



ANALYSIS OF DIGITAL TRANSFORMATION PROCESSES OF INDUSTRIAL ENTERPRISES AND DEVELOPMENT OF A MULTIFACTOR INDEX SYSTEM (DIGITAL MATURITY INDEX – RYI) FOR ASSESSING THEIR DIGITAL MATURITY LEVEL

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Abstract

This article examines the development and application mechanisms of a multifactor Digital Maturity Index designed to assess digital transformation processes in industrial enterprises. In the modern economy, industrial competitiveness increasingly depends not only on the availability of digital technologies, but also on the degree to which these technologies are systematically integrated into production, management, logistics, human resources, financial control, and strategic decision-making. The study emphasizes that digital transformation should be evaluated as a complex organizational and economic process rather than as a narrow technological modernization. The proposed index system combines several key assessment dimensions, including digital infrastructure, automation of production processes, data-driven management, cybersecurity, digital skills of personnel, innovation activity, integration of enterprise resource planning systems, and the economic effectiveness of digital solutions. The article substantiates the need for a comprehensive methodological approach that allows industrial enterprises to



determine their current level of digital maturity, identify internal weaknesses, compare performance across structural units, and formulate targeted transformation strategies. Special attention is given to the relevance of such an index for enterprises operating in an emerging digital economy, where uneven technological development, limited investment capacity, and insufficient digital competencies may restrict the effectiveness of modernization. The research concludes that a multifactor Digital Maturity Index can serve as an analytical tool for strategic planning, investment prioritization, monitoring of transformation outcomes, and improvement of industrial management efficiency.

Keywords: Digital transformation, industrial enterprises, digital maturity, multifactor index, economic efficiency, automation, data-driven management, innovation development

**SANOAT KORXONALARINING RAQAMLI TRANSFORMATSIYA
JARAYONLARINI TAHLIL QILISH HAMDA ULARNING RAQAMLI
YETUKLIK DARAJASINI BAHOLASH UCHUN KO‘P OMILLI
INDEKS TIZIMINI (DIGITAL MATURITY INDEX – RYI) ISHLAB
CHIQISH**

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Annotatsiya

Ushbu maqolada sanoat korxonalarida raqamli transformatsiya jarayonlarini baholashga mo‘ljallangan ko‘p omilli raqamli yetuklik indeksini ishlab chiqish va qo‘llash mexanizmlari tahlil qilinadi. Zamonaviy iqtisodiyot sharoitida sanoat korxonalarining raqobatbardoshligi faqat raqamli texnologiyalarning



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mavjudligiga emas, balki ularning ishlab chiqarish, boshqaruv, logistika, inson resurslari, moliyaviy nazorat va strategik qarorlar qabul qilish jarayonlariga tizimli integratsiyalashuv darajasiga ham bog‘liqdir. Tadqiqotda raqamli transformatsiya tor texnologik modernizatsiya emas, balki murakkab tashkiliy-iqtisodiy jarayon sifatida baholanishi zarurligi asoslanadi. Taklif etilayotgan indeks tizimi raqamli infratuzilma, ishlab chiqarish jarayonlarini avtomatlashtirish, ma’lumotlarga asoslangan boshqaruv, kiberxavfsizlik, xodimlarning raqamli kompetensiyalari, innovatsion faollik, korxonalar resurslarini rejalashtirish tizimlarining integratsiyasi hamda raqamli yechimlarning iqtisodiy samaradorligi kabi asosiy baholash yo‘nalishlarini birlashtiradi. Maqolada sanoat korxonalariga raqamli yetuklikning amaldagi darajasini aniqlash, ichki zaif jihatlarni ko‘rsatish, tarkibiy bo‘linmalar faoliyatini taqqoslash va maqsadli transformatsiya strategiyalarini shakllantirish imkonini beruvchi kompleks metodologik yondashuv zarurligi yoritiladi. Raqamli iqtisodiyot shakllanayotgan sharoitda texnologik rivojlanishdagi nomutanosiblik, investitsiya imkoniyatlarining cheklanganligi va raqamli kompetensiyalarning yetarli emasligi modernizatsiya samaradorligini pasaytirishi mumkinligi alohida ta’kidlanadi. Tadqiqot natijalariga ko‘ra, ko‘p omilli raqamli yetuklik indeksi strategik rejalashtirish, investitsion ustuvorliklarni belgilash, transformatsiya natijalarini monitoring qilish va sanoat boshqaruvi samaradorligini oshirish uchun muhim tahliliy vosita bo‘lib xizmat qiladi.

Kalit so‘zlar. raqamli transformatsiya, sanoat korxonalar, raqamli yetuklik, ko‘p omilli indeks, iqtisodiy samaradorlik, avtomatlashtirish, ma’lumotlarga asoslangan boshqaruv, innovatsion rivojlanish.

Introduction

The acceleration of digital transformation has become one of the decisive factors shaping the competitiveness, adaptability, and long-term sustainability of industrial enterprises. In the contemporary economic environment, enterprises are required not only to modernize production equipment, but also to revise the logic of management, communication, resource allocation, technological



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planning, and market interaction. Digital transformation changes the traditional structure of industrial activity by introducing automated systems, integrated information platforms, artificial intelligence, industrial Internet of Things, cloud technologies, big data analytics, digital twins, cybersecurity solutions, and enterprise resource planning mechanisms. However, the effectiveness of these technologies depends on how deeply they are embedded into the organizational, production, financial, and strategic processes of an enterprise. Therefore, the assessment of digital transformation requires a systematic and measurable approach that reflects the real level of digital maturity.

Industrial enterprises often face the problem of uneven digital development. Some departments may actively use automated production systems, while others continue to rely on manual documentation, fragmented information flows, and traditional management practices. In such conditions, the presence of isolated digital tools cannot be considered sufficient evidence of successful transformation. Digital maturity should be understood as the ability of an enterprise to use digital technologies in an integrated, purposeful, economically justified, and strategically coordinated manner. This means that digital maturity includes not only technological readiness, but also managerial flexibility, personnel competencies, innovation culture, information security, data quality, process transparency, and the ability to convert digital solutions into measurable economic results.

The development of a multifactor Digital Maturity Index is important because digital transformation is a multidimensional phenomenon. It cannot be assessed only through the number of computers, software systems, automated machines, or digital platforms used by an enterprise. A reliable assessment model should include several interrelated indicators that reflect both technical and economic aspects of transformation. For example, digital infrastructure determines the basic technological capacity of the enterprise, while data-driven management shows the degree to which decisions are made on the basis of analytical information rather than subjective assumptions. Cybersecurity reflects the protection of digital assets, while digital competence of personnel indicates the human capacity to use new technologies effectively. Innovation activity



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demonstrates readiness for continuous improvement, and economic efficiency shows whether digital investments produce practical results.

For an Economical University audience, the relevance of this topic is especially significant because digital transformation should be studied not only as a technological process, but also as an economic management mechanism. The creation of a multifactor index allows researchers, managers, investors, and policymakers to compare enterprises, identify development gaps, determine investment priorities, and monitor progress over time. Such an index can also support strategic decision-making by showing which factors most strongly influence digital maturity and which areas require institutional, financial, or organizational intervention.

Thus, the study of development and application mechanisms of a multifactor Digital Maturity Index provides a methodological basis for evaluating industrial transformation in a comprehensive way. It helps connect technological modernization with economic performance, managerial efficiency, and sustainable industrial development.

Methods

The methodological basis of this study is formed by a systematic, analytical, and index-based approach to assessing the digital maturity of industrial enterprises. Since digital transformation is a complex process involving technological, organizational, economic, managerial, and human-resource factors, the research methodology is based on the principle of multidimensional evaluation. The main objective of the methodological approach is to develop a Digital Maturity Index that can reflect the real state of digital transformation in industrial enterprises and provide a practical tool for comparing, monitoring, and improving their digital development.

The study applies a combination of qualitative and quantitative methods. The qualitative part is aimed at identifying the key components of digital maturity and determining their relevance for industrial enterprises. This includes the analysis of scientific literature, international digital maturity models, industrial modernization concepts, enterprise management approaches, and digital economy development trends. On the basis of this analysis, the main dimensions



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of the proposed index are selected. These dimensions include digital infrastructure, automation of production processes, integration of information systems, data-driven management, cybersecurity, personnel digital competence, innovation capacity, digital customer and supplier interaction, and economic efficiency of digital investments. Each of these dimensions reflects a specific aspect of digital transformation and contributes to the overall maturity level of the enterprise.

The quantitative part of the methodology is based on the construction of a multifactor index model. For each dimension, a set of measurable indicators is defined. For example, digital infrastructure can be assessed through the availability of broadband connectivity, cloud services, modern software platforms, digital equipment, and internal information networks. Automation can be measured through the share of automated operations, the use of programmable control systems, robotics, and digital monitoring tools. Data-driven management can be evaluated through the availability of databases, analytical dashboards, forecasting systems, and management decisions based on real-time information. Personnel digital competence can be measured through training frequency, digital literacy level, ability to work with specialized software, and readiness to adopt new technologies.

To make the indicators comparable, the study uses a normalization procedure. Since indicators may have different units of measurement, each value is transformed into a unified scale from zero to one, where zero reflects the lowest level of digital readiness and one reflects the highest level of development. After normalization, indicators are grouped according to the main dimensions of the index. The overall Digital Maturity Index is calculated as a weighted aggregate of these dimensions. Weight coefficients may be determined through expert assessment, analytical hierarchy methods, or equal distribution depending on the research design and availability of empirical data. In the context of industrial enterprises, higher weights may be assigned to automation, data management, cybersecurity, and economic efficiency because these factors directly influence production stability and competitiveness.

The application mechanism of the index includes several stages. First, data are collected from enterprise reports, surveys, interviews with managers and



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specialists, internal digital system records, and financial indicators. Second, the collected data are verified and classified according to index dimensions. Third, normalized values are calculated for each indicator. Fourth, dimension scores and the final Digital Maturity Index are determined. Finally, the results are interpreted according to maturity levels such as initial, developing, integrated, advanced, and intelligent digital maturity. This classification allows enterprises to identify their current position and formulate targeted digital transformation strategies.

The proposed methodology is designed to be flexible and applicable to different types of industrial enterprises. It can be used by managers for internal diagnostics, by researchers for comparative analysis, and by policymakers for evaluating the digital development of industrial sectors.

Results

The results of the study show that the development of a multifactor Digital Maturity Index creates a structured basis for assessing the real level of digital transformation in industrial enterprises. The proposed index makes it possible to move from a general and descriptive understanding of digitalization to a measurable analytical model. In many industrial enterprises, digital technologies are introduced gradually and unevenly, which makes it difficult to determine whether transformation is systematic or fragmented. The index approach solves this problem by dividing digital maturity into several measurable dimensions and showing how each dimension contributes to the overall level of enterprise development.

The analysis demonstrates that digital maturity depends on the interaction of technological, managerial, human, and economic factors. Digital infrastructure forms the foundation of transformation, because without stable networks, modern software, cloud services, and reliable data storage systems, enterprises cannot effectively automate production or organize data exchange. At the same time, infrastructure alone does not guarantee digital maturity. The enterprise may possess modern equipment, but if production processes are not integrated with management systems, the transformation remains incomplete. Therefore,



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automation and integration of information systems are among the most important indicators in the proposed index.

The results also indicate that data-driven management is a key factor in achieving a higher level of digital maturity. Enterprises that use analytical dashboards, real-time monitoring, forecasting tools, and digital reporting systems are able to make faster and more accurate decisions. In contrast, enterprises that rely on paper documentation, delayed reporting, and subjective managerial judgment remain at the lower stages of digital maturity. This confirms that digital transformation should be assessed not only by the presence of technologies, but also by the quality of their use in decision-making processes. Another important result is the identification of personnel digital competence as a decisive condition for successful transformation. Even the most advanced technologies may remain ineffective if employees do not have sufficient skills to use them. The index therefore includes indicators related to digital literacy, professional training, readiness for technological change, and the ability to work with specialized industrial software. The assessment shows that enterprises with systematic employee training and internal digital culture are more capable of adapting to technological modernization and reducing resistance to innovation. The study further shows that cybersecurity must be considered an integral component of digital maturity. As industrial enterprises become more dependent on digital platforms, automated systems, and data exchange, the risks related to information leakage, system failure, unauthorized access, and cyberattacks increase. A digitally mature enterprise is not only technologically advanced, but also capable of protecting its digital assets and ensuring the continuity of production processes.

The proposed index also reveals the importance of measuring the economic efficiency of digital transformation. Digital solutions should lead to practical results such as reduced production costs, increased labor productivity, improved resource utilization, faster operational control, lower downtime, and higher product quality. If digital investments do not generate measurable economic outcomes, their strategic value remains limited. Therefore, the inclusion of economic efficiency indicators allows the Digital Maturity Index to serve not



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only as a technological assessment tool, but also as an instrument of economic analysis.

Overall, the results confirm that the multifactor Digital Maturity Index can classify industrial enterprises into different maturity levels, from initial digital readiness to advanced and intelligent transformation. This classification helps enterprises identify weak areas, determine priority directions for investment, compare internal departments, and develop targeted modernization strategies. The index can also be used for continuous monitoring, allowing enterprises to evaluate progress over time and adjust transformation policies according to changing technological and economic conditions.

Discussion

The findings of the study indicate that the assessment of digital transformation in industrial enterprises requires a broader analytical framework than traditional technological evaluation. In practice, many enterprises associate digital transformation mainly with the purchase of new equipment, the introduction of software, or the automation of separate production operations. However, such an approach does not fully reflect the depth and quality of transformation. Digital maturity is formed when technologies, management systems, human capital, business processes, and economic goals function as a unified mechanism. Therefore, the proposed multifactor Digital Maturity Index is significant because it allows enterprises to evaluate transformation as an integrated organizational and economic process.

One of the main advantages of the index approach is that it reveals the internal structure of digital development. A general assessment of digitalization often produces vague conclusions, while a multifactor index shows which components are strong and which require improvement. For example, an enterprise may have relatively developed digital infrastructure but weak data analytics, insufficient cybersecurity, or low digital competence among employees. In this case, the final maturity score is not simply a numerical result; it becomes a diagnostic tool that explains the real reasons for uneven transformation. This is especially important for industrial enterprises where production, logistics, accounting, procurement, sales, and maintenance systems are closely interconnected.



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The discussion of the proposed model also shows that the economic interpretation of digital maturity is essential. Digital transformation should not be viewed as a fashionable technological trend, but as a mechanism for increasing productivity, reducing costs, improving product quality, optimizing resources, and strengthening competitiveness. If digital tools are introduced without clear economic objectives, they may increase expenses without producing significant managerial or production benefits. For this reason, the inclusion of economic efficiency indicators in the Digital Maturity Index strengthens its practical value. It allows enterprises to evaluate not only whether digital technologies are present, but also whether they contribute to measurable economic performance.

Another important aspect is the role of human capital. Industrial digitalization changes the requirements for personnel, because employees must be able to work with automated systems, digital dashboards, enterprise resource planning platforms, databases, and analytical tools. Resistance to change, insufficient digital literacy, and lack of continuous training may reduce the effectiveness of even well-designed technological projects. Thus, the digital maturity of an enterprise depends not only on investments in equipment and software, but also on investments in people. The index reflects this by treating personnel competence as one of the key components of transformation.

The application of the Digital Maturity Index can also support strategic management. Enterprise managers can use index results to determine priorities, allocate investment resources, design training programs, strengthen cybersecurity, and improve integration between production and management systems. At the sectoral level, the index can help compare industrial enterprises and identify general barriers to digital modernization. This is relevant for economies where industrial enterprises differ significantly in technological readiness, financial capacity, and organizational culture.

At the same time, the implementation of such an index requires accurate data collection and clear indicator selection. If indicators are chosen superficially or measured inconsistently, the final results may not reflect the real maturity level. Therefore, the index should be adapted to the size, sector, technological profile,



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and strategic goals of each enterprise. The model should remain flexible, but its core dimensions must be stable enough to ensure comparability and reliability. Overall, the multifactor Digital Maturity Index can become an effective instrument for evaluating, planning, and managing digital transformation. It links technological modernization with economic efficiency, human capital development, information security, and strategic decision-making. Its main practical value lies in transforming digital transformation from an abstract concept into a measurable and manageable process.

Conclusion

The development and application of a multifactor Digital Maturity Index for assessing digital transformation processes in industrial enterprises is an important methodological and practical task in the modern economy. Industrial enterprises increasingly operate in conditions where competitiveness depends not only on production capacity, but also on the ability to use digital technologies for improving management, reducing costs, accelerating decision-making, increasing productivity, and ensuring sustainable development. Therefore, digital transformation must be evaluated through a comprehensive system of indicators that reflects the real level of technological, organizational, human, and economic readiness of an enterprise.

The study shows that digital maturity cannot be determined only by the presence of modern equipment, software, or automated systems. These elements are important, but they become effective only when they are integrated into a unified management and production environment. A digitally mature enterprise is characterized by the coordinated use of digital infrastructure, automated production processes, integrated information systems, data-driven management, cybersecurity mechanisms, skilled personnel, innovative activity, and measurable economic results. For this reason, the proposed multifactor index provides a more accurate and balanced assessment than simple technological indicators.

The Digital Maturity Index allows enterprises to identify their current position in the process of digital transformation and determine the main barriers to further development. It helps reveal whether digitalization is systematic or fragmented,



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whether investments in technology produce economic benefits, and whether personnel are prepared to work effectively in a digital environment. Through this index, enterprises can compare different departments, monitor progress over time, and define priority areas for modernization. This makes the index not only an assessment tool, but also a mechanism for strategic planning and managerial decision-making.

The practical value of the proposed approach is especially visible in industrial enterprises where production, logistics, finance, procurement, quality control, maintenance, and human resource management are closely connected. If digital tools are introduced separately and without coordination, their impact remains limited. However, when digital solutions are evaluated and managed through a multifactor system, enterprises can create a more transparent and efficient transformation model. Such an approach supports better resource allocation, improves investment planning, and strengthens the relationship between technological modernization and economic performance.

The study also confirms that human capital and cybersecurity must be considered essential components of digital maturity. Employees' digital competencies determine how effectively new technologies are used, while cybersecurity ensures the reliability and stability of digital operations. Without these elements, digital transformation may create additional risks instead of providing sustainable advantages. Therefore, the development of digital maturity requires not only technological renewal, but also continuous training, organizational adaptation, and protection of digital assets.

In general, the multifactor Digital Maturity Index can serve as a reliable analytical instrument for industrial enterprises, researchers, and economic policymakers. It provides a clear structure for evaluating transformation processes and supports the transition from isolated digital initiatives to a systematic digital development strategy. The effective application of this index can contribute to higher productivity, improved management quality, stronger innovation capacity, and more sustainable industrial growth.



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