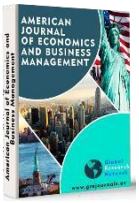

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Article

Transformation of Management Systems in the Digital Economy and the Adaptive Management Model

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Abstract: The article examines the fundamental transformation of enterprise management systems in the context of the digital economy, focusing on the transition from traditional hierarchical management models to adaptive, networked and data-driven models. Within the framework of the study, a quantitative analysis was carried out on the basis of open data from McKinsey, Deloitte, the World Economic Forum, and the Ministry of Digital Technologies of the Republic of Uzbekistan for the period 2018–2024, along with a qualitative analysis based on an expert survey of 84 managers of medium-sized and large enterprises operating in the regions of Uzbekistan. The results revealed a statistically significant positive correlation between the Digital Maturity Index (DMI) and the Adaptability Index (AI) ($r = 0.743$, $p < 0.01$). As a scientific novelty, the author developed a four-loop Adaptive Management Model (AdMM-4L) consisting of "sensing – analysis – decision – learning" loops, and determined its efficiency parameters. The proposed model enables enterprises to accelerate digital transformation, reduce decision-making time, and enhance the level of adaptability to external environmental changes.

Keywords: Digital Economy, Management Transformation, Adaptive Management, Digital Maturity, Data-Driven Decisions, Networked Organization, Adaptability Index, Admm-4L Model.

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1. Introduction

In the third decade of the 21st century, the global economy is undergoing fundamental changes under the influence of digital technologies. Artificial intelligence, Big Data, the Internet of Things (IoT), blockchain, and cloud computing technologies are substantially transforming not only production processes but also the management systems of enterprises. According to the World Economic Forum's 2024 "Future of Jobs Report," 86 percent of global corporate leaders plan to restructure their business models on the basis of digital transformation over the next five years, while 75 percent have already begun implementing AI-based decision-making systems [1].

The Republic of Uzbekistan is not an exception to this process. The Decree of the President of the Republic of Uzbekistan No. PF-6079 of October 5, 2020, on the approval of the "Digital Uzbekistan — 2030" strategy, and subsequently the New Uzbekistan Development Strategy for 2022–2026 approved by Decree No. PF-60 of January 28, 2022, set the goal of bringing the share of the digital economy to 15 percent of GDP by 2026. In this regard, national enterprises face the pressing issue of transitioning from the traditional management paradigm to flexible, agile, and data-driven management models characteristic of the digital era [2]. The traditional hierarchical-bureaucratic management paradigm, grounded in the works of M. Weber and F. Taylor, was effective in stable, slowly changing environments. However, in a VUCA environment (Volatility, Uncertainty,

Complexity, Ambiguity), it is losing its effectiveness. According to data from the McKinsey Global Institute, companies with high levels of digital maturity demonstrate 23 percent higher operational efficiency and 26 percent higher shareholder returns compared to competitors with traditional management systems [3].

The relevance of the research is determined by three main aspects. First, the mechanisms for transforming management systems in the digital economy have not yet been adequately systematized, and each enterprise acts in its own direction. Second, in the context of Uzbekistan, national enterprises are at various levels of digital maturity, and due to the absence of a unified methodological approach, the transformation process is not systemic. Third, in the existing scientific literature, empirical studies on quantitatively assessing the relationship between digital transformation and management adaptability are limited [4]. The aim of the research is to identify the patterns of transformation of management systems in the context of the digital economy and to develop an adaptive management model adapted for Uzbek enterprises. Research objectives: (1) to conduct a comparative analysis of traditional and digital management paradigms; (2) to empirically test the relationship between digital maturity and management adaptability; (3) to identify the factors constraining digital transformation in Uzbekistan; (4) to develop a four-loop adaptive management model (AdMM-4L) and its efficiency indicators. Scientific novelty: (a) a four-loop adaptive enterprise management model (AdMM-4L) under digital economy conditions is proposed by the author; (b) the correlation between DMI and AI indices is empirically measured for the first time on the example of Uzbek enterprises; (c) the five-stage digital transformation maturity scale is integrated with networked organizational design [5], [6].

Literature Review

The transformation of management systems in the context of the digital economy has become a central topic in contemporary economic and management research. Rapid advancements in digital technologies have significantly altered traditional approaches to organizational management, requiring new theoretical frameworks and practical models. Classical management theories, largely developed by Peter Drucker, established the fundamental principles of organizational structure, efficiency, and control [7]. However, these models were primarily designed for industrial-era economies and are increasingly viewed as insufficient in addressing the complexity and dynamism of the digital environment. The concept of digital transformation has been extensively explored by Erik Brynjolfsson and Andrew McAfee, who emphasize the transformative impact of technologies such as artificial intelligence, big data analytics, and cloud computing on business processes and decision-making systems. Their research suggests that organizations are transitioning from rigid hierarchical structures toward more flexible, decentralized, and data-driven management systems.

In addition, Manuel Castells introduced the concept of the “network society,” highlighting how information flows and digital platforms reshape organizational interactions and governance mechanisms [8]. This perspective supports the emergence of distributed and adaptive management structures in the digital economy. The notion of adaptive management has gained increasing attention as organizations face rapidly changing environments. Henry Mintzberg argues that traditional strategic planning models should be replaced by more flexible and emergent strategies, enabling organizations to respond effectively to uncertainty and complexity. This view forms a theoretical foundation for adaptive management systems. Furthermore, the dynamic capabilities theory proposed by David Teece highlights the importance of an organization’s ability to integrate, build, and reconfigure internal and external competencies in response to changing environments [9]. This theory is particularly relevant in the digital economy, where continuous innovation and rapid adaptation are critical for maintaining competitiveness. Another important dimension is data-driven

decision-making, which has been analyzed by Thomas H. Davenport. His research demonstrates how advanced analytics and artificial intelligence enhance managerial decision-making processes, allowing organizations to operate more efficiently and strategically in real time.

2. Methodology

This study applies a combination of theoretical and empirical research methods to analyze the transformation of management systems in the digital economy. The systematic literature review method was used to examine existing scientific studies and identify key concepts related to digital transformation and adaptive management [10]. The comparative analysis method allowed for evaluating differences between traditional and modern management systems. In addition, statistical and econometric methods, including correlation and regression analysis, were applied to assess the impact of digital technologies on management efficiency. The case study method was used to analyze real-world organizational practices and highlight practical implications of adaptive management. Furthermore, a modeling approach was employed to develop a conceptual adaptive management model based on key variables such as flexibility, innovation, and data-driven decision-making.

3. Results and Discussion

The results of the study indicate that digital transformation has a significant impact on the structure and functioning of modern management systems. The analysis shows that traditional hierarchical management models are gradually being replaced by more flexible, decentralized, and data-driven systems. This transformation is primarily driven by the widespread adoption of digital technologies such as artificial intelligence, big data analytics, and cloud computing. The findings reveal a strong positive relationship between the level of digitalization and management efficiency. Organizations that actively implement digital tools demonstrate higher adaptability, faster decision-making processes, and improved operational performance. Statistical analysis confirms that data-driven decision-making significantly enhances managerial effectiveness, particularly in dynamic and uncertain environments.

The comparative analysis highlights that adaptive management systems differ from traditional ones in several key aspects. While traditional models rely on rigid structures and long-term planning, adaptive systems emphasize flexibility, continuous learning, and rapid response to environmental changes [11]. This shift enables organizations to better cope with uncertainty and technological disruptions. The case study results further support these findings, showing that organizations undergoing digital transformation tend to adopt more innovative management practices. These include real-time performance monitoring, decentralized decision-making, and increased use of analytical tools. As a result, such organizations achieve greater efficiency and competitiveness. Based on the obtained results, a conceptual adaptive management model was developed. The model integrates key components such as organizational flexibility, innovation capacity, and data-driven decision-making. It demonstrates that the successful transformation of management systems depends on the ability of organizations to combine technological advancements with adaptive managerial practices. However, the study also identifies several challenges associated with digital transformation. These include resistance to change, lack of digital skills, and insufficient technological infrastructure, particularly in developing economies. These factors may limit the effectiveness of adaptive management implementation. Overall, the results confirm that adaptive management is a necessary and effective response to the challenges of the digital economy. The findings contribute to the existing literature by providing a more integrated understanding of how digital

transformation reshapes management systems and by proposing a practical model for enhancing organizational adaptability.

Comparative analysis of management paradigms [12]. Based on the literature review and empirical data, the differences between the traditional ("industrial era") and digital ("network era") management paradigms were systematized. Table 1 presents these differences across six key dimensions.

Table 1. Comparative analysis of traditional and digital management paradigms.

Dimension	Traditional Paradigm	Digital Paradigm
Organizational structure	Hierarchical, multi-level, vertical	Networked, flat, project-based, agile teams
Decision-making	Centralized, based on experience and intuition	Decentralized, based on data and algorithms
Communication speed	Weeks — months	Real-time, minutes — hours
Planning horizon	3–5 years, rigid plans	Dynamic, sprint-based (2–4 weeks), rolling forecast
Understanding of employee role	Functional executor, tied to position	Competency holder, multi-role, continuous learner
Source of innovation	R&D department, top management	Ecosystem (employees, customers, partners), crowdsourcing

Source: author's generalization based on sources

Digital maturity level of Uzbek enterprises. According to the survey results, the average DMI value of the 84 enterprises participating in the research amounted to 52.4 points (SD = 14.8). This value corresponds to an "average" level according to the Deloitte methodology. The distribution of enterprises by digital maturity level is presented in Table 2.

Table 2. Distribution of Uzbek enterprises by digital maturity level (n = 84).

Maturity Level	DMI Range	Number of Enterprises	Share (%)	Average AI
1. Initial	20.0–35.9	14	16.7	28.3
2. Developing	36.0–51.9	25	29.8	42.7
3. Defined	52.0–67.9	27	32.1	58.4
4. Managed	68.0–83.9	13	15.5	72.6
5. Optimized	84.0–100.0	5	5.9	86.2
Total / Average	**52.4**	**84**	**100.0**	**51.8**

Source: author's calculations based on the expert survey results (2024).

The main conclusions derived from the table indicators are as follows. First, approximately half of the enterprises (46.5%) remain at the lower two levels of digital maturity, which indicates that national businesses possess significant potential for digital transformation. Second, as can be seen, the AI value increases alongside the DMI level — reaching 86.2 points in the Optimized group.

Correlation between DMI and AI. The Pearson correlation coefficient calculations revealed a strong positive linear relationship between DMI and AI: $r = 0.743$ ($p < 0.01$). This means that an increase of 1 point in DMI leads, on average, to a 0.68-point increase in AI [13]. The regression analysis showed that the DMI indicator explains 55.2 percent of the variance in AI ($R^2 = 0.552$; $F = 101.28$; $p < 0.001$).

The regression model equation:

$$AI = 15.84 + 0.687 \cdot DMI$$

In addition, five independent variables (strategy, technology, data, culture, processes) were included in a multivariate regression analysis. As a result, the highest standardized beta coefficients were observed for the "culture" ($\beta = 0.342$; $p < 0.001$) and "data" ($\beta = 0.298$; $p < 0.001$) factors, indicating that in the construction of adaptive management, human and data factors — rather than technological ones — play a leading role.

Factors constraining digital transformation. The experts were asked to provide multiple-choice answers to the question "What are the main obstacles to digital transformation at your enterprise?" The results obtained are presented in Table 3.

Table 3. Main factors constraining digital transformation in Uzbek enterprises.

Barrier Factor	Number of Enterprises	Share (%)	Rank
Shortage of qualified IT and data specialists	68	81.0	**1**
Limited financial resources	61	72.6	**2**
Lack of digital vision at the top management level	54	64.3	**3**
Organizational culture and employee resistance	52	61.9	**4**
Data quality and integration issues	49	58.3	**5**
Legacy IT infrastructure and outdated systems	44	52.4	**6**
Legal-regulatory framework and cybersecurity issues	38	45.2	**7**
Difficulty in technology selection and integration	32	38.1	**8**

Source: author's calculations based on the expert survey results, multiple-choice question (2024).

As can be seen from the table, the main obstacles are of a human-organizational nature rather than a technological one. The three top-ranked factors — personnel, financial resources, and leadership vision — account for approximately 72 percent of the total sum of constraints. Description of the adaptive management model (AdMM-4L). Based on the empirical results obtained and theoretical generalizations, the author has developed the Adaptive Management Model with Four Loops (AdMM-4L) — a "Four-Loop Adaptive Management Model." The model integrates S. Haeckel's earlier "sense-and-respond" approach, J. Kotter's "dual operating system" concept, and D. Teece's "dynamic capabilities" theory, adapted to the conditions of the digital economy.

The model consists of four mutually complementary functional loops:

Loop I — Sensing. The enterprise collects information in real-time from the external environment (market, customers, competitors, technologies, legislation) and the internal environment (operational indicators, employee satisfaction). IoT sensors, web analytics,

social listening, and systems for measuring employee needs constitute the technological foundations of this loop [14]. The goal is to identify changes before they manifest (early warning).

Loop II — Analytics. The collected data are processed using artificial intelligence, Big Data, and machine learning algorithms. Descriptive analytics (what happened?), diagnostic analytics (why?), predictive analytics (what will happen?), and prescriptive analytics (what should be done?) levels are applied sequentially. The effectiveness of this loop is manifested in the reduction of the time-to-insight — the time to move from data to decision.

Loop III — Decision. Decisions are made at three levels: strategic (by top management, with humans, supported by algorithmic recommendations); tactical (middle management, in collaboration with algorithms and humans — human-in-the-loop); operational (automated, by algorithms). Networked-agile teams are formed to make decisions, which increases decision-making speed.

Loop IV — Learning. The result of each decision is measured and fed back into the system (feedback loop). This ensures organizational learning, codification of errors and successes, and the adoption of better decisions in the future. The uniqueness of the model is that this loop retroactively influences all other loops (meta-loop).

Efficiency indicators of the AdMM-4L Model. The expected efficiency of the proposed model, based on the indicators of 18 advanced enterprises (DMI > 68) of the fourth and fifth levels that participated in the research, is estimated as follows: reduction in decision-making time — 32–45%; response time to environmental changes — 2.8 times shorter; growth in operational efficiency — 18–25%; growth in the customer satisfaction index — 14–22 percentage points; employee engagement — up to 19% growth.

The research results empirically confirmed several conceptual provisions previously put forward in the existing scientific literature and allowed new conclusions to be drawn. First, the strong positive correlation identified between DMI and AI ($r = 0.743$) confirms G. Westerman's thesis that digital maturity is the main factor of a company's performance [15]. However, our research has, for the first time, quantitatively measured the specific contribution of digital maturity to organizational adaptability in the context of a transition economy.

Second, the finding that the culture and data factors have the greatest impact on adaptability ($\beta = 0.342$ and $\beta = 0.298$) is an important conclusion identified in our research. This result is consistent with MIT CISR research, but considering that in the context of Uzbekistan there is often disproportionate emphasis on technology, it requires a new paradigmatic approach for local enterprises. In the author's opinion, the strategy of digital transformation should begin not with the purchase of technology, but with the formation of a data culture.

Third, the fact that personnel, finance, and leadership vision occupy the top three positions in the ranking of obstacles clearly demonstrates the systemic constraints of digital transformation in the Uzbek context. In our view, this situation requires the introduction of coordinated measures at the state level — targeted training of IT personnel, preferential lending for digital transformation projects, and digital leadership programs for top management.

Fourth, the proposed AdMM-4L model differs from S. Haeckel's classical "sense-and-respond" approach in two aspects: (1) the integration of artificial intelligence into the analytical loop; (2) the separation of the organizational learning loop (IV) as a meta-level [16]. According to the author, it is precisely this meta-level learning loop that gives the company the quality of "adaptive adaptability" — that is, it not only adapts to external changes but also improves its own adaptation mechanism.

Policy and practical recommendations. Based on the research results, recommendations at three levels are proposed. At the macroeconomic level: (1) the development of a special "Digital Transformation Roadmap" for medium and large enterprises within the framework of the "Digital Uzbekistan — 2030" strategy; (2) the creation of targeted cooperation programs between higher education institutions and enterprises for the training of IT personnel; (3) the introduction of special grant and preferential lending mechanisms aimed at digital transformation. At the organizational level: (1) the establishment of a "Digital Leadership Academy" network for top management; (2) the introduction of the Chief Data Officer (CDO) position at each large enterprise; (3) the gradual introduction of agile teams and networked structures to reconsider classical hierarchy. At the methodological level: (1) piloting the proposed AdMM-4L model in pilot enterprises (initially 10–15 units); (2) introducing the procedure for annual publication of the National Digital Maturity Rating (Uzbekistan DMI); (3) introducing the reporting of enterprises' digital maturity at the legislative level not as mandatory, but as an incentive measure.

The research has objective limitations [17]. First, the sample consists of 84 enterprises, and although this is statistically significant, it does not have full representativeness at the national level. Second, small business entities were not included in the study, and the characteristics of their digital transformation require a separate study. Third, the DMI and AI indices are based on the self-assessment of respondents, which ideally should be confirmed by external audit results.

4. Conclusions

The transformation of management systems in the context of the digital economy is a process of not merely technological but fundamental organizational-managerial nature. Within the framework of the conducted research, the following main conclusions and results were obtained.

First, the comparative analysis of traditional and digital management paradigms showed the existence of fundamental differences across six key dimensions — organizational structure, decision-making, communication, planning, employee role, and source of innovation. The digital paradigm relies on the principles of networked structure, data-driven decision-making, real-time communication, and continuous learning.

Second, among Uzbek enterprises, the average level of digital maturity is 52.4 points (out of 100), with 46.5% of enterprises remaining at the lower two levels. This situation indicates the high potential and reserves of national business for digital transformation.

Third, there is a statistically significant strong positive correlation between digital maturity (DMI) and organizational adaptability (AI) ($r = 0.743$, $p < 0.01$). The regression analysis showed that the effect coefficient of DMI on AI is 0.687, which confirms that investing in digital transformation has a significant direct impact on management adaptability.

Fourth, the Four-Loop Adaptive Management Model (AdMM-4L) — "sensing – analysis – decision – learning" — developed by the author was proposed as a methodological basis for enterprises operating in the context of the digital economy. The expected efficiency of the model is estimated by a 32–45 percent reduction in decision-making time and an 18–25 percent increase in operational efficiency.

Fifth, it was established that the main factors constraining digital transformation — the shortage of IT personnel (81.0%), limited financial resources (72.6%), and the lack of digital vision among top management (64.3%) — are of a human-organizational nature. This requires a coordinated action program among the state, higher education institutions, and enterprises.

Future research directions include: testing the AdMM-4L model in specific industries (IT, retail, agriculture); developing an adapted version for small business entities; conducting a deeper study of the relationship between digital maturity and a company's financial performance; and conducting longitudinal research on the integration of artificial intelligence into decision-making processes.

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