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ARTIFICIAL INTELLIGENCE-BASED MODELING OF DECISION-MAKING PROCESSES IN MANAGEMENT SYSTEMS AND DEVELOPMENT OF AN INTELLIGENT DECISION SUPPORT SYSTEM

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Abstract: This article examines the theoretical and practical foundations of modeling decision-making processes in management systems through artificial intelligence methods and analyzes the development of intelligent decision support systems as an advanced tool for improving managerial effectiveness. The study emphasizes the role of machine learning, expert systems, neural networks, fuzzy logic, natural language processing, and predictive analytics in transforming managerial decision-making from intuition-based and experience-dependent processes into data-driven, adaptive, and intelligent mechanisms. The article also discusses the architecture, functional components, advantages, limitations, and implementation challenges of intelligent decision support systems.

Keywords: *artificial intelligence, decision-making, management systems, intelligent decision support system, machine learning, predictive analytics, managerial efficiency, decision modeling.*

1. INTRODUCTION

In the modern stage of digital transformation, decision-making has become one of the most important and complex functions of management systems. Organizations operate in an environment where economic uncertainty, technological change, increasing competition, data expansion, market volatility, and institutional complexity directly influence the quality of managerial decisions. Traditional decision-making approaches, which are mainly based on personal experience, intuition, limited statistical analysis, and retrospective information, are no longer sufficient for solving complex managerial problems. In this context, artificial intelligence has emerged as a powerful scientific and technological tool for modeling decision-making processes and developing intelligent decision

support systems. The application of artificial intelligence methods in management creates opportunities for analyzing large volumes of data, identifying hidden patterns, forecasting future scenarios, evaluating alternatives, reducing uncertainty, and improving the rationality of managerial decisions (Ali et al., 2023).

Decision-making in management systems is a multidimensional process that includes the identification of a problem, collection and analysis of information, development of alternative solutions, assessment of possible consequences, selection of the most appropriate option, implementation of the decision, and evaluation of its results. In classical management theory, this process is often presented as a rational and logical sequence. However, in real organizational practice, decision-making is influenced by time pressure, incomplete information, subjective judgments, cognitive biases, resource limitations, institutional constraints, and unpredictable external factors. These circumstances make managerial decisions more difficult and increase the risk of mistakes. Artificial intelligence-based modeling helps to overcome these limitations by transforming decision-making from a mainly intuition-based process into a data-driven, analytical, adaptive, and intelligent mechanism.

2. PROBLEM STATEMENT

Artificial intelligence allows management systems to process both structured and unstructured data. Structured data may include financial indicators, production statistics, sales results, employee performance data, customer transactions, inventory levels, and operational reports. Unstructured data may include emails, customer reviews, social media content, market news, expert opinions, legal documents, and internal communication. The ability to analyze such diverse data sources gives artificial intelligence-based systems a significant advantage over traditional decision support tools. By using machine learning, natural language processing, neural networks, fuzzy logic, expert systems, and predictive analytics, artificial intelligence can reveal relationships that are difficult or impossible for human decision-makers to detect through ordinary analysis (Kourkoumelis et al., 2024).

The modeling of decision-making processes through artificial intelligence begins with the formalization of the managerial problem. Any decision model must clearly define the purpose of the decision, the variables affecting the situation, the criteria for evaluation, the available alternatives, and the constraints under which the decision must be made. For example, if a management system is designed to support investment decisions, the model should consider profitability, risk level, payback period, market demand, technological feasibility, financial sustainability, and strategic relevance. If the system is developed for human resource management, it should analyze employee competencies, productivity indicators, professional experience, motivation, training needs, and organizational

requirements. Therefore, the effectiveness of an artificial intelligence-based decision model depends not only on the algorithm used but also on the correct formulation of the decision problem.

Machine learning plays a central role in artificial intelligence-based decision-making. It enables systems to learn from historical data and improve their performance over time. In management systems, machine learning can be used for sales forecasting, customer segmentation, financial risk assessment, demand prediction, employee turnover analysis, fraud detection, production planning, and supply chain optimization. The main advantage of machine learning is that it does not rely only on fixed rules. Instead, it identifies patterns in data and uses them to make predictions or recommendations. This feature is especially important in dynamic environments where market conditions, consumer behavior, and organizational performance indicators change continuously.

Artificial neural networks are particularly useful for modeling complex and nonlinear decision-making problems. Many managerial situations involve relationships that cannot be explained through simple cause-and-effect logic. For instance, customer satisfaction may depend on price, product quality, service speed, brand reputation, emotional perception, and previous experience at the same time. Neural networks can process such complex relationships and produce more accurate predictions. In strategic management, neural networks can be used to forecast market trends, evaluate investment risks, identify potential crises, and support long-term planning. Their ability to analyze large datasets and detect nonlinear patterns makes them highly valuable for intelligent decision support systems (Vasilj & Torbica, 2025).

Expert systems are another important artificial intelligence method used in decision-making. These systems imitate the reasoning process of human experts by using a knowledge base and an inference mechanism. The knowledge base includes professional rules, facts, experience, and domain-specific information, while the inference mechanism applies logical reasoning to generate conclusions or recommendations. In management systems, expert systems can support decisions related to risk classification, compliance control, project evaluation, personnel selection, financial analysis, and operational diagnostics. Their importance becomes especially clear in areas where expert knowledge is limited, expensive, or difficult to access. By transferring expert knowledge into an intelligent system, organizations can make more consistent and standardized decisions.

The development of an intelligent decision support system requires the integration of several functional elements into a unified technological architecture. Such a system must include data collection mechanisms, data storage infrastructure, analytical models, artificial intelligence algorithms, knowledge representation tools, reasoning mechanisms, user interfaces, and feedback channels. The data management component ensures that relevant information is collected from internal and external sources, cleaned, organized, updated, and made available for analysis. The model management component contains machine learning models, forecasting tools, optimization

algorithms, simulation mechanisms, and analytical procedures. The knowledge management component stores expert rules, organizational policies, best practices, historical cases, and domain-specific knowledge. The user interface presents the system's results in a clear and understandable form, allowing managers to interact with the system, compare alternatives, test scenarios, and make informed decisions (Onwujekwe & Weistroffer, 2025).

An intelligent decision support system should not be understood as a tool that replaces managers. Its primary function is to support human decision-making by providing analytical, predictive, and evidence-based assistance. Managerial decisions often require ethical judgment, strategic vision, contextual understanding, creativity, leadership, and responsibility. These qualities cannot be fully automated. Therefore, the most effective model is human-machine collaboration, where artificial intelligence performs data processing, pattern recognition, forecasting, and recommendation generation, while human managers interpret the results and make the final decision. This approach combines the computational power of artificial intelligence with the experience, intuition, and responsibility of human decision-makers.

The practical importance of artificial intelligence-based decision support systems is especially visible in strategic management. Strategic decisions are usually long-term, high-risk, and resource-intensive. They may relate to market expansion, investment planning, innovation strategy, digital transformation, diversification, mergers, or organizational restructuring. Artificial intelligence can support such decisions by analyzing market trends, forecasting demand, evaluating risks, comparing scenarios, and identifying the most promising strategic alternatives. Scenario analysis is particularly important because it allows managers to assess possible future developments under different conditions. This increases the flexibility and resilience of management systems (Almtrf, 2025).

In operational management, intelligent decision support systems can improve efficiency by optimizing resource allocation, production schedules, logistics, inventory levels, workflow processes, and quality control. For example, artificial intelligence can predict equipment failures before they occur, recommend optimal inventory levels, identify bottlenecks in production, and improve supply chain coordination. This reduces costs, increases productivity, and improves organizational responsiveness. In financial management, artificial intelligence can be used for budgeting, profitability analysis, credit risk assessment, fraud detection, investment evaluation, and financial forecasting. By identifying hidden financial risks and providing early warning signals, intelligent systems strengthen financial stability and managerial control.

Human resource management is another area where artificial intelligence-based decision support systems can create significant value. These systems can support recruitment, employee selection, performance evaluation, training planning, career development, and workforce forecasting. By analyzing employee data, skill profiles, productivity indicators, and organizational needs, artificial

intelligence can help managers make more objective and evidence-based personnel decisions. However, this area also requires special ethical attention because biased data or poorly designed algorithms may lead to unfair outcomes. Therefore, artificial intelligence in human resource management must be transparent, explainable, and controlled by human judgment.

Despite its advantages, the implementation of artificial intelligence-based decision support systems is associated with several challenges. One of the most important challenges is data quality. Artificial intelligence models are only as reliable as the data on which they are trained. If the data is incomplete, outdated, biased, inconsistent, or inaccurate, the system's recommendations may also be misleading. For this reason, organizations must establish strong data governance mechanisms, ensure data accuracy, protect data security, and continuously update information sources. Without high-quality data, even the most advanced artificial intelligence algorithm cannot produce reliable decision support (Kourkoumelis et al., 2024).

Another serious challenge is algorithmic transparency. Some artificial intelligence models, especially deep learning systems, may function as black boxes, meaning that their internal decision logic is difficult to understand. In management systems, this creates problems of trust, accountability, and responsibility. Managers need to understand why a system recommends a particular decision, which factors influenced the result, and how reliable the recommendation is. Therefore, explainable artificial intelligence is essential for the development of intelligent decision support systems. Explainability increases user trust, improves managerial control, and allows organizations to justify decisions more clearly.

Ethical and legal issues must also be considered. Artificial intelligence-based systems may affect employees, customers, partners, and society. If these systems are used irresponsibly, they may reinforce discrimination, violate privacy, reduce human autonomy, or create unfair decision outcomes. Therefore, the development of intelligent decision support systems should be based on principles such as fairness, transparency, accountability, privacy protection, security, and human oversight. Organizations must ensure that artificial intelligence supports responsible management rather than creating uncontrolled automation.

The successful implementation of intelligent decision support systems also requires organizational readiness. Many organizations face difficulties because of weak digital infrastructure, lack of qualified specialists, and resistance to technological change, insufficient data culture, and limited understanding of artificial intelligence. Employee training, managerial support, technological investment, process redesign, and cultural adaptation should therefore accompany the introduction of such systems. Artificial intelligence is not only a technical tool; it also changes the logic of management, the structure of decision-making, and the relationship between humans and information systems (Onwujekwe & Weistroffer, 2025).

3. CONCLUSİONS

In conclusion, artificial intelligence-based modeling of decision-making processes represents a major transformation in the development of modern management systems. It enables organizations to analyze complex data, forecast future developments, assess alternatives, reduce uncertainty, and improve the quality of managerial decisions. The development of intelligent decision support systems creates new opportunities for strategic planning, operational efficiency, financial control, human resource management, risk assessment, and organizational innovation. At the same time, successful implementation requires careful attention to data quality, algorithmic transparency, ethical principles, cybersecurity, and human-machine collaboration. Artificial intelligence should not be viewed as a replacement for managers, but as an intelligent support mechanism that enhances their analytical capacity and decision-making effectiveness. As organizations continue to operate in increasingly complex and data-rich environments, the integration of artificial intelligence into management decision-making will become not only an advantage but also a strategic necessity for sustainable development and competitive performance.

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