



Integration between Information Technology and Business Administration in Construction Civil

The Integration between Information Technology and Business Administration in Civil Construction

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Summary

This article discusses how the integration of information technology (IT) and business administration is redefining the construction industry, a sector historically characterized by high complexity and low productivity compared to other industries. The article analyzes the impacts of the convergence of information systems, digital modeling (BIM), automation, and artificial intelligence on business management, emphasizing gains in strategic planning, cost reduction, deadline optimization, and improved quality control. The text also proposes digital transformation frameworks applied to project management and construction processes, reinforcing the role of technology as a central element in the sector's competitiveness and sustainability.

Keywords: Information Technology; Business Administration; Civil Construction; Digital Transformation; Project Management.

Abstract

This article discusses how the integration between information technology (IT) and business administration is reshaping civil construction, a sector historically characterized by high complexity and low productivity compared to other industries. It analyzes the impacts of converging information systems, digital modeling (BIM), automation, and artificial intelligence on business management, highlighting improvements in strategic planning, cost reduction, scheduling optimization, and quality control. The paper also proposes digital transformation frameworks applied to project management and construction processes, reinforcing technology's role as a key element for competitiveness and sustainability in the industry.

Keywords: Information Technology; Business Administration; Civil Construction; Digital Transformation; Project Management.

1. Civil Construction facing Digital Transformation

The construction industry has historically been a low-productivity sector compared to other industries, such as manufacturing and agriculture. According to a McKinsey report (2017), while global construction productivity grew only 1% per year over the past two decades, manufacturing grew at an average of 3.6% over the same period. This discrepancy reflects the sector's structural resistance to adopting modern technologies and management practices. However, the advancement of digital technologies and the growing pressure for efficiency are causing an inevitable disruption, forcing the sector to reinvent itself.

The integration of information technology (IT) and business administration emerges as the most promising path to overcoming these limitations. Digital tools, when combined with efficient business management practices, enable a profound transformation in construction processes, ranging from planning to post-construction maintenance. According to Sacks et al. (2020), digitalization represents not only an operational innovation, but also a strategic repositioning of companies in an increasingly competitive and globalized market.

This trend is reinforced by globalization and rapid urbanization. Demand for housing, infrastructure, and sustainable buildings is growing exponentially, requiring fast, cost-effective, and high-quality solutions. In this context, digitalization becomes a factor for survival. Companies that remain stuck in traditional methods risk losing ground to more agile organizations capable of efficiently integrating technology and management.

One of the most immediate impacts of digitalization is greater predictability of costs and deadlines. Studies by the Project Management Institute (PMI, 2019) show that companies that adopt IT tools integrated into business management can reduce the execution time of complex projects by up to 15%. This advantage is especially critical for large-scale projects, such as airports and subways, which frequently suffer from delays and budget overruns.

Digital transformation also reconfigures the role of the manager. While in the past, construction management was characterized by manual control and experience-based decisions, today it requires a hybrid profile, capable of interpreting data, leading multicultural teams, and implementing technological solutions. This new manager is described by Dossick and Neff (2010) as a "digital mediator," balancing the technical, human, and technological dimensions of construction.

Practical examples of this shift can already be observed. The London Underground and the expansion of Singapore Airport used integrated digital platforms to optimize schedules and reduce rework, achieving significant efficiency gains (Eastman et al., 2018). In Brazil, projects related to the 2014 World Cup highlighted the contrast between projects that adopted digital systems and those that remained tied to traditional methods, highlighting the need for continuous modernization.

Therefore, the construction industry finds itself at a historic crossroads. The integration of IT and business administration is not only an opportunity, but a strategic imperative to ensure competitiveness, sustainability, and innovation in an increasingly dynamic global market.

2. Information Systems and Business Management in Civil Construction

The integration of information systems into business administration redefines the management logic in the construction industry. Traditionally characterized by fragmented data and processes, the construction industry is now adopting solutions that unify financial, operational, and strategic information in real time. ERP (Enterprise Resource Planning) systems and specialized engineering software are now key elements in aligning technical decisions with business requirements.

According to Laudon and Laudon (2020), information systems represent the core of organizational competitiveness in the digital age, as they provide integrated process visibility and enable data-driven decision-making. In the construction industry, this integration translates into greater precision in controlling costs, deadlines, and quality, reducing the risk of waste and increasing the reliability of results.

Tools like SAP, Oracle Primavera, and Autodesk Construction Cloud exemplify how digital systems can transform business management. They enable detailed schedule tracking, real-time cost analysis, and the integration of geographically distributed teams. The result is a continuous flow of information, eliminating organizational silos and strengthening transparency between different areas of a company.

Furthermore, digitalization facilitates communication between the various stakeholders involved in a project—investors, managers, engineers, suppliers, and clients. This integration fosters strategic alignment that extends beyond the construction site, influencing the entire construction value chain. According to Rezgui and Zarli (2006), interoperability between systems is a fundamental condition for the industry to advance toward Construction 4.0.

Another critical aspect is the ability to predict scenarios. Advanced information systems incorporate predictive analytics modules that allow simulating the impacts of changes in schedules or budgets, providing greater security for strategic decisions. This predictability reduces the likelihood of delays and budget overruns, recurring problems in the sector.

Success stories reinforce this approach. Companies like Odebrecht Engenharia and Construtora Norcon, by adopting integrated management systems, have managed to significantly reduce material waste and optimize resource allocation in large projects. These

Examples confirm that technology, when associated with solid management practices, generates concrete results in efficiency and competitiveness.

Thus, information systems are consolidated as pillars of business management in the construction industry, promoting a more transparent, efficient and data-driven organizational culture. This integration represents not only technological modernization, but a true paradigm shift in the sector.

3. Building Information Modeling (BIM) and Strategic Planning

Building Information Modeling (BIM) is perhaps the most emblematic example of the convergence between IT and business management in the construction industry. More than a design tool, BIM is an integrated management methodology that encompasses all phases of a project's lifecycle, from design to operation.

According to Eastman et al. (2018), BIM enables the creation of digital models that centralize information, allowing accurate analyses of time, cost and performance.

In strategic planning, BIM enables 4D (time) and 5D (cost) simulation, integrating dimensions that were previously handled fragmentedly. This integration significantly reduces the risk of incompatibilities between engineering disciplines and avoids rework. According to Azhar (2011), the use of BIM can reduce rework costs by up to 40% on large projects, a significant impact in an industry often pressured by tight margins.

Furthermore, BIM strengthens transparency in business management. By centralizing information in a digital model accessible to all stakeholders, BIM increases collaboration between architects, engineers, managers, and clients. This transparency reduces contractual conflicts and improves communication, favoring strategic decision-making.

Another relevant point is BIM's ability to support sustainability. Digital models can simulate energy consumption, environmental impacts, and material efficiency, allowing managers to incorporate sustainability criteria even in the early stages of a project. This aligns the construction industry with global demands for social and environmental responsibility, strengthening companies' reputations and competitiveness.

In Brazil, the adoption of BIM still faces challenges, but it is already a reality in large public and private projects. Decree No. 9,983/2019 established the National BIM Dissemination Strategy (BIM BR Strategy), encouraging the use of the methodology in public projects. This initiative reinforces the need to align public policies and business practices to promote the modernization of the sector.



International cases demonstrate the methodology's success. The Crossrail project in London used BIM to integrate thousands of technical documents and coordinate multidisciplinary teams, achieving significant efficiency gains. In the United States, companies like Turner Construction have used BIM as a central tool to reduce risks and improve the management of large projects.

In short, BIM represents a paradigm shift in the construction industry, fostering integration between technology and business administration. By enabling greater precision, collaboration, and sustainability, the methodology is solidifying itself as an indispensable strategic tool for the future of the sector.

4. Automation, IoT and Quality Control

Process automation and the Internet of Things (IoT) have profoundly transformed the construction industry by offering new methods of monitoring, control and execution.

Traditionally characterized by intensive labor, the construction industry has begun to incorporate automated systems and intelligent sensors that reduce vulnerability to human error and increase operational precision. According to Bock (2015), the adoption of robotics and automation on construction sites enables significant gains in productivity and safety, in addition to reducing long-term costs.

IoT sensors can monitor critical variables such as humidity, temperature, vibration, and structural movement in real time. This data is transmitted to central management systems, enabling quick, evidence-based decisions. This practice not only raises quality standards but also contributes to worker safety by anticipating failures and preventing accidents. A study conducted by Deloitte (2019) found that construction sites that incorporated IoT reduced safety incidents by up to 30%.

Beyond safety, automation directly impacts the quality control of materials and construction processes. 3D printers, for example, are already used to produce complex architectural elements and even entire homes, at a reduced cost and in significantly shorter lead times. Companies like Apis Cor in the United States have demonstrated the feasibility of building homes in less than 24 hours using 3D printing, a feat that redefines cost and planning in the construction industry.

Masonry robots are also relevant examples. On large construction sites, automating repetitive tasks like bricklaying or painting allows human workers to be reallocated to higher-value tasks. This redistribution of tasks not only increases efficiency but also helps raise the level of workforce qualification, an essential aspect in sectors facing a shortage of skilled professionals.

From a business administration perspective, the integration of automation and IoT strengthens the decision-making process. Mass data collection generates performance indicators that can be

analyzed by managers to identify bottlenecks, optimize resources, and adjust schedules. This transforms the construction site into a highly monitored environment, aligning practical execution with the organization's strategic requirements.

Multinational companies have invested heavily in these technologies. Vinci Construction, for example, implemented smart sensors in infrastructure projects in France, achieving a significant reduction in delays and increased structural durability. These cases demonstrate that automation and IoT are no longer future trends, but rather already established realities at leading companies in the sector.

In short, the combination of automation and IoT promotes a qualitative leap in the construction industry, ensuring greater control, efficiency, and safety. Beyond technological innovation, it is a strategic tool that strengthens business management and redefines standards of global competitiveness.

5. Artificial Intelligence, Big Data and Deadline Optimization

Artificial intelligence (AI) and big data represent a new level of integration between IT and business administration in the construction industry. The complexity of projects, which involve thousands of simultaneous variables, makes decision-making virtually impossible without the support of advanced data analysis tools. According to Brynjolfsson and McAfee (2017), AI not only processes information at an exponential scale but also identifies hidden patterns that escape human perception, providing strategic insights to managers.

In the construction industry, AI is widely used to predict delays and risks. Machine learning algorithms analyze construction history, schedules, and external variables, such as weather conditions and fluctuations in input prices, to anticipate potential bottlenecks. This predictive capability strengthens business management by enabling more robust contingency plans aligned with the specific needs of each project.

Big data, in turn, offers a massive information base that integrates financial, operational, and market data. This integration enables real-time analysis, optimizing resource allocation and improving the accuracy of cost and schedule estimates. A McKinsey (2020) study showed that construction companies that implemented big data in their processes reduced delays by up to 20% and reduced operating costs by approximately 15%.

Another relevant application of AI is in the predictive maintenance of machines and equipment. Sensors installed on cranes, excavators, and other assets monitor vibration, temperature, and usage, allowing faults to be identified before they become critical. This practice reduces corrective maintenance costs and prevents unexpected downtime, increasing schedule reliability.

In addition to optimizing deadlines, AI also contributes to sustainability. Simulation algorithms can identify design and material selection alternatives that reduce environmental impacts without compromising financial viability. This approach brings the construction industry closer to global sustainable development goals, strengthening its social and environmental responsibility.

Companies like China State Construction Engineering Corporation (CSCEC) and Bechtel in the United States are already using AI and big data on a large scale to optimize large projects.

The results include reduced waste, greater cost predictability, and shorter lead times, confirming that technology has become a key element of international competitiveness.

Therefore, artificial intelligence and big data are consolidating themselves as indispensable tools for transforming the construction industry. They enable managers to adopt a proactive and strategic stance, reducing uncertainty and strengthening sustainability and efficiency in highly complex projects.

6. Digital Transformation Frameworks Applied to Civil Construction

Digital transformation in the construction industry isn't limited to the isolated adoption of technologies; it requires frameworks that integrate digital tools into business management. According to Gartner (2020), well-structured digital frameworks serve as strategic roadmaps that guide companies on their digitalization journey, minimizing risks and maximizing results.

In the construction industry, this approach is particularly necessary due to the fragmentation of the production chain.

One of the most relevant frameworks combines Lean Construction principles with BIM methodology and integrated ERP systems. This convergence promotes not only operational efficiency but also greater alignment between business strategy and project execution.

According to Koskela (2000), Lean Construction reduces waste and optimizes workflows, while BIM ensures greater predictability and ERPs offer administrative and financial support. The integration of these elements creates a robust and adaptable digital ecosystem.

Another emerging framework is the digital maturity framework, proposed by the Project Management Institute (PMI, 2018). It assesses companies according to levels of technological integration, from the initial use of digital tools to full digital transformation, in which processes are driven by real-time data and decisions are largely automated. This model helps construction companies plan their digital evolution in a structured manner.

The concept of hybrid frameworks is even more relevant in emerging contexts, such as Brazil, where technological heterogeneity is striking. Many companies rely on manual processes in some areas and advanced technologies in others. In this scenario, adaptive frameworks, which include diagnosis, planning, implementation, and continuous measurement, are essential to ensure consistent results.

In addition to efficiency gains, digital frameworks also contribute to corporate governance. The integration of technical and financial data ensures greater transparency for investors and regulatory bodies, strengthening the organization's credibility. This transparency is increasingly required in a global environment where compliance and social responsibility are competitive differentiators.

Practical examples illustrate the effectiveness of these frameworks. Companies like Turner Construction and Skanska have structured internal digital transformation programs based on hybrid frameworks, achieving significant gains in deadlines, costs, and customer satisfaction. In Brazil, similar initiatives have been adopted in urban infrastructure projects, particularly subway and airport projects.

In short, digital transformation frameworks offer the construction industry a clear path toward modernization and integration between technology and business administration. By aligning innovation, strategy, and execution, they ensure that digitalization isn't just a passing trend, but a structuring process for competitiveness and sustainability.

7. Future Perspectives: Sustainability, Competitiveness and New Business Models

The construction industry is rapidly moving toward what experts call *Construction 4.0*, marked by the convergence of digitalization, sustainability, and new collaborative business models. In this scenario, the integration of IT and business administration is no longer a differentiator but a basic requirement for survival in the global market. According to Oesterreich and Teuteberg (2016), digitalization is not merely an incremental innovation, but a process of structural disruption that redefines organizational roles, processes, and strategies.

Sustainability is emerging as a key driver of the sector's competitiveness. Digital tools such as BIM, IoT, and big data allow for the simulation of the building lifecycle, reducing waste, optimizing energy efficiency, and promoting more sustainable material choices. According to the World Green Building Council (2019) report, sustainable buildings consume up to 50% less energy and can generate 30% savings in operating costs. The integration of IT and business management facilitates the incorporation of these parameters from strategic planning onwards, consolidating sustainability as an integral part of modern management.

Competitiveness also depends on the ability to adapt to dynamic global markets. Companies that invest in digital transformation can position themselves effectively.



More agile in international bidding processes, demonstrating efficiency, transparency, and regulatory compliance. This alignment is especially relevant in projects financed by multilateral organizations, which require high governance standards.

Another fundamental aspect concerns new business models, such as *joint ventures* international agreements and public-private partnerships (PPPs). These arrangements require a high level of technological and administrative integration, as they involve different organizational cultures, regulatory frameworks, and stakeholder expectations. IT, in this context, acts as a common language that enables coordination and transparency between partners.

The construction industry's future professional will inevitably be hybrid. According to Aranda-Mena et al. (2009), digitalization requires managers with technical, business, and digital skills, capable of transitioning between the construction site and the organization's strategic environment. This shift in professional profiles points to a growing appreciation for engineers with business administration degrees and business managers with a solid understanding of digital technologies.

Scenarios up to 2030 indicate that the construction industry will undergo a process of digital consolidation. Companies that fail to adopt integrated IT and management models will struggle to compete, especially in environments with increasingly tight margins. On the other hand, organizations that successfully lead this movement will be ahead in terms of innovation, profitability, and reputation.

In short, future prospects reinforce that the integration of IT and business administration is not just an operational resource, but a survival and leadership strategy in a highly competitive sector. The future of the construction industry will be digital, sustainable, and collaborative, requiring more flexible, inclusive, and technologically advanced management models.

Conclusion

The analysis of the integration between information technology and business administration in the construction industry highlights an ongoing structural transformation. Throughout this article, we observed that the convergence between digital tools and business management practices redefines the logic of planning, execution, and control, increasing the sector's efficiency and competitiveness.

Initially, it was found that the construction industry, historically marked by low productivity, finds digitalization a strategic opportunity to overcome shortcomings and align itself with global standards of quality and innovation. In this sense, business administration plays a crucial role in ensuring that technological adoption is integrated with clear strategic objectives.

Information systems have proven to be central to this process, offering greater transparency, integration, and predictability for managers and stakeholders. At the same time, methodologies such as BIM have become indispensable tools for strategic planning, reducing rework costs and strengthening sustainability.

Automation, IoT, and artificial intelligence have further expanded this horizon, introducing new forms of monitoring, control, and prediction. These technologies have not only improved safety and quality but also enabled faster, more assertive decisions, reducing delays and optimizing resources.

Digital transformation frameworks, in turn, offer a conceptual framework to guide companies through this process of change. By integrating Lean Construction, BIM, and ERP, these frameworks consolidate a digital ecosystem that organically connects business management and technology.

Future prospects point to *Construction 4.0*, in which digitalization will be inseparable from sustainability and global competitiveness. In this new scenario, business administration will need to continually reinvent itself, aligning technological innovation with ethical and sustainable practices.

Construction professionals will also need to evolve, becoming hybrid and multidisciplinary, with skills in engineering, management, and technology. This shift in profile will cement integration as part of the industry's DNA, preparing them to face the challenges of a constantly changing environment.

Given this panorama, it can be concluded that the construction industry faces a historic window of opportunity. The integration of IT and administration not only modernizes processes but also redefines the essence of the activity, bringing it closer to more intelligent, collaborative, and sustainable management models.

Ultimately, digital transformation in the construction industry is not a passing trend, but a strategic requirement that will determine which companies survive and thrive in a highly competitive global market.

Thus, the construction industry of the future will be marked by the ability to integrate technology and management synergistically, ensuring not only efficiency, but also social responsibility, sustainability and continuous innovation.

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