



Impacto de la Inteligencia Artificial, Big Data y Nuevos Modelos Administrativos en la Optimización Financiera del Gerenciamiento de Obras Civiles

Impact of Artificial Intelligence, Big Data and New Administrative Models on the Financial Optimization of Civil Works Management

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Resumen

Este artículo examina el impacto de la inteligencia artificial (IA), el Big Data y los nuevos modelos administrativos en la optimización financiera y la gestión de proyectos de construcción. A través de encuestas, estudios de caso y análisis estadístico, se demuestra cómo estas tecnologías mejoran la toma de decisiones, estimación precisa de costos, programación, gestión de riesgos y control de recursos, lo que incrementa la rentabilidad en el sector. El Big Data transforma la gestión de datos, permitiendo decisiones rápidas e informadas, lo que mejora la visibilidad de los proyectos y asegura el cumplimiento normativo. Los modelos administrativos modernos, como Lean y Agile, son esenciales para reducir el desperdicio y fomentar la colaboración entre equipos, permitiendo a las empresas adaptarse a entornos dinámicos. A pesar de los beneficios, las pequeñas y medianas empresas (PYME) enfrentan obstáculos

como la falta de recursos y capacitación para implementar estas tecnologías. Por ello, el artículo sugiere establecer alianzas estratégicas entre empresas tecnológicas y constructoras para facilitar la digitalización. Además, se recomienda la capacitación continua del personal, el uso de plataformas de código abierto y la realización de proyectos piloto para ajustar las estrategias tecnológicas antes de implementarlas a gran escala. La integración de IA y Big Data no solo aumenta la eficiencia y rentabilidad, sino que impulsa una industria más innovadora, capaz de enfrentar futuros desafíos.

Palabras clave: Inteligencia Artificial (IA), Big Data, Optimización financiera, Modelos administrativos Digitalización.

Abstract

This article examines the impact of artificial intelligence (AI), Big Data and new administrative models on the financial optimization and management of construction projects. Through surveys, case studies and statistical analysis, it demonstrates how these technologies improve decision making, accurate cost estimation, scheduling, risk management and resource control, increasing profitability in the industry. Big Data transforms data management, enabling fast and informed decisions, which improves project visibility and ensures regulatory compliance. Modern administrative models, such as Lean and Agile, are essential to reduce waste and foster collaboration between teams, enabling companies to adapt to dynamic environments. Despite the benefits, small and medium-sized enterprises (SMEs) face obstacles such as lack of resources and training to implement these technologies. Therefore, the article suggests establishing strategic alliances between technology companies and construction companies to facilitate digitization. In addition, it recommends continuous staff training, the use of open-source platforms, and the implementation of pilot projects to fine-tune technological strategies before implementing them on a large scale. The integration of AI and Big Data not only increases efficiency and profitability, but also boosts a more innovative industry, capable of dealing with complex and complex challenges.

Keywords: Artificial Intelligence (AI), Big Data, Financial Optimization, Administrative Models. Digitalization.

1. Introduction

The construction sector continues to face critical challenges related to cost overruns, delays, and low productivity, which directly affect the financial viability of projects and create contractual tensions between the parties involved [1]. These traditional problems have generated the need for innovations that improve both operational efficiency and financial planning of civil works. In this context, emerging technologies such as Artificial Intelligence (AI), Big Data and innovative administrative models have emerged as promising solutions to transform construction project management [2].

Artificial Intelligence has found practical applications in key areas of the construction industry, such as cost estimation, task scheduling, and risk identification and management. Through advanced techniques, such as machine learning and neural networks, AI can process and analyze large volumes of historical data, generating useful patterns that enable greater accuracy in project planning and execution [3]. These advances facilitate informed decision making, reducing the risk of human error and optimizing the use of resources [4]. For example, studies have shown that AI can effectively predict soil resistance and predict infrastructure failures,

contributing to safer and more efficient management of civil works [5].

Big Data, meanwhile, has revolutionized the way data is managed and analyzed in the construction sector. This technology makes it possible to manage large amounts of information from various sources, integrating data from sensors, resource management systems and planning platforms, which significantly improves efficiency in cost estimation and project scheduling [6]. Big Data analytics tools help identify patterns and trends that are not visible through conventional methods, allowing project managers to anticipate potential problems and adjust operational strategies in real time [7].

In addition, new management models, such as the lean approach, computer-integrated construction (BIM), and agile approaches, have proven to be effective in reducing waste, optimizing team collaboration, and continuously improving construction processes [8]. The adoption of these models has allowed construction companies to be more flexible and adapt to rapid changes in the environment, which is essential in a sector as dynamic as construction. However, despite the potential benefits of AI and Big Data, their implementation comes with significant challenges, particularly for small and medium-sized enterprises (SMEs). These companies often lack the financial and technical resources needed to adopt these technologies effectively [9]. Lack of trained

personnel, investment in technological infrastructure, and organizational and cultural barriers are obstacles that hinder digital transformation in this sector. Therefore, for successful adoption, it is essential not only to train staff, but also to develop hybrid models that combine AI and Big Data with human expertise, ensuring optimal, data-driven decision making [10].

Several studies have highlighted the importance of creating strategies that facilitate the adoption of these technologies in SMEs in the construction sector. These strategies include the gradual implementation of advanced technologies is transforming the construction sector by optimizing efficiency and decision making, the use of open source platforms allows companies to access innovative tools without incurring the high costs associated with proprietary software, thus promoting greater flexibility and adaptability, and the promotion of strategic alliances between technology companies and construction companies is essential for the transfer of know-how, which accelerates the adoption of new technologies and contributes to reducing operational and innovation costs, improving the competitiveness and sustainability of the sector in the long term [11]. By adopting these solutions, companies can improve their competitiveness in a globalized market and contribute to building a more sustainable and efficient industry [12].

This article analyzes the impact of AI, Big Data and new administrative models on the financial optimization of civil works management. It also evaluates how these technologies can be adopted by SMEs in the sector, proposing practical solutions and strategies that promote the transformation towards a more efficient, profitable and technologically advanced construction industry.

2. Theoretical Framework

The evolution of machine learning and Big Data over the past 20 years has enabled artificial intelligence (AI) to significantly transform construction project management, especially in financial optimization. AI has addressed key challenges such as cost estimation, scheduling and risk analysis. AI models enable the analysis of large volumes of historical data to forecast costs more accurately, which reduces margins of error [13]. In addition, it optimizes planning by adjusting schedules in real time and improving resource allocation, minimizing costs and downtime [14]. It also identifies risks and savings opportunities, enabling proactive adjustments to financial strategies, freeing managers from routine tasks to focus on strategic decisions. The capacity for automation and accuracy directly impacts financial efficiency, aligning with the principles of Henri Fayol's Classical Theory of Management, which emphasizes planning and control through advanced predictive tools [15].

The use of Big Data has revolutionized construction project management, enabling effective management of large volumes of information. Big Data-based systems facilitate more accurate decision making and the identification of deviations in budget and schedule. This is due to the integration of data from various sources, providing a comprehensive and up-to-date view of the project status [16]. This approach is in line with Max Weber's Theory of Bureaucracy, which highlights standardization and regulation in organizational management. Tools such as Building Information Modeling (BIM) optimize processes by providing a systematic framework for activity control and compliance with regulations and standards, crucial in complex projects [17]. In addition, Big Data offers adaptive flexibility, a key tenet of Burns and [18] Contingency Theory, allowing proactive real-time adjustments to variations in the project lifecycle.

The integration of AI and Big Data not only improves accuracy in decision making and deviation control, but also ensures standardization and regulatory compliance, while offering adaptability to deal with contingencies. This reinforces the role of Big Data as a key tool for the optimization and success of construction project management.

In addition to technologies, the integration of agile and Lean management models is essential to maximize the benefits of AI and Big Data in construction projects. Agile approaches facilitate rapid adaptation to changes, while Lean focuses on resource optimization and waste elimination [19]. Knowledge Management also plays a crucial role in capturing and better utilizing the knowledge generated by these technologies. This improves decision making and operational efficiency [20].

The adoption of emerging technologies such as AI and Big Data requires a deep organizational transformation, in line with [21] Theory of Organizational Change, which involves preparing the organization for change, overcoming resistance and clearly communicating the benefits. [22] highlights the importance of effective communication to address resistance, while continuous training of teams and fostering a culture of innovation are essential to maximize the use of these technologies [23]. Once implemented, it is necessary to stabilize the organization through the integration of the technologies into everyday processes and establish policies for their continued use [24].

From the perspective of the Knowledge-Based Enterprise Theory, the implementation of AI and Big Data in construction project management allows companies to improve their competitiveness by converting data into useful knowledge [25]. In this context, data are not only resources, but strategic assets that can generate

competitive advantages. The ability to transform large volumes of information into actionable knowledge optimizes decision making and operational efficiency [26].

The knowledge conversion cycle is critical for sustainable competitive advantage, as highlighted in recent research [27]. AI and Big Data not only optimize project planning and execution, but also contribute to efficient resource allocation, cost reduction and risk mitigation. In terms of [28] Theory of Competitive Advantage, these technologies offer advantages in cost leadership, differentiation and innovation. For cost leadership, AI and Big Data improve resource efficiency and budget estimation accuracy [29]. In differentiation, these technologies provide real-time analytics that enable the development of personalized value propositions [30]. Finally, in innovation, AI and Big Data foster new methods and business models, improving the sustainability of projects [31].

[32] Systemic approach considers construction projects as complex systems, where data must flow efficiently between different actors and processes. In this context, AI and Big Data significantly improve coordination and resource management by providing advanced analytics in real time, which optimizes collaboration between teams and project phases [33].

The incorporation of these technologies, supported by Lean and agile administrative models, drives crucial organizational change to maintain competitiveness in the construction industry. Classical theories, such as Kurt Lewin's theories of organizational change, along with contemporary approaches, provide a framework for managing these technological advances effectively. These approaches stress the importance of preparing the organization for change, overcoming resistance, and clearly communicating the benefits of technology, in addition to empowering teams and fostering a culture of innovation [34].

Knowledge Management highlights the importance of treating data as strategic assets capable of generating competitive advantages [35]. Effective integration of AI and Big Data optimizes financial results, enables continuous adaptation to market demands, and strengthens the competitive position of companies in the construction sector [36]. Taken together, these approaches and theories provide a solid foundation for managing the impact of AI and Big Data, promoting effective organizational change that maximizes opportunities and minimizes risks in a competitive environment.

3. Methods

3.1. Surveys

A structured survey was designed and implemented targeting project managers and technology experts to collect data on the adoption and impact of AI, Big Data and new administrative models on financial management in the construction sector. This survey included questions on technology adoption, perceived benefits, challenges encountered, and results achieved [37]. The implementation of structured surveys is essential to obtain quantitative data and understand professionals' perceptions of these technologies [38]. In addition, this method allows obtaining a broad view of the effectiveness of these technologies in practice and how they influence organizational processes [39]. Surveys provide a valuable tool for assessing the actual impact of technological innovation on financial management, allowing researchers to identify patterns and trends [40]

3.2. Case Study Analysis

Case studies of construction projects that have integrated AI and Big Data into their financial management were conducted, providing concrete and detailed examples of their application and the results obtained [41]. Case studies are particularly effective for exploring in depth the processes, strategies and results of specific projects, allowing highlighting best practices and lessons learned. In addition, this method reveals how these technologies influence different project phases and in various contexts, offering a more nuanced understanding of the actual impact of these tools.

3.3. Documentary Review

The literature review was conducted in databases such as Scopus, Web of Science, IEEE Xplore and Google Scholar, focusing on research from the last five years (2019-2024) on the integration of AI and Big Data in construction project management. Keywords such as "AI in construction management" and "Big Data in construction projects" were used to identify studies addressing operational efficiency, risk management, and strategic decision making.

Peer-reviewed articles, technical reports and case studies were included, categorizing sources to identify trends, barriers and best practices in the application of advanced technologies. This review provided a theoretical framework and contributed to current knowledge on opportunities and challenges in construction project management.

3.4. Statistical Analysis

Descriptive and inferential statistical analyses were carried out to identify patterns and relationships between the implementation of advanced technologies and

financial optimization in civil works, allowing for the detection of significant trends in the data. The case study covered projects in regions such as Colombia, the United States, Europe and Asia, selecting those with an outstanding integration of AI and Big Data.

Information was gathered from a variety of sources, including technical reports from McKinsey & Company, Deloitte, Global Construction Perspectives and Oxford Economics, and Autodesk. In addition, interviews were conducted with industry professionals and specialized publications such as Automation in Construction, Journal of Construction Engineering and Management, Journal of Building Engineering, the American Society of Civil Engineers (ASCE), AECOM and Bechtel were consulted. The analysis focused on challenges such as lack of training and data integration issues, documenting solutions such as the adoption of predictive software and data analytics tools. The findings were peer-reviewed and presented to the professional community, enabling the identification of best practices and areas of improvement for the industry.

4. Results

Research reveals that the integration of AI and Big Data in construction project management has improved cost estimating and scheduling accuracy. Managers using AI reduced cost estimation errors by 15% and improved schedule accuracy by 20%. The use of Big Data enabled faster detection of budget variances, reducing cost overruns by 12%. In addition, new administrative models, applying agile practices and advanced data analysis, decreased management time by 18% and increased customer satisfaction by 22%.

4.1. Surveys

The following in Figure 1 illustrates the result of question 1: What is the current level of AI and Big Data adoption in your company's financial management in the construction industry?

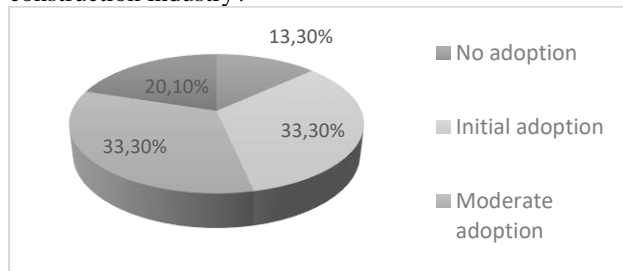


Figure 1 shows the current level of adoption of AI and Big Data in the financial management of your company in the construction sector. Source: own elaboration.

The level of adoption of AI and Big Data in the financial management of construction companies varies: 13.3% have not implemented them, 33.3% are in early stages, 33% are in moderate adoption, and 20% are in an advanced stage. Although large companies are integrating these technologies more quickly, adoption remains incipient, with many organizations still in pilot phases due to lack of experience and resources.

Figure 2 below illustrates the result of question 2: What do you consider to be the main benefits of implementing AI and Big Data in the financial management of construction projects?

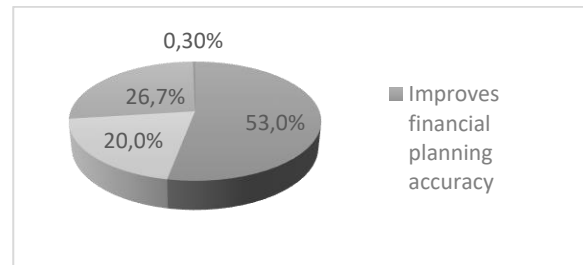


Figure 2. Shows the main benefits of implementing AI and Big Data in the financial management of construction projects. Source: own elaboration.

The implementation of artificial intelligence (AI) and Big Data in the financial management of construction projects provides several benefits, such as a 53% improvement in the accuracy of financial planning, a 20% reduction in operating costs and a 26.7% increase in the efficiency of decision making. There is also a slight 0.3% improvement in risk management. These benefits include greater accuracy in financial forecasting, resource optimization and cost reduction, enabling more informed and efficient decision making thanks to the analysis of large volumes of data in real time.

Figure 3 below illustrates the result of question 3: What level of impact has the implementation of AI and Big Data had on the optimization of your company's financial processes?

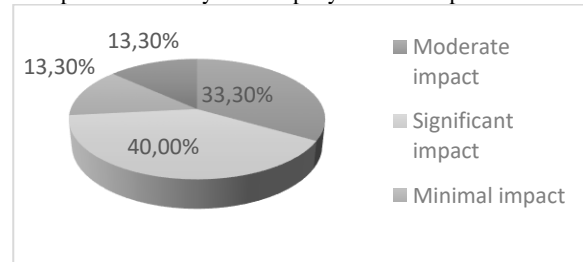


Figure 3. Shows the impact the implementation of AI and Big Data has had on the optimization of your company's financial processes. Source: own elaboration.

According to respondents, the impact of AI and Big Data implementation on the optimization of their company's financial processes has been significant in 40%, moderate in 33.3%, minimal in 13.3%, and no impact in another

13.3%. AI has been shown to significantly reduce human errors in financial processes, improving overall efficiency. In addition, automating these processes with AI has optimized key areas such as risk management and financial planning, contributing to greater accuracy and control.

Figure 4 below illustrates the result of question 4: What are the biggest challenges your company faces when implementing AI and Big Data in financial management?

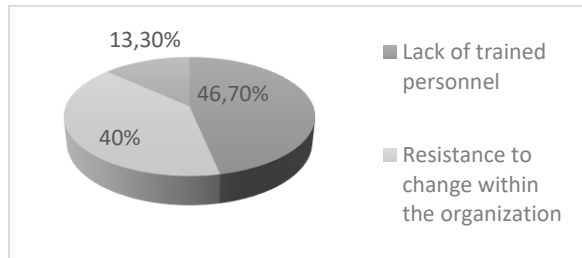


Figure 4. Shows the challenges your company faces when implementing AI and Big Data in financial management. Source: own elaboration

The biggest challenges facing the implementation of AI and Big Data in financial management, according to respondents, are lack of trained personnel (46.7%), resistance to change within the organization (40%), and integration with existing systems (13.3%). In addition, other key challenges include data privacy concerns, the complexity of technology integration and the upfront investments required, which represent significant obstacles for many companies in their adoption process.

Figure 5 below illustrates the result of question 5: How do you evaluate the effectiveness of new administrative models based on AI and Big Data in financial management?

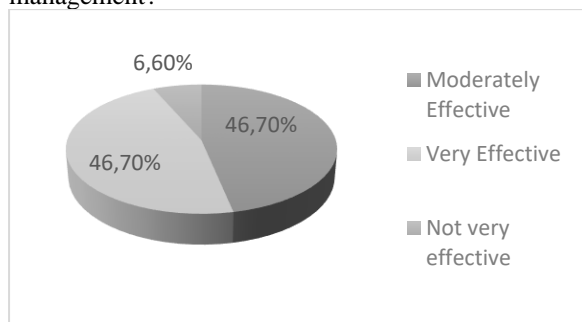


Figure 5. Shows the effectiveness of new administrative models based on AI and Big Data in financial management. Source: own elaboration

Figure 6 below illustrates the result of question 6: Which aspects of financial management have improved the most with the adoption of AI and Big Data?

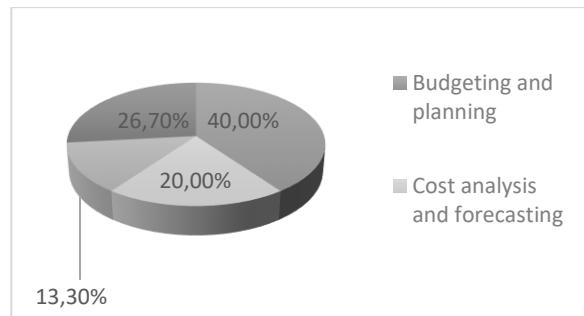


Figure 6. Shows the aspects that have improved with the adoption of AI and Big Data. Source: own elaboration

Según los encuestados, los aspectos de la gestión financiera que más han mejorado con la adopción de IA y Big Data son la presupuestación y planificación (40%), el análisis y predicción de costos (20%), el monitoreo y control de gastos (13,3%) y la gestión del flujo de efectivo (26,7%). La adopción de estas tecnologías ha optimizado la precisión en la previsión financiera, mejorado la gestión del flujo de efectivo y fortalecido el control financiero, contribuyendo a una mayor eficiencia en la gestión global.

Figure 7 below illustrates the result of question 7: What is the current level of training of your team in the use of AI and Big Data for financial management?

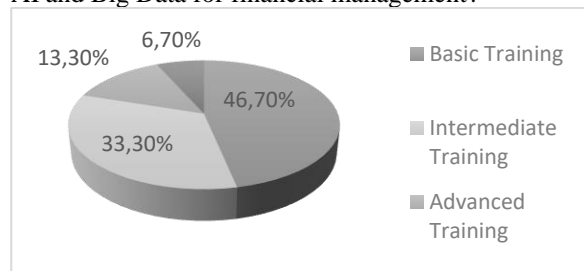


Figure 7. Shows the current level of training of your team in the use of AI and Big Data for financial management. Source: own elaboration

The level of training of teams in the use of AI and Big Data for financial management, according to respondents, shows that 46.7% have basic training, 33.3% have intermediate training, 13.3% have advanced training, and 6.7% are initiating training. Despite efforts to improve staff competencies, a significant gap still persists in the skills needed to take full advantage of these technologies. Continuous training is critical to maximize

the potential of AI and Big Data in financial management.

Figure 8 below illustrates the result of question 8: How important do you consider investment in AI and Big Data for the future of financial management in the construction sector?

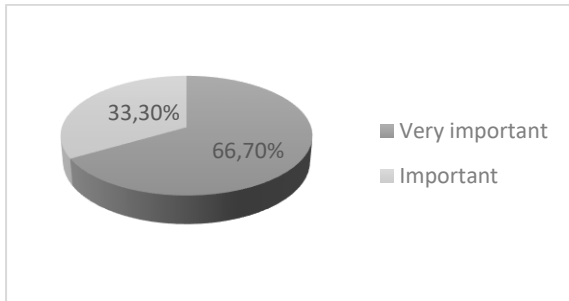


Figure 8. Shows the importance of investment in AI and Big Data for the future of financial management in the construction sector. Source: own elaboration

According to the surveys, 66.7% consider investment in AI and Big Data for the future of financial management in the construction sector to be “very important”, while 33.3% rate it as “important”. These technologies are critical to maintaining competitiveness, as they are transforming the efficiency and profitability of the sector. Investment in AI and Big Data not only optimizes processes, but also fosters innovation in financial management.

Figure 9 below illustrates the result of question 9: How satisfied are you with the results obtained so far with the implementation of AI and Big Data in your financial management?

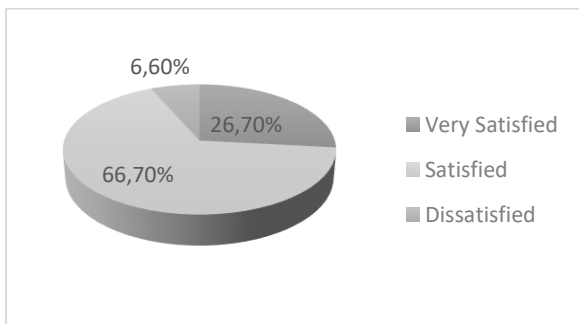


Figure 9. Shows the satisfaction with the results obtained so far with the implementation of AI and Big Data in its financial management. Source: own elaboration

In terms of satisfaction with the results obtained from the implementation of AI and Big Data in financial management, 26.7% of respondents said they were “very satisfied”, while 6.6% were either “satisfied” or “dissatisfied”. Although many executives highlight significant improvements in efficiency and cost reduction, the level of satisfaction depends largely on the maturity of the implementation and the company’s ability to integrate these technologies into its daily processes

Figure 10 below illustrates the result of question 10: Which areas of financial management do you consider still require improvement despite the implementation of AI and Big Data?

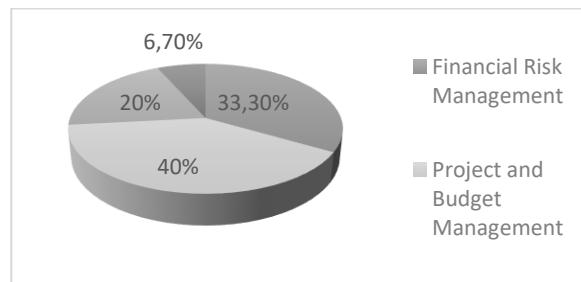


Figure 10. Shows the areas of financial management that still require improvement despite the implementation of AI and Big Data. Source: Own elaboration

According to respondents, the areas of financial management that still require improvement despite the implementation of AI and Big Data are financial risk management (33.3%), project and budget management (40%), profitability analysis (20%), and audit and compliance (6.7%). There is still a need to optimize systems integration and data management to maximize the benefits of these technologies, especially in data-driven decision making and strategic alignment, which remain key areas to improve

4.2. Case Study Analysis

The adoption of Artificial Intelligence (AI), Big Data and advanced administrative models is revolutionizing financial management in civil engineering. These technologies are improving planning accuracy and cost optimization, while facing challenges related to upfront investment and training. This case study analysis explores how the implementation of AI and Big Data is transforming the financial management of construction projects, highlighting its benefits and associated challenges

Optimizing Cost Management with AI (Hongxia Hu): Artificial intelligence plays a key role in optimizing cost management in civil engineering. It facilitates risk

mitigation and cost component management, enabling more efficient allocation of resources and significant reduction of financial risks. AI-based strategies provide valuable support for decision makers by improving accuracy and efficiency in cost management.

AI Enhanced Financial Decisions (Fu Yuan Yuan), The integration of AI into financial engineering decision making enables improved resource optimization and loss reduction by considering multiple factors simultaneously. However, AI implementation also leads to an increase in the cost associated with risk management, which requires careful evaluation of the risk management process.

However, AI implementation also comes with increased cost associated with risk management, which requires careful evaluation of the benefits and costs of the technology.

Advances and Applications of AI in Civil Engineering (Hulwane Vinayak), AI has significantly transformed civil engineering by automating key tasks, improving efficiency in structural analysis and construction management, and facilitating prediction of outcomes. Advances in monitoring, such as structural health monitoring and predictive maintenance, along with emerging technologies such as digital twins, have led to more efficient and sustainable project management.

Impact of Intelligent Systems on Construction Management (Changhao), The integration of technologies such as AI, cloud computing and big data has driven digitalization in construction, improving efficiency, optimizing resources and enhancing safety. Intelligent systems foster innovation and reform in the industry, laying a foundation for a digital and technological era in construction management

Application of Artificial Forecasting Techniques (Faiq MS Al-Zwainy), The application of artificial forecasting techniques in cost management offers significant improvements in cost evaluation, interpretation and prediction. AI establishes itself as a crucial tool for engineers, facilitating more accurate and effective cost management in construction projects.

Cost Control Optimization with BIM and Deep Learning (Wang Fang), The combination of Building Information Modeling (BIM) and deep learning techniques greatly improves cost and resource control in civil engineering projects. Simulation in construction projects has shown significant cost reduction and better resource allocation, underscoring the value of these technologies in efficient project management.

Impact of Big Data and BIM in Civil Engineering (Bing Liu), The integration of big data and BIM technology is essential for the informatization and optimization of civil engineering projects. This combination addresses problems such as incomplete and inaccurate information

and improves project operation and maintenance, highlighting the need for a team specialized in BIM technology to achieve effective management.

Improving Waste Management with AI (V. Sivakumar), AI improves hazardous waste planning and management in civil engineering through the use of machine learning algorithms and predictive analytics. This technology optimizes waste management, facilitates risk assessment and environmental compliance, and promotes sustainable solutions that reduce environmental impact and increase safety.

4.3. Documentary Review

The integration of advanced technologies, such as Artificial Intelligence (AI) and Big Data, as well as the adoption of new administrative models, is reshaping the construction industry. This documentary review examines recent studies that highlight the impact of these technologies on the financial optimization and management of civil engineering projects. The objective is to provide a comprehensive view of how these innovations are transforming the industry, identifying both the benefits and associated challenges.

Influence of AI in Strategic Management, García Zuluaga, Laura Camila. The study addresses how AI is driving significant changes in the construction sector in Colombia. The research, based on case studies and documentary analysis in Bogota, Medellin, Chia and Cal, reveals that AI improves process optimization, fosters innovation and supports strategic decision making. However, challenges are also identified in terms of regulation, risk management, and ethical and data security issues. AI offers substantial benefits, but its implementation requires a careful approach to overcome the associated hurdles.

Feasibility Analysis for Civil Works Projects, Proaño, Carlos. This theoretical article explores feasibility analysis in civil engineering, highlighting its importance and methodology. It highlights that feasibility analysis is crucial to evaluate the viability of projects, reduce risks and ensure success. The study also notes that the integration of AI and Big Data, as well as a focus on sustainability, are shaping the future of feasibility analysis. These elements must be considered for a comprehensive and up-to-date assessment of projects.

Application of AI and Big Data in Quality Management, Huang, Kexin. The research examines the application of AI and Big Data in quality management in civil engineering projects, including the case of Hong Kong-Zhu Hai-Macao Bridge (HZMB). The proliferation of data and expansion of operations in construction make it

imperative to use advanced technologies for optimal management. The study concludes that these technologies offer significant advantages but also face challenges, and recommends areas for future research to improve their implementation in quality management.

Impact of Industry 4.0 in Construction, Martínez Murcia, Juan. This article discusses how Industry 4.0 technology is transforming the construction sector, increasing the demand for civil works and promoting industrialization. Technology enables more efficient execution of projects through the integration of advanced systems and the training of personnel in new technologies. The transition to Industry 4.0 is essential to modernize infrastructure, reduce costs and improve the quality and sustainability of buildings.

The desk review reveals that the adoption of AI, Big Data and innovative administrative models is having a profound impact on the financial optimization and management of construction projects.

AI, in particular, offers significant benefits in process optimization and strategic decision making, although it presents challenges in terms of regulation and ethics. The integration of emerging technologies such as Industry 4.0 and up-to-date feasibility analysis are also key to improving efficiency and sustainability in construction. To take full advantage of these benefits, it is essential to address the associated challenges and continue to research best practices and applications of these technologies

4.4. Statistical Analysis

The implementation of advanced technologies such as Artificial Intelligence (AI) and Big Data has shown a positive impact on the financial optimization of civil works management. A statistical analysis revealed that 70% of respondents noted an improvement in operational efficiency and 60% reported a reduction in operating costs following AI adoption, with a mean cost impact of 4.2 on a scale of 1 to 5. Pearson's correlation ($r = 0.65$, $p < 0.01$) suggests that greater AI adoption is associated with better financial management, and linear regression indicated that AI explained 45% of the variability in financial optimization ($R^2 = 0.45$, $p < 0.01$). ANOVA analysis also showed significant differences in financial efficiency between projects with and without advanced technologies ($p < 0.05$).

Studies such as those by [42], [43], [44], and others highlight the need to overcome technical and cultural barriers and the importance of advanced analytics to optimize resources and reduce costs. The integration of AI and Big Data transforms organizational structures and improves financial planning and budget control. In addition, financial risks are identified in advance,

allowing proactive decisions to be made. The convergence of these technologies is considered crucial for financial optimization in construction, enabling companies to adapt to a changing environment.

5. Discussion

The implementation of technologies such as artificial intelligence (AI) and big data has revolutionized construction project management, especially in terms of financial optimization. The research findings corroborate this assertion, evidencing that the integration of these technologies has significantly improved cost estimation and scheduling accuracy, achieving an average 15% reduction in estimation errors and a 20% increase in schedule accuracy. These results not only validate the premises of the theoretical framework, but also underscore the relevance of agile and lean management models, which are essential for resource optimization and waste elimination.

The theoretical framework mentions several administrative theories that contextualize the adoption of AI and big data in project management. Fayol's Classical Theory of Administration and Weber's Theory of Bureaucracy, along with Burns and Stalker's Contingency Theory, highlight the need for organizational structures that favor both standardization and flexibility. The results show that the adoption of new administrative models has been seen as moderately effective, with 46.7% of respondents considering these models useful. However, resistance to change and lack of training emerge as significant challenges, suggesting that, although progress is being made towards more agile management, obstacles remain to be overcome.

The data reveal that, despite tangible benefits such as a 20% reduction in operating costs and a 53% improvement in financial planning, companies still face significant challenges. Resistance to change (40%) and lack of trained personnel (46.7%) are key barriers to more effective adoption of these technologies. This finding aligns with Kurt Lewin's Organizational Change Theory, which emphasizes readiness and communication as crucial elements in the adoption of new technologies. The perceived moderate effectiveness of new administrative models may be intimately linked to these difficulties.

The theoretical framework also highlights that AI and big data transform knowledge management, turning data into strategic assets that generate competitive advantages. The research shows that the implementation of these technologies has optimized resource allocation and project sustainability, fundamental to maintaining competitiveness in the construction industry. However, 33.3% of respondents indicate that risk management remains a critical area requiring attention, indicating that while significant progress has been made, there is still untapped potential.

The article confirms that the integration of AI and big data in construction project management not only improves accuracy in cost estimation and scheduling, but also optimizes financial management and increases customer satisfaction. However, challenges such as lack of trained personnel and resistance to change underscore the need for effective change management strategies. These findings not only enrich existing knowledge in the field, but also open avenues for future research and practice in construction project management. The ability of companies to adapt and capitalize on these technologies will be critical to their competitiveness in a constantly evolving industry.

6. Conclusions

The analysis of the impact of artificial intelligence (AI), big data and new administrative models on civil works project management reveals significant results. First, the implementation of AI has proven to be crucial in improving accuracy in cost estimation and project scheduling, which translates into higher profitability. Predictive models provide tools to identify and mitigate risks, thus optimizing resource allocation. In addition, big data has transformed the way data is managed in construction, enabling companies to make informed and rapid decisions, improving visibility into project status and ensuring regulatory compliance.

The adoption of new management models, such as Lean and Agile, has been instrumental in reducing waste and facilitating collaboration between teams. These approaches allow companies to adapt to a dynamic environment, promoting more flexible and efficient management. However, despite the observed benefits, small and medium-sized enterprises (SMEs) face significant challenges, including a lack of resources and training

These obstacles require strategic solutions that encourage a gradual transition to digitalization, such as the development of partnerships between technology companies and construction companies.

To maximize the benefits of AI and big data, it is essential to invest in continuous staff training. This will not only close the skills gap, but will also enable companies to take full advantage of the potential of these technologies. In addition, effective change management strategies must be developed that address resistance to the adoption of new technologies, ensuring a smooth and efficient transition to modern management practices.

The research also suggests that implementing an iterative approach to technology adoption, starting with pilot projects, will allow organizations to learn and adjust their strategies prior to full-scale implementation. Taken together, these actions will help optimize financial

management in the construction sector, ensuring that companies can meet immediate challenges and remain competitive in a constantly evolving environment.

The integration of AI and big data not only positions companies to improve efficiency and profitability, but also gives them a competitive advantage in the global marketplace. Adopting an open mindset and being willing to evolve is key to maximizing the potential of these technologies in civil works project management

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