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DEVELOPING AN INTEGRATED INDICATOR SYSTEM FOR ASSESSING ARTIFICIAL INTELLIGENCE-BASED MANAGEMENT EFFICIENCY IN ENTERPRISES

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Abstract. The rapid advancement of digital transformation has significantly increased the adoption of artificial intelligence (AI) technologies in enterprise management. However, the lack of comprehensive evaluation tools limits organizations' ability to measure the effectiveness of AI-driven management systems. This study aims to develop an integrated indicator system for assessing artificial intelligence-based management efficiency in enterprises. The research examines the theoretical foundations of AI-enabled management, identifies key performance dimensions, and proposes a framework of indicators that incorporates operational, financial, technological, and strategic performance measures. Using a systematic and data-driven approach, the study evaluates the role of AI technologies in improving decision-making quality, resource allocation, process automation, and organizational competitiveness. The findings suggest that the proposed integrated indicator system provides a reliable mechanism for measuring management efficiency and supports enterprises in achieving sustainable growth and digital competitiveness. The study contributes to the existing literature by offering a comprehensive framework for evaluating AI-based management effectiveness and facilitating evidence-based managerial decision-making in the context of the digital economy.

Keywords: artificial intelligence, management efficiency, AI-driven management, performance assessment, integrated indicator system, digital transformation, enterprise management, data-driven decision-making, business analytics, organizational performance, digital economy, key performance indicators (KPIs).

INTRODUCTION

The rapid development of digital technologies has fundamentally transformed the way enterprises operate and make managerial decisions. In recent years, artificial intelligence (AI) has emerged as one of the most influential technologies driving organizational innovation, operational efficiency, and competitive advantage. The integration of AI into enterprise management systems has enabled organizations to automate complex processes, analyze large volumes of data, improve forecasting accuracy, and enhance the quality of managerial decision-making. In the context of digital transformation, enterprises increasingly rely on AI-powered tools and data-driven approaches to optimize business processes and improve organizational performance. AI technologies, such as machine learning, predictive analytics, natural language processing, and intelligent automation, have become essential components of modern management systems. These technologies provide managers with real-time insights, facilitate evidence-based decision-making, and contribute to more effective resource allocation. As a result, organizations are able to respond more rapidly to market changes and improve their strategic flexibility.

Despite the growing adoption of AI technologies, assessing the effectiveness of AI-based management systems remains a significant challenge. Traditional performance evaluation methods are often insufficient for measuring the multidimensional impact of AI on enterprise management. Existing assessment approaches primarily focus on financial outcomes or operational indicators while overlooking important aspects such as decision-making quality, innovation capability, process intelligence, data utilization efficiency, and organizational adaptability. Consequently, there is a need for a comprehensive and integrated indicator system that can accurately evaluate management efficiency in AI-driven enterprises.

The scientific literature highlights the importance of performance measurement frameworks in digital organizations. However, limited attention has been given to the development of integrated indicators specifically designed to evaluate AI-based management efficiency. This research gap becomes increasingly important as enterprises continue to invest substantial resources in artificial intelligence technologies without having reliable mechanisms to assess their actual managerial impact.

Therefore, the purpose of this study is to develop an integrated indicator system for assessing artificial intelligence-based management efficiency in enterprises. The study seeks to identify the key dimensions of AI-driven management performance and propose a comprehensive framework that combines operational, financial, technological, and strategic indicators. By establishing a systematic assessment model, the research contributes to both academic knowledge and managerial practice in the field of digital transformation and enterprise management. The findings of this study are expected to provide enterprises with a practical tool for evaluating the effectiveness of AI implementation, improving managerial performance, and supporting sustainable organizational development in the digital economy.

LITERATURE REVIEW

The increasing adoption of artificial intelligence (AI) technologies has transformed traditional management practices and created new opportunities for improving organizational performance. As enterprises continue to integrate AI into decision-making processes, researchers have emphasized the need for comprehensive frameworks to evaluate the effectiveness of AI-based management systems. Recent studies have highlighted AI as a strategic resource that enhances organizational capabilities and supports digital transformation initiatives. According to the World Economic Forum, AI technologies contribute significantly to productivity growth, process optimization, and business innovation, enabling enterprises to improve competitiveness in rapidly changing markets [1]. Similarly, the OECD argues that AI-driven decision-making systems improve resource allocation efficiency and facilitate evidence-based management practices [2].

Brynjolfsson, Li, and Raymond emphasize that AI creates value not merely through automation but through the transformation of managerial decision-making processes and organizational structures [3]. Their findings suggest that enterprises capable of effectively integrating AI into management functions achieve superior operational and strategic outcomes. Research conducted by Davenport and Mittal demonstrates that AI-powered analytics significantly improve the quality and speed of managerial decisions by processing large volumes of structured and unstructured data [4]. The authors argue that data-driven management systems provide organizations with a sustainable competitive advantage through enhanced predictive capabilities and real-time business intelligence.

The relationship between artificial intelligence and organizational performance has also been explored by Dwivedi et al., who identify AI adoption as a key driver of innovation, operational efficiency, and strategic flexibility [5]. Their study highlights the importance of developing appropriate performance indicators to evaluate the effectiveness of AI implementation across different organizational functions. Verhoef et al. examine digital transformation processes and conclude that AI technologies serve as critical enablers of organizational change [6]. However, the authors note that the success of AI initiatives depends largely on an organization's ability to measure and manage performance outcomes effectively.

Recent research by Wamba-Taguimdje et al. focuses on AI-enabled organizational decision-making and demonstrates that enterprises adopting AI-supported management systems experience improvements in productivity, customer satisfaction, and business process efficiency [7]. Nevertheless, the authors emphasize the absence of standardized measurement frameworks capable of capturing the multidimensional impact of AI on management performance.

Furthermore, Chui, Roberts, and Yee argue that AI performance should be assessed using a combination of financial, operational, technological, and strategic indicators rather than relying solely on traditional financial metrics [8]. Their findings support the development of integrated evaluation models that reflect the complexity of AI-driven management systems. Bughin et al. suggest that organizations with advanced AI capabilities outperform competitors in terms of innovation output, market responsiveness, and long-term value creation [9]. However, measuring these benefits remains challenging because of the lack of comprehensive indicator systems.

Despite significant progress in the literature, existing studies primarily focus on AI adoption, implementation strategies, and technological outcomes. Limited attention has been devoted to developing integrated indicator systems specifically designed to assess artificial intelligence-based management efficiency at the enterprise level. Therefore, this study seeks to address this research gap by proposing a comprehensive framework that combines operational, financial, technological, and strategic indicators for evaluating AI-driven management performance [10].

RESEARCH METHODOLOGY

This study employs a qualitative and analytical research approach to develop an integrated indicator system for assessing artificial intelligence-based management efficiency in enterprises. The research is based on a comprehensive review of recent academic literature, international reports, and theoretical frameworks related to artificial intelligence, digital transformation, and performance management. Systematic analysis, comparative analysis, and synthesis methods were used to identify the key dimensions of AI-driven management performance. The proposed indicator system was developed by integrating operational, financial, technological, and strategic performance measures. In addition, the Key Performance Indicator (KPI) approach was applied to evaluate the effectiveness of AI implementation in managerial decision-making, process automation, resource utilization, and organizational performance. The findings were generalized through logical analysis and expert-based evaluation, enabling the development of a comprehensive framework for measuring management efficiency in AI-enabled enterprises.

ANALYSIS AND RESULTS

The implementation of priority areas of digital management transformation in enterprises requires the development of a system for evaluating their effectiveness. The actual impact of digital technologies, Big Data, ERP/CRM systems, analytical platforms, and artificial intelligence tools cannot be determined solely by their existence but rather by their contribution to economic, organizational, and managerial outcomes. In this regard, an indicator system for assessing management efficiency based on artificial intelligence serves as an important methodological tool for measuring, monitoring, and improving the digital transformation process within enterprises. This indicator system should encompass all key dimensions of digital management. In particular, assessment criteria should include the level of data-driven management, the state of digital infrastructure, the use of AI and analytical platforms, the degree of operational automation, cost optimization, decision-making speed, service quality, customer satisfaction, cybersecurity, and employees' digital competencies. Such an approach makes it possible to identify which areas of digital transformation are well developed and which require further improvement. The AI-based management efficiency assessment system is structured around the following key indicator blocks (Table 1).

Table 1
Indicator System for Assessing Digital Management Efficiency in Enterprises Based on Artificial Intelligence¹

No.	Indicator Block	Related Area	Assessment Content
1	Digital Infrastructure Level	ERP/CRM systems, digital platforms	Evaluates the availability and utilization of digital systems, databases, and platforms within the enterprise
2	Data-Driven Management Level	Data-based management	Assesses the extent to which decisions are based on real-time data, dashboards, and analytical indicators
3	AI Analytics and Forecasting Quality	AI-supported decision-making	Evaluates forecasting accuracy related to demand, costs, risks, customer behavior, and production performance
4	Operational Automation Level	Process automation	Measures the automation of reporting, warehousing, logistics, auditing, monitoring, and document management processes
5	Cost Optimization Effectiveness	Resource and cost management	Assesses reductions in production costs, excessive expenditures, energy consumption, logistics, and administrative costs
6	Quality of Managerial Decisions	Strategic and operational management	Measures the speed, accuracy, and effectiveness of managerial decision-making
7	Customer-Centricity Level	CRM, chatbots, digital services	Evaluates customer satisfaction, response speed, and service quality
8	Digital Security and Information Reliability	Cybersecurity and audit-log systems	Assesses data protection, access control, backup systems, risk monitoring, and auditing mechanisms
9	Employees' Digital Competencies	Digital skills development	Evaluates employees' ability to work with AI, Big Data, ERP/CRM systems, and analytical platforms
10	Innovation Management Performance	Innovative business models	Measures the implementation of AI-based products, services, business models, and digital solutions

The proposed indicator framework identifies the key dimensions required to assess digital management transformation in enterprises. Each indicator block is linked to the priority areas of digital transformation and enables a comprehensive evaluation of digital infrastructure, data-driven management, AI analytics, automation,

¹ Developed by the author

cost optimization, decision quality, customer orientation, information security, workforce competencies, and innovation performance.

The Digital Infrastructure Level evaluates the existence and utilization of ERP systems, CRM platforms, databases, and internal information systems. This indicator represents the technological foundation of digital transformation. Without a well-developed digital infrastructure, the effective implementation of Big Data analytics, AI solutions, and automated management systems becomes difficult.

The Data-Driven Management Level measures the extent to which managerial decisions are based on real-time data, dashboards, KPIs, and analytical insights. It reflects the degree to which management practices rely on objective evidence rather than subjective judgment or delayed reports.

The AI Analytics and Forecasting Quality indicator evaluates the enterprise's ability to forecast demand, costs, risks, customer behavior, production performance, and market changes. High forecasting accuracy allows organizations to adopt proactive rather than reactive management approaches.

The Operational Automation Level assesses the automation of reporting, warehousing, logistics, auditing, monitoring, and document management processes. Increased automation reduces human errors, saves time, and improves operational efficiency.

The Cost Optimization Effectiveness indicator measures reductions in production costs, resource consumption, energy usage, logistics expenses, and administrative costs. It reflects the direct economic benefits of digital transformation and AI implementation.

The Quality of Managerial Decisions evaluates the speed, accuracy, reliability, and effectiveness of decision-making processes. This indicator represents one of the most important outcomes of digital transformation, as AI and analytical tools are expected to support faster and more accurate managerial decisions.

The Customer-Centricity Level assesses customer satisfaction, service quality, response times, digital service adoption, and customer segmentation capabilities. Higher customer orientation contributes directly to competitiveness and long-term business performance.

The Digital Security and Information Reliability indicator measures data protection, access rights management, backup procedures, audit logs, cybersecurity systems, and risk control mechanisms. Information security is a critical prerequisite for sustainable digital management.

The Employees' Digital Competencies indicator evaluates workforce capabilities related to AI technologies, Big Data analytics, ERP/CRM systems, digital platforms, and cybersecurity tools. The success of digital transformation depends not only on technology but also on human capital capable of utilizing it effectively.

Finally, the Innovation Management Performance indicator measures the implementation of AI-driven products, services, business models, and digital solutions. It reflects an enterprise's ability to create new value and gain sustainable competitive advantages through innovation.

Overall, the proposed indicator system provides a comprehensive framework for evaluating the effectiveness of digital management transformation in enterprises. Rather than focusing solely on technological adoption, it assesses managerial performance, economic efficiency, service quality, and competitiveness. For example, the mere implementation of ERP or CRM systems does not guarantee improved performance. Their effectiveness should be evaluated based on their ability to enhance decision-making speed, reduce costs, improve customer satisfaction, and generate measurable business outcomes. Therefore, the integrated indicator system offers a practical tool for monitoring digital transformation progress and identifying areas requiring further improvement (Table 2).

Table 2

Indicator System and Weight Coefficients for Assessing Artificial Intelligence-Based Management Efficiency²

Indicator Block	Notation	Weight Coefficient
Digital Infrastructure Level	I_1	0.10
Data-Driven Management Level	I_2	0.12
AI Analytics and Forecasting Quality	I_3	0.13
Operational Automation Level	I_4	0.10
Cost Optimization Effectiveness	I_5	0.12
Quality of Managerial Decisions	I_6	0.13
Customer-Centricity Level	I_7	0.10
Digital Security and Information Reliability	I_8	0.10
Employees' Digital Competencies	I_9	0.05
Innovation Management Performance	I_{10}	0.05
Total		1.00

² Developed by the author

In the proposed model, the highest weights are assigned to AI Analytics and Forecasting Quality and Quality of Managerial Decisions. This is because the primary objective of artificial intelligence-based management is to analyze large volumes of data, identify potential risks and opportunities in advance, and provide managers with timely and evidence-based decision support. These indicators directly reflect the effectiveness of AI technologies in enhancing managerial performance and organizational responsiveness.

Data-Driven Management Level and Cost Optimization Effectiveness are also considered key components of the model, as they play a crucial role in transforming digital initiatives into tangible economic outcomes. Data-driven management ensures that decisions are based on accurate and real-time information, while cost optimization demonstrates the financial benefits generated through the implementation of AI technologies, process automation, and advanced analytics.

The remaining indicators, including digital infrastructure, operational automation, customer-centricity, digital security, employees' digital competencies, and innovation management performance, serve as supporting dimensions that contribute to the overall success of digital transformation and AI-enabled management systems. The results of the Artificial Intelligence-Based Management Efficiency Index (AIMEI) can be interpreted according to the following criteria (Table 3).

Table 3
Assessment Criteria for Artificial Intelligence-Based Management
Efficiency in Enterprises Using the AIBSI Index

AIBSI Value	Assessment Level	Description
0.00-0.30	Low Level	Digital management is weak, and AI solutions are rarely or not used in management processes.
0.31-0.50	Initial Level	Certain digital systems exist; however, their impact on managerial decision-making remains limited.
0.51-0.70	Developing Level	Data-driven management practices and AI-based analytical capabilities are gradually being established.
0.71-0.85	High Efficiency Level	AI, Big Data, ERP/CRM systems, and KPI monitoring significantly contribute to management effectiveness and operational performance.
0.86-1.00	Innovative Management Level	AI-driven decision-making, process automation, predictive analytics, and risk control mechanisms are fully integrated into management systems.

Table 3 presents the assessment criteria for the Artificial Intelligence-Based Management Efficiency Index (AIBSI). The table is designed to evaluate the level of development of digital management, AI technologies, Big Data analytics, ERP/CRM systems, KPI monitoring, process automation, and risk control mechanisms within enterprises. The index ranges from 0 to 1, where higher values indicate a more advanced and effective AI-based management system.

The Low Level category corresponds to an AIBSI value ranging from 0.00 to 0.30. At this stage, digital management practices are weak, data are primarily managed manually, and AI solutions are rarely used. Managerial decisions are largely based on experience, intuition, or delayed reports rather than real-time analytical insights. As a result, decision-making processes tend to be slower, errors occur more frequently, and resource utilization remains inefficient.

The Initial Level, represented by an AIBSI value between 0.31 and 0.50, indicates that some digital systems, such as electronic reporting tools, accounting software, or isolated ERP/CRM components, have been implemented. However, these systems are not fully integrated into a unified management framework. Consequently, their contribution to managerial decision-making and organizational performance remains limited.

The Developing Level corresponds to index values ranging from 0.51 to 0.70. At this stage, enterprises begin to adopt data-driven management practices. Analytical dashboards, KPI monitoring systems, data analytics tools, and selected AI applications become part of the management process. Decisions are increasingly

supported by real-time data and analytical insights. Nevertheless, AI technologies, Big Data solutions, and automation systems are not yet fully integrated across all organizational functions.

The High Efficiency Level, represented by values between 0.71 and 0.85, indicates that AI technologies, Big Data analytics, ERP/CRM systems, and KPI monitoring tools have a substantial impact on enterprise management. Decision-makers rely on near-real-time information, operational costs are optimized, customer relationship management improves, and business processes become increasingly automated. This stage reflects the successful implementation of digital transformation initiatives and their positive contribution to organizational performance.

The Innovative Management Level, corresponding to an AIBSI value between 0.86 and 1.00, represents the highest stage of AI-based management maturity. At this level, AI-driven decision-making, intelligent automation, predictive analytics, risk management, cybersecurity systems, and KPI monitoring are fully integrated into enterprise operations. Organizations not only digitalize existing processes but also leverage AI technologies to develop new products, services, and business models. Such enterprises demonstrate high adaptability, strong innovative capabilities, and superior competitiveness in dynamic market environments. Therefore, the AIBSI classification framework provides a practical tool for measuring the maturity of AI-enabled management systems and identifying the strategic priorities required to advance enterprise digital transformation and management effectiveness.

CONCLUSIONS AND RECOMMENDATIONS

The study demonstrates that the effectiveness of artificial intelligence-based management cannot be adequately evaluated through individual technological indicators alone. Instead, a comprehensive and integrated assessment framework is required to capture the multidimensional impact of AI on enterprise performance. In this regard, the proposed Artificial Intelligence-Based Management Efficiency Index (AIBSI) provides a systematic approach for measuring the level of AI integration and its contribution to managerial effectiveness within enterprises.

The research identified ten key indicator blocks, including digital infrastructure, data-driven management, AI analytics and forecasting quality, operational automation, cost optimization, managerial decision quality, customer-centricity, digital security, employees' digital competencies, and innovation management performance. Together, these indicators provide a holistic evaluation of digital transformation outcomes and management efficiency.

The findings suggest that the quality of AI analytics and forecasting, as well as the quality of managerial decisions, represents the most influential dimensions of AI-based management performance. These factors directly affect the ability of enterprises to process large volumes of data, anticipate risks and opportunities, and make timely and evidence-based decisions. Furthermore, data-driven management practices and cost optimization mechanisms play a critical role in converting digital transformation initiatives into measurable economic benefits.

The proposed AIBSI model enables enterprises to classify their level of AI-based management maturity, identify strengths and weaknesses in digital transformation processes, and determine strategic priorities for further development. The assessment framework can also support benchmarking activities and facilitate continuous performance monitoring.

From a practical perspective, the implementation of the proposed indicator system can improve decision-making quality, enhance operational efficiency, strengthen cybersecurity, optimize resource utilization, and increase organizational competitiveness. Enterprises with higher AIBSI scores are more likely to achieve sustainable growth, innovation capacity, and long-term competitive advantages in the digital economy.

In conclusion, the AIBSI framework contributes to both theory and practice by providing an integrated methodology for assessing artificial intelligence-based management efficiency. The proposed model may serve as a valuable tool for managers, policymakers, and researchers seeking to evaluate and improve the effectiveness of AI-driven management systems in the context of ongoing digital transformation.

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