



## FEATURES OF THE DEVELOPMENT OF SERVICES BASED ON ARTIFICIAL INTELLIGENCE IN THE REPUBLIC OF KARAKALPOGISTAN AND THEIR IMPACT ON THE CONSTRUCTION INDUSTRY

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## QORAQALPOG'ISTON RESPUBLIKASINING SUN'IY INTELKT ASOSIDA XIZMAT KURSATISHNI RIVOJLANTIRISH XUSUSIYATLARI VA ULARNING QURILISH SOHASIGA TA'SIRI

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**Abstract:** This article examines the features of the development of artificial intelligence-based services in the Republic of Karakalpakstan and their impact on the construction industry. The study evaluates the role of artificial intelligence, Building Information Modeling (BIM), the Internet of Things (IoT), Big Data, and other digital technologies in improving construction services. Particular attention is given to AI applications in project planning, resource allocation, construction logistics, predictive maintenance, quality control, and occupational safety. The findings indicate that AI-driven service systems contribute to higher productivity, reduced project costs, enhanced decision-making, and improved sustainability in the construction sector. The study also proposes practical recommendations for accelerating digital transformation and expanding AI-based service ecosystems in the construction industry of the Republic of Karakalpakstan.

**Keywords:** Artificial Intelligence, construction industry, digital transformation,

BIM, IoT, construction logistics, Big Data, smart services, innovation.

**Annotatsiya:** Mazkur maqolada Qoraqalpog'iston Respublikasida sun'iy intellekt asosida xizmat ko'rsatish tizimlarini rivojlantirishning zamonaviy xususiyatlari hamda ularning qurilish sanoatiga ko'rsatayotgan ta'siri tahlil qilingan. Tadqiqotda sun'iy intellekt, raqamli texnologiyalar, Building Information Modeling (BIM), Internet of Things (IoT) va katta ma'lumotlar (Big Data) texnologiyalarining qurilish xizmatlarini takomillashtirishdagi o'rni baholangan. Shuningdek, qurilish loyihalarini boshqarish, resurslardan samarali foydalanish, logistika jarayonlarini optimallashtirish va xavfsizlikni ta'minlashdagi sun'iy intellekt yechimlari o'rganilgan. Tadqiqot natijalari Qoraqalpog'iston Respublikasida raqamli transformatsiyani jadallashtirish, qurilish tarmog'ida innovatsion xizmatlarni rivojlantirish hamda sohaning raqobatbardoshligini oshirish bo'yicha amaliy tavsiyalar ishlab chiqishga xizmat qiladi.

**Kalit so'zlar:** *sun'iy intellekt, qurilish sanoati, raqamli transformatsiya, BIM, IoT, xizmatlar, logistika, Big Data, innovatsiyalar.*

## INTRODUCTION

The rapid development of artificial intelligence (AI) technologies has become one of the main driving forces behind digital transformation across various sectors of the global economy. AI-based services are increasingly improving operational efficiency, reducing costs, supporting evidence-based decision-making, and enhancing service quality in industries such as healthcare, education, finance, manufacturing, transportation, and construction. As digitalization accelerates worldwide, governments are adopting strategies to integrate AI into economic development, recognizing its significant role in achieving sustainable growth and improving competitiveness.

The construction industry is among the sectors undergoing profound technological transformation. Traditional construction management approaches are gradually being replaced by intelligent digital systems capable of automating design processes, optimizing logistics, forecasting project risks, monitoring construction quality, and managing resources in real time. Technologies such as Artificial Intelligence, Building Information Modeling (BIM), the Internet of Things (IoT), cloud computing, unmanned aerial vehicles, and Big Data analytics are reshaping construction services and enabling the development of smart construction ecosystems.

The Republic of Karakalpakstan has also entered a new stage of digital transformation as part of Uzbekistan's national development priorities. Expanding digital infrastructure,

improving public and private electronic services, and introducing innovative technologies create favorable conditions for implementing AI-driven solutions in regional economic sectors. In particular, the construction industry requires modern service platforms capable of supporting efficient project management, transparent procurement, intelligent logistics, predictive maintenance, and sustainable infrastructure development.

Despite increasing attention to AI adoption, several challenges remain in the effective implementation of intelligent service systems in the construction sector of the Republic of Karakalpakstan. These challenges include insufficient digital infrastructure in some regions, limited availability of qualified AI specialists, fragmented information systems, cybersecurity concerns, and the need for stronger regulatory frameworks supporting digital innovation. Addressing these issues is essential for maximizing the economic and social benefits of AI technologies.

This study aims to analyze the characteristics of AI-based service development in the Republic of Karakalpakstan and evaluate their impact on the construction industry. The research identifies key digital technologies supporting intelligent construction services, assesses their contribution to productivity, quality, sustainability, and project efficiency, and develops recommendations for strengthening AI integration within the regional construction ecosystem. The results of this research may contribute to improving digital governance, accelerating technological modernization, and enhancing the competitiveness of the construction industry in the Republic of Karakalpakstan.

## LITERATURE REVIEW

The rapid advancement of Artificial Intelligence (AI) has significantly transformed service industries by enabling intelligent decision-making, predictive analytics, process automation, and real-time resource optimization. Recent studies emphasize that AI has become a strategic driver of digital transformation, particularly in sectors requiring complex project coordination such as construction. According to recent research, AI technologies enhance operational efficiency, reduce project delays, and improve service quality through intelligent data processing and automated management systems [1].

Digital transformation in construction is closely associated with the integration of AI, Building Information Modeling (BIM), cloud computing, and Internet of Things (IoT) technologies. Researchers argue that BIM serves as the foundation for digital construction management, while AI complements BIM by enabling predictive analysis, automated scheduling, and intelligent risk assessment. The combination of these technologies has been shown to improve collaboration among project stakeholders and increase construction productivity [2].

Construction logistics has emerged as one of the most promising areas for AI implementation. Recent investigations demonstrate that machine learning algorithms can optimize transportation routes, forecast material demand, reduce equipment idle time, and improve warehouse management. AI-based logistics systems contribute to minimizing operational costs and increasing supply chain resilience, particularly in large-scale infrastructure projects [3].

Several scholars have highlighted the growing importance of AI-driven predictive

maintenance in construction equipment management. Deep learning algorithms analyze sensor-generated data to identify equipment failures before they occur, thereby reducing maintenance costs and preventing project interruptions. Predictive maintenance has become a key component of smart construction services and sustainable infrastructure development [4].

Another important direction in the literature concerns AI applications in occupational safety and risk management. Computer vision, drone technologies, and intelligent monitoring systems are increasingly being used to detect hazardous conditions at construction sites. These technologies improve worker safety by identifying unsafe behaviors and providing real-time alerts to project managers. Consequently, AI significantly contributes to reducing workplace accidents and enhancing regulatory compliance [5].

Recent studies also emphasize the role of Big Data analytics in improving construction decision-making. AI-powered analytical platforms process large volumes of project data to forecast project performance, estimate construction costs, optimize resource allocation, and support strategic planning. Data-driven management has become one of the key characteristics of digital construction ecosystems [6].

Sustainability has become another central topic in AI-related construction research. Intelligent algorithms facilitate energy-efficient building design, optimize material consumption, and reduce carbon emissions throughout the project lifecycle. AI-supported sustainable construction practices contribute to achieving environmental objectives while improving economic performance [7].

From a regional development perspective, researchers note that successful AI implementation depends not only on technological readiness but also on institutional capacity, digital infrastructure, human capital, and supportive public policies. Developing economies face challenges related to digital skills, investment, regulatory frameworks, and technological integration. Therefore, comprehensive digital transformation strategies are considered essential for accelerating AI adoption across regional industries [8].

Although numerous international studies investigate AI applications in construction, limited research specifically addresses the development of AI-based services within the Republic of Karakalpakstan. Existing studies mainly focus on national digitalization policies or general construction modernization without examining regional service ecosystems and their practical implications. This research seeks to bridge this gap by analyzing the distinctive characteristics of AI-based service development in Karakalpakstan and evaluating their influence on construction efficiency, logistics, project management, and sustainable regional development [9].

### RESEARCH METHODOLOGY

This study applies scientific abstraction, comparative analysis, system analysis, logical analysis, and synthesis to examine the development of artificial intelligence (AI)-based services and their impact on the construction industry in the Republic of Karakalpakstan. Recent scientific publications, international reports, and official statistical data were used as the primary sources of secondary data.

The research evaluates the application of AI technologies, including Building

Information Modeling (BIM), the Internet of Things (IoT), Big Data, and intelligent decision-support systems in construction planning, logistics, resource management, quality control, and occupational safety. Comparative analysis was conducted to identify differences between traditional construction management and AI-supported service systems.

In addition, SWOT analysis was employed to identify the strengths, weaknesses, opportunities, and threats associated with implementing AI-based services in the regional construction sector. The research findings provide practical recommendations for accelerating digital transformation and improving the efficiency and competitiveness of the construction industry in the Republic of Karakalpakstan.

### ANALYSIS AND RESULTS

The analysis indicates that the introduction of artificial intelligence (AI)-based services has significantly improved the efficiency of construction activities in the Republic of Karakalpakstan. AI technologies enable construction organizations to automate planning, optimize resource allocation, improve logistics, and support real-time decision-making. Compared with conventional management methods, AI-supported systems reduce project delays, minimize operational costs, and enhance overall service quality.

The study shows that the integration of Building Information Modeling (BIM) with AI enhances project coordination by enabling accurate digital modeling, automated scheduling, and early detection of design conflicts. Similarly, Internet of Things (IoT) technologies facilitate real-time monitoring of construction equipment and materials, while

Big Data analytics supports demand forecasting and efficient resource utilization.

A comparative assessment of the major AI applications in construction demonstrates that project planning and logistics receive the greatest benefits from intelligent technologies. AI-driven predictive analytics improves scheduling accuracy, reduces idle time, and optimizes transportation routes for construction materials. In addition, computer vision and intelligent monitoring systems contribute to safer working environments by identifying potential hazards and supporting preventive safety measures.

The overall results indicate that AI-based services positively influence five key dimensions of construction performance: operational efficiency, cost optimization, project quality, occupational safety, and sustainability. The strongest impact was observed in operational efficiency and project management, while environmental sustainability also improved through more efficient use of materials and energy resources.

Overall, the findings suggest that expanding AI-based services can accelerate digital transformation in the construction industry of the Republic of Karakalpakstan. However, successful implementation requires further investment in digital infrastructure, workforce training, and institutional support to ensure the effective adoption of intelligent technologies across the sector.

## **CONCLUSION AND RECOMMENDATIONS**

The findings demonstrate that artificial intelligence (AI)-based services are becoming an important driver of digital transformation in the construction industry of the Republic of Karakalpakstan. The integration of AI with technologies such as Building Information

Modeling (BIM), the Internet of Things (IoT), and Big Data improves project planning, resource management, construction logistics, quality control, and occupational safety. These technologies contribute to higher productivity, lower operational costs, better decision-making, and more sustainable construction practices.

Despite these benefits, the wider adoption of AI remains constrained by limited digital infrastructure, insufficient AI expertise, and the need for stronger institutional and regulatory support. Therefore, coordinated efforts from government institutions, construction companies, and research organizations are essential to accelerate digital transformation and strengthen the competitiveness of the regional construction sector.

### **Recommendations**

- Expand digital infrastructure to support AI-based construction services across the Republic of Karakalpakstan.
- Promote the integration of AI with BIM, IoT, and cloud technologies in construction project management.
- Develop training programs to improve the digital and AI competencies of engineers, architects, and construction managers.
- Encourage investment in smart construction technologies through public-private partnerships and innovation incentives.
- Establish regional standards and regulatory frameworks for the safe and effective implementation of AI in construction.
- Strengthen collaboration among universities, research institutions, technology companies, and construction enterprises to support innovation and technology transfer.
- Increase the use of AI-powered predictive analytics for project planning,



construction logistics, and equipment maintenance to improve efficiency and sustainability.

The implementation of these recommendations will contribute to

accelerating digital transformation, improving service quality, increasing productivity, and enhancing the long-term competitiveness of the construction industry in the Republic of Karakalpakstan.

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