives

Economic efficiency is a fundamental concept in economics that pertains to the optimal allocation of resources to maximize output or minimize costs. It is achieved when an economy or enterprise can produce the maximum possible output with a given set of inputs or achieve a desired output level at the lowest possible cost. Economic efficiency can be categorized into several types (Table 1).

Table 1

TYPES OF ECONOMIC EFFICIENCY [4]

Type of efficiency	*Definition*
Allocative efficiency	Resources are distributed in a way that maximizes societal welfare, aligning production with consumer preferences.
Productive efficiency	Goods and services are produced at the lowest possible cost, utilizing the least amount of resources.
Dynamic efficiency	Focuses on the long-term ability of an economy or enterprise to innovate and improve productivity over time.
Technical efficiency	Achieving the maximum output from a given set of inputs without wasting resources.
Distributive efficiency	Ensures that resources are distributed fairly and equitably across society, enhancing overall economic welfare.

Measuring economic efficiency involves various quantitative and qualitative metrics. Common quantitative measures include cost-benefit analysis, which compares the costs of an action or investment to its benefits, and productivity ratios, such as output per labor hour or capital unit. Qualitative measures may encompass assessments of technological advancement, managerial effectiveness, and market conditions. These metrics provide a comprehensive view of how well an enterprise utilizes its resources and identifies areas for improvement. The financial metric, ROI, is extensively utilized to measure the efficiency of an investment by comparing the return generated to the initial investment cost:

$$ROI(\%) = \frac{Net\ Profit}{Investment\ Cost} x\ 100$$

This metric is crucial for decision-making processes in both private and public sectors, as it helps determine the viability and profitability of investments. The conceptual framework of ROI extends beyond a simple financial calculation. It encompasses various dimensions, including time horizon, risk factors, and opportunity costs [5].

The time horizon is important, as it distinguishes between short-term and long-term returns, which can significantly impact investment decisions. Short-term ROI might prioritize immediate gains, while long-term ROI considers sustained benefits over an extended period. Risk factors are also integral to the ROI framework, acknowledging that higher returns are often associated with higher risks. Assessing risk involves evaluating market volatility, economic conditions, and the specific uncertainties related to the investment. Opportunity cost, another vital component of the ROI framework, refers to the potential benefits foregone by choosing one investment over another. The application of ROI in digital innovations presents unique challenges and opportunities (Table 2).

According to the author, economic efficiency and ROI are critical concepts for understanding and evaluating the performance of investments. Economic efficiency focuses on the optimal use of resources to maximize output or minimize costs, while ROI provides a financial measure of the profitability of investments. Both concepts require a nuanced understanding of various factors,

Т. 10. №10 2024
https://doi.org/10.33619/2414-2948/107

including time horizon, risk, and opportunity cost, to make informed decisions that enhance the long-term sustainability and growth of enterprises. As digital innovations continue to transform business landscapes, developing robust methodologies to measure their economic impact remains a priority for researchers and practitioners alike.

Table 2

ROI IN DIGITAL INNOVATIONS: CHALLENGES AND OPPORTUNITIES [6]

Aspect	*Challenges*	*Opportunities*
Intangible assets	Difficulty in measuring returns from intellectual property, software, and technological expertise.	Leveraging unique intangible assets to gain a competitive edge and drive innovation.
Quantifiable benefits	Challenges in immediately quantifying benefits like improved customer satisfaction and data analytics.	Long-term enhancements in customer loyalty, data-driven decision-making, and operational efficiency.
Time horizon	Balancing short-term and long-term returns, with potential delays in realizing benefits.	Strategic planning for sustainable growth and future-proofing business operations.
Risk factors	Higher risk associated with new and untested technologies.	Potential for high returns and market leadership through early adoption and innovation.
Opportunity cost	Assessing the trade-offs and potential benefits of alternative investments.	Optimizing resource allocation to maximize overall returns and strategic advantages.
Adaptation of traditional models	Adjusting conventional ROI models to fit the dynamic nature of digital projects.	Developing robust and flexible ROI frameworks that accurately reflect digital transformation impacts.

Methodologies for measuring ROI of digital projects

Evaluating the ROI for digital projects is a complex process that involves both traditional and advanced analytical methodologies. Traditional ROI measurement techniques are used to assess the profitability and effectiveness of investments. They typically involve straightforward financial calculations that compare the net benefits of an investment to its costs. While traditional ROI methods are widely used due to their simplicity and ease of application, they often fail to capture the comprehensive impact of digital projects, which may include intangible benefits and long-term gains not directly reflected in financial statements.

Traditional ROI methods primarily focus on direct financial metrics, such as increased revenue, cost savings, and improved productivity. These metrics are tangible and easily quantifiable, making them suitable for straightforward investment evaluations. However, digital projects frequently yield benefits that extend beyond immediate financial returns. For instance, enhancements in customer experience, brand value, and employer satisfaction can significantly contribute to the overall success of digital initiatives but are challenging to quantify using traditional ROI approaches. Digital projects often involve substantial upfront costs and ongoing investments in technology, training, and maintenance, which necessitate a more nuanced assessment of their long-term value and impact.

Advanced analytical methods for ROI assessment have emerged to address the limitations of traditional techniques, offering more comprehensive and sophisticated tools for evaluating digital investments (Table 3).

The methodologies for measuring ROI of digital projects have evolved from traditional financial metrics to advanced analytical techniques that account for a broader range of factors. While traditional ROI measurement techniques remain valuable for their simplicity and direct

Т. 10. №10 2024
https://doi.org/10.33619/2414-2948/107

financial focus, advanced methods offer more comprehensive and nuanced assessments. These advanced methodologies enable organizations to capture the full value of digital investments, including intangible benefits and long-term strategic impacts, ultimately supporting more informed and effective decision-making in the rapidly evolving digital landscape.

Table 3

ADVANCED ANALYTICAL METHODS FOR ROI ASSESSMENT [7, 8]

Method	*Description*
Cost-benefit analysis (CBA)	Evaluates all potential costs and benefits associated with a project, providing a holistic view by including both direct and indirect effects.
Real options analysis (ROA)	Treats investments as options, allowing for strategic flexibility and adaptation based on changing market conditions and technological advancements.
Predictive analytics	Utilizes large datasets to identify patterns and forecast the impact of digital projects on various business metrics, aiding in data-driven decision-making.
Machine learning techniques	Enhances predictive analytics by continuously learning from new data, improving the accuracy and reliability of ROI assessments over time.
Balanced scorecard (BSC)	Incorporates financial and non-financial metrics, such as customer satisfaction, internal processes, and growth perspectives, for a comprehensive evaluation of performance.

Proposed models for assessing ROI in digital innovations

Developing effective models for assessing the ROI in digital innovations is crucial for understanding their impact on the economic efficiency of enterprises. Traditional ROI methods often fall short in capturing the full spectrum of benefits and complexities associated with digital projects. Consequently, there is a need for more sophisticated models that provide a comprehensive evaluation of these investments.

Integrative framework for economic efficiency measurement is proposed to address this need. This framework combines various advanced analytical methods to assess both tangible and intangible benefits of digital innovations, providing a holistic view of their economic impact. The integrative framework encompasses several key components:

Multi-dimensional value assessment: this approach extends beyond the basic financial ROI to include multiple dimensions of value creation. It evaluates direct financial returns, such as cost savings and revenue growth, alongside intangible benefits like enhanced customer satisfaction, improved brand reputation, and increased employee productivity. By incorporating these additional dimensions, the model offers a more nuanced understanding of the overall value generated by digital projects.

Dynamic risk management: digital innovations are often associated with high levels of uncertainty and risk. The proposed model integrates dynamic risk management techniques to evaluate potential risks and uncertainties. This includes analyzing market volatility, technological advancements, and implementation challenges. Continuous monitoring and adjustment for these risks enable enterprises to make more informed investment decisions and better manage potential downsides.

Scenario planning and forecasting: the integrative framework employs scenario planning and forecasting to predict the long-term impact of digital innovations. This involves creating multiple scenarios based on different assumptions about market trends, technological changes, and competitive dynamics. By simulating various outcomes, enterprises can anticipate future challenges and opportunities, allowing them to adapt their strategies accordingly.

Feedback and continuous improvement: the integrative framework emphasize the importance of continuous improvement and feedback. Regularly reviewing and updating the assessment model

Т. 10. №10 2024
https://doi.org/10.33619/2414-2948/107

based on new data and insights allows enterprises to refine their evaluation methods and improve the accuracy of their ROI assessments. This iterative process ensures that the model remains relevant and effective in capturing the dynamic nature of digital innovations.

By leveraging the integrative framework for economic efficiency measurement, enterprises can gain a more comprehensive understanding of the ROI of digital innovations. This framework addresses the limitations of traditional methods. Ultimately, it provides enterprises with the tools needed to capture the full value of digital investments, enhancing their economic efficiency and strategic decision-making capabilities.

Conclusions

The development of robust methodologies for measuring the ROI of digital projects is essential for accurately assessing the economic impact of digital innovations on enterprises. The proposed integrative framework combines various advanced methods, including cost-benefit analysis, predictive analytics, and balanced scorecards, to evaluate both tangible and intangible benefits. This holistic approach addresses the complexities and dynamic nature of digital transformations, incorporating dimensions such as enhanced customer satisfaction, improved brand reputation, and increased employee productivity. Dynamic risk management and scenario planning ensure that enterprises can anticipate and adapt to future challenges and opportunities. Continuous feedback and iterative improvements refine the assessment process, ensuring accuracy and relevance. By employing this framework, enterprises can better understand the full value of digital investments, thereby enhancing their economic efficiency and strategic decision-making capabilities.

References:

1. Mahboub, H., Sadok, H., Chehri, A., & Saadane, R. (2023). Measuring the Digital Transformation: A Key Performance Indicators Literature Review. *Procedia Computer Science*, *225*, 4570-4579. https://doi.org/10.1016/j.procs.2023.10.455

2. Dudaiti, G. (2024). Cross-cultural business strategies in ride-hailing: How understanding local markets contributes to successful expansion. *Mezhdunarodnyi nauchnyi zhurnal "INNOVATsIONNAYa NAUKA", 7-2*, 77-82.

3. Kendjaev, A. (2024). Features of establishing foreign economic activities when entering the American market: Practical steps and legal nuances. *Sciences of Europe, 144*, 8-11.

4. Jensen, M. H., Persson, J. S., & Nielsen, P. A. (2023). Measuring benefits from big data analytics projects: an action research study. *Information Systems and e-Business Management*, *21*(2), 323-352. https://doi.org/10.1007/s10257-022-00620-0

5. Setiawan, C. A., & Rosa, T. (2023). The Analysis of The Effect of Return of Investment (ROI) on Stock Price and Financial Performance of a Company. *Journal of Accounting, Management, Economics, and Business (ANALYSIS)*, *1*(1), 20-29. https://doi.org/10.56855/analysis.v1i1.177

6. Jarvis, A., & King, C. W. (2024). Economy-wide rebound and the returns on investment in energy efficiency. *Energy Efficiency*, *17*(6), 60. https://doi.org/10.1007/s12053-024-10236-7

7. Kim, H., Park, S., Choi, S., & Kim, T. (2024). Ship Investment Valuation Using Real Option Analysis (ROA). *Journal of Coastal Research*, *116*(SI), 423-427. https://doi.org/10.2112/JCR-SI116-086.1

8. Camanho, A. S., Silva, M. C., Piran, F. S., & Lacerda, D. P. (2024). A literature review of economic efficiency assessments using Data Envelopment Analysis. *European Journal of Operational Research*, *315*(1), 1-18.

Список литературы:

1. Mahboub H., Sadok H., Chehri A., Saadane R. Measuring the Digital Transformation: A Key Performance Indicators Literature Review // Procedia Computer Science. 2023. V. 225. P. 4570-4579. https://doi.org/10.1016/j.procs.2023.10.455

2. Dudaiti G. Cross-cultural business strategies in ride-hailing: How understanding local markets contributes to successful expansion // Международный научный журнал "ИННОВАЦИОННАЯ НАУКА". 2024. №7-2. С. 77-82.

3. Kendjaev A. Features of establishing foreign economic activities when entering the American market: Practical steps and legal nuances // Sciences of Europe, 2024. 144, 8-11.

4. Jensen M. H., Persson J. S., Nielsen P. A. Measuring benefits from big data analytics projects: an action research study //Information Systems and e-Business Management. 2023. V. 21. №2. P. 323-352. https://doi.org/10.1007/s10257-022-00620-0

5. Setiawan C. A., Rosa T. The Analysis of The Effect of Return of Investment (ROI) on Stock Price and Financial Performance of a Company // Journal of Accounting, Management, Economics, and Business (ANALYSIS). 2023. V. 1. №1. P. 20-29. https://doi.org/10.56855/analysis.v1i1.177

6. Jarvis A., King C. W. Economy-wide rebound and the returns on investment in energy efficiency // Energy Efficiency. 2024. V. 17. №6. P. 60. https://doi.org/10.1007/s12053-024-10236-7

7. Kim H., Park S., Choi S., Kim T. Ship Investment Valuation Using Real Option Analysis (ROA) // Journal of Coastal Research. 2024. V. 116. №SI. P. 423-427. https://doi.org/10.2112/JCR-SI116-086.1

8. Camanho A. S., Silva M. C., Piran F. S., Lacerda D. P. A literature review of economic efficiency assessments using Data Envelopment Analysis // European Journal of Operational Research. 2024. V. 315. №1. P. 1-18. https://doi.org/10.1016/j.ejor.2023.07.027

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