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Automated procurement system in construction based on ERP (1C), EDI, and BIM: Architecture, integration principles, and managerial impact

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Abstract
The article examines the information technologies used to automate procurement processes in construction, including enterprise resource planning (ERP) systems, electronic data interchange (EDI), and building information modeling (BIM). It analyzes their functional roles, architectural structures, and integration principles that enable the creation of a unified digital environment. Comparative models of component integration and data exchange formats (IFC, XML, API) are explored to ensure system interoperability. The study emphasizes the impact of integration on improving controllability, transparency, and the efficiency of interdepartmental coordination. It also considers the organizational effects and transformation of management processes resulting from the transition to an end-to-end digital procurement system. Prospects for development are highlighted through data standardization, the adoption of openBIM, and the expansion of analytical functions based on digital platforms.

Keywords: Enterprise resource planning (ERP), 1C, electronic data interchange (EDI), building information modelling (BIM), digital integration, construction procurement, project management, construction digitalization

1. Introduction

Modern construction projects are characterized by the high organizational and technological complexity of processes, the involvement of numerous stakeholders, and strict requirements regarding deadlines and quality. Under these conditions, the efficiency of the procurement system becomes a critical factor shaping overall project performance. In practice, however, many construction organizations face fragmented information flows, data duplication, low transparency of procurement activities, and limited controllability of material and technical supply. These issues are further exacerbated by the technological heterogeneity of IT tools used by different departments and the absence of a unified digital environment.

In recent years, a digitalization approach based on the integration of enterprise resource planning (ERP) systems (particularly 1C), electronic data interchange (EDI), and building information modeling (BIM) has been actively evolving. Such an architecture enables end-to-end automation of processes-from design and demand planning to delivery at the construction site. The purpose of this article is to analyze the architectural and integration principles underlying the development of an automated procurement system in construction using ERP, EDI, and BIM, as well as to assess its impact on controllability, transparency, and the efficiency of interactions among project stakeholders.

2. Main part. Information and digital technologies in the automation of construction procurement processes

The digital transformation of the construction industry involves the implementation of a set of technologies that support the automation and integration of all stages in the life cycle of a capital construction asset [1]. Among the most significant solutions for the digitalization of procurement processes are ERP systems (particularly those based on 1C), EDI, and BIM. Collectively, these components enable the establishment of a unified information environment that integrates planning, procurement, logistics, document management, and managerial control.

ERP systems serve as the core platform for managing an organization's resources, supporting demand generation, procurement planning, inventory control, and the integration of financial operations. Within an automated procurement framework, the ERP environment interfaces with EDI modules for document exchange with suppliers and with BIM models to accurately determine material volumes, delivery timelines, and their alignment with construction schedules [2]. According to Global Market Insights, the global construction ERP software market was valued at $3.7 billion in 2024 and is projected to grow at an average rate of 7.7% between 2025 and 2034 (fig. 1).

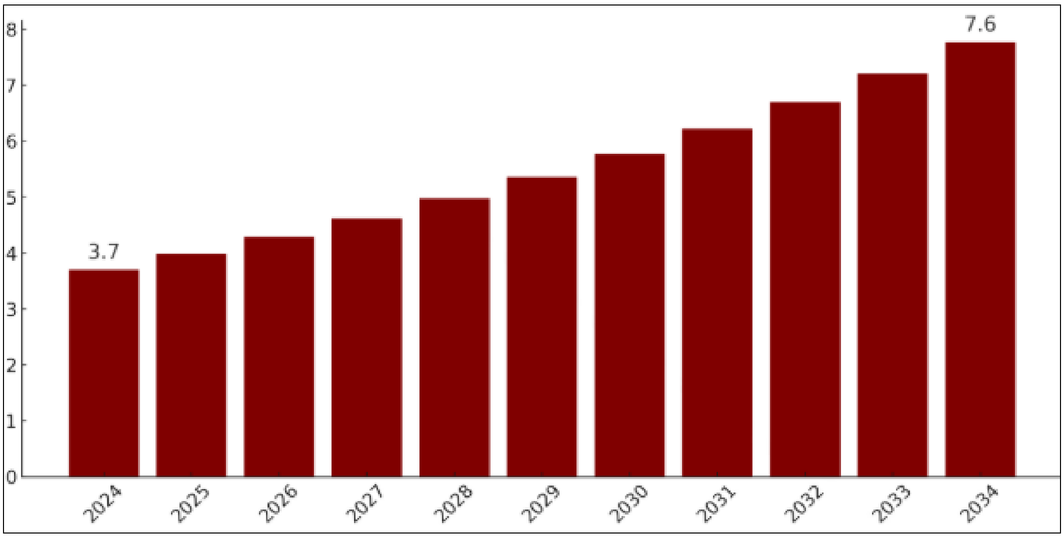

Fig 1: Projected growth of the global construction ERP market, billion dollars [3].

In Russian practice, the 1C: Enterprise platform has gained the widest adoption, being extensively adapted to the needs of construction companies [4]. According to estimates from the developer and industry reports, 1C-based solutions are used to automate management and accounting in more than 2 million organizations, and in terms of the number of automated workplaces, 1C: Enterprise ranks first in the Russian ERP market; moreover, 80-90% of Russian companies rely on 1C products for financial and managerial accounting. For the construction sector, a broad range of specialized configurations has been developed, including 1C: ERP Construction Company Management 2, 1C: Construction Production Management, as well as modules for leasing and property management aimed at developers, contractors, and vertically integrated holding structures operating a full construction cycle. This enables the adaptation of a standard platform to the specifics of the sector: accounting for complex cost structures by construction site, integrating cost estimates, planning resources, and controlling contracts within a unified information environment. As a result, 1C: Enterprise has become the most widely used digital tool supporting category-based procurement management in Russian construction organizations.

The functional capabilities of ERP systems, particularly the 1C: Enterprise platform, cover a wide range of tasks related to procurement management in construction firms. A key advantage of such systems is the ability to ensure a comprehensive and centralized approach to information processing, facilitating continuity across the stages of planning, purchasing, warehousing, and financial support for supplies (table 1).

Table 1: Functional capabilities of ERP in construction supply management [5].

Function	Description of implementation in ERP
Demand planning	Calculation based on project documentation and construction schedules.
Procurement request generation	Automated creation of purchase requests with parameters for quantities, deadlines, and nomenclature.
Nomenclature specification management	Support for complex hierarchical structures of materials, equipment, and products.
Budget and cost control	Verification of requests against budget limits and cost items across sites and activities.
Contract and proposal Management	Maintenance and approval of supply contracts, commercial offers, and disagreement protocols.
Warehouse and logistics tracking	Monitoring of stock levels, reservations, and distribution across construction sites.

Despite its extensive capabilities, the implementation of ERP systems - including 1C - is associated with several limitations and risks. One of the primary challenges lies in the complexity of initial configuration and customization to fit the specific workflows of a construction enterprise, which often requires substantial resources and involvement of highly qualified specialists. Inadequate integration with other digital systems (such as BIM and EDI) may lead to data duplication, process inconsistencies, and reduced reliability of management information. Additional risks include employee resistance to digital transformation, incomplete coverage of supply chain scenarios, and vendor lock-in related to the chosen ERP platform.

Unlike ERP systems, EDI represents a mechanism for the electronic exchange of structured documents between business participants without human intervention [6]. In the construction industry, EDI is actively used to automate document workflows between the client, general contractor, suppliers, and logistics operators. Standardized formats (such as XML and UN/EDIFACT) ensure compatibility across heterogeneous IT systems and eliminate errors associated with manual data entry. According to Research and Markets, the global EDI market was valued at approximately $36.5 billion in 2024 (fig. 2).

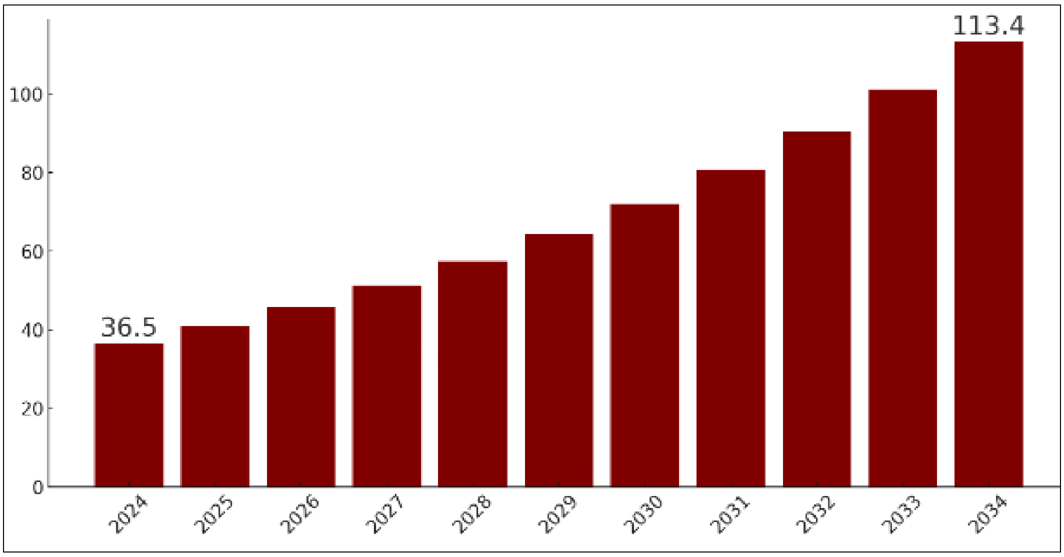

Fig 2: Projected growth of the global EDI market, billion dollars [7].

In the 2024 industry review by Commport, focused on the global lumber and construction supply market, it is emphasized that the widespread adoption of EDI has become a key driver of operational efficiency across supply chains [8]. The report estimates that about 70% of all B2B transactions in these international supply chains are already handled using EDI systems, which cut order-processing time by 50-60% and greatly reduces the order-to-cash cycle. This is critical, considering supply chain costs can shave off nearly 13% from manufacturing profitability, and there is a dire need to automate processes in order to maintain the margin. The review further establishes that up to 20% of invoice data entry is incorrect, reinforcing the need for standardized and fully automated electronic document exchange.

Drawing on these findings, it is evident that EDI is not a supporting instrument but a structural component of modern supply-chain management in construction. In fact, the functional capability of EDI goes way beyond document exchange into influencing the accuracy, speed, and transparency of procurement and logistics processes. To illustrate the role of EDI within an integrated digital procurement environment, table 2 summarizes the key functions of EDI systems relevant to construction supply chains.

Table 2: Key EDI functions in construction procurement.

EDI function	Description
Automated order exchange	Transmission of material orders between the client, general contractor, and suppliers without human intervention.
Electronic invoices and certificates	Generation, sending, and receiving of financial documents in standardized formats.
Advance Shipping Notices (ASN)	Notification of the composition, volume, and expected arrival time of deliveries.
Integration with ERP and warehouse systems	Alignment of EDI documents with warehouse operations and financial modules.
Data format standardization	Use of international standards such as XML and EDIFACT to ensure system compatibility.

After describing the main functions of EDI, it would be appropriate to mention that EDI also introduces a number of risks and operational difficulties when implemented. One of the significant problems is the harmonization of data formats and communication protocols among project participants, especially when contractors depend on heterogeneous or outdated IT systems. Integration with ERP and warehouse modules may require complex configuration of document routing, access rights, and processing rules. Another challenge arises from the fact that the different levels of digital maturity among suppliers mean that organizations with low levels of automation will turn into bottlenecks within the supply chain. Finally, the transition to EDI requires updating internal procedures, training personnel, and establishing data-quality controls, which raises initial costs and can lengthen the adaptation period.

BIM technology enables the creation of a digital prototype of a construction asset that incorporates all design and operational characteristics [9]. In the context of procurement automation, BIM plays a crucial role by providing accurate, structured data on required materials and equipment, their delivery timelines, and the sequence of their use on the construction site.

According to the global State of BIM 2024 survey, which included participants from the construction industry worldwide, BIM technology has become nearly ubiquitous: 92.6% of respondents reported that their organizations use it (fig. 3).

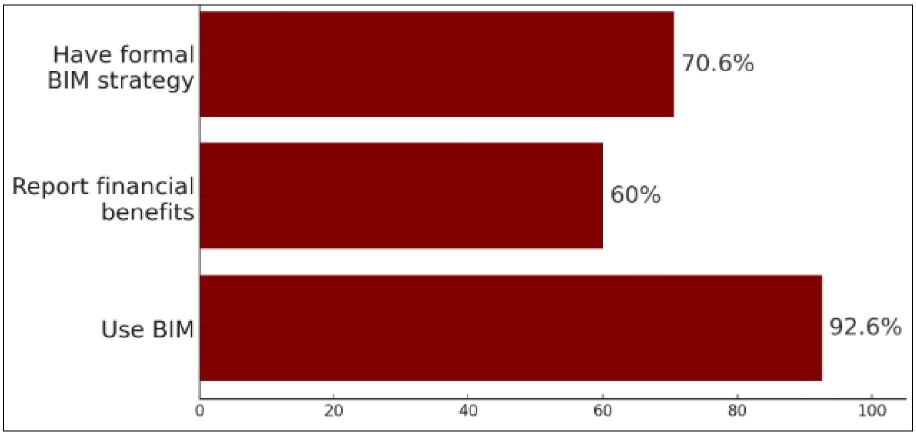

Fig 3: BIM adoption and benefits according to the 2024 State of BIM survey [10].

According to the report, BIM is applied most intensively in detailed design and 3D modelling (about 17%) and conceptual planning and design (around 14%), followed by construction documentation (13%) and cost estimation (11%). Clash detection and coordination also represent a significant share of BIM use (approximately 15%), reflecting its role in reducing design and on-site risks. Scheduling and sequencing account for about 9%, while more specialized applications-including energy performance analysis (6%), CO_2 assessment and sustainability analysis (7%), site logistics (5%), lifecycle management (4%), prefabrication (7%) and regulatory compliance (3%) - remain less prevalent. Overall, the distribution shows that BIM adoption in design, documentation, and coordination tasks is most mature, while analytical and lifecycle functions are still developing.

The results stated above allow a clear view: BIM allows for a wide spectrum of design, analytical, and managerial tasks, since it has moved from being a tool for modeling to a general digital environment for the management of construction processes. Such multifunctionality underlines the requirement for systematization of the main functions that BIM performs to sustain planning, coordination, analysis, and control at all stages of a project's life cycle. Table 3 summarizes the key BIM functions most relevant to contemporary construction organizations.

Table 3: Key BIM functions in construction projects [11, 12].

BIM function	Description
3D modelling and visualization	Creation of a digital model with geometric, structural, and engineering attributes to improve clarity and accuracy of design solutions.
Coordination and clash detection	Integration of discipline-specific models and automated identification of conflicts between structural and engineering elements.
Schedule planning (4D BIM)	Linking model components to time parameters, simulating construction sequences, and optimizing project schedules.
Cost estimation and quantity takeoff (5D BIM)	Integration of cost and quantity data with the model, supporting automated estimation, budgeting, and resource control.
Construction documentation management	Centralized creation, updating, and coordination of drawings, specifications, and technical documentation.
Energy and sustainability analysis	Modelling thermal performance, assessing operational characteristics, and evaluating environmental and sustainability indicators.
Facility management and asset lifecycle support	Using the model during operation for maintenance planning, repairs, and long-term asset management.
Site logistics planning	Coordination of material flows, temporary infrastructure, and equipment placement on the construction site.

Generally, BIM implementation has several risks and organizational challenges despite the obvious advantages. Such challenges include standardization of data, incompatibility of software, and more coordination in integrating discipline-specific models. Other requirements for adoption will be internal changes in workflow, training of staff, and quality control of data. Further complications arise from the different levels of digital maturity among the various contractors, and high costs of software and infrastructure are also a factor.

In conclusion, ERP, EDI, and BIM are the basic elements of a digital construction procurement system. ERP offers control of resources and finances from a single point, EDI means swift document exchange, and BIM provides accurate planning and analytical data. Together, they enable a transparent and coordinated information environment. Although implementation is complex, the resulting improvements in supply chain efficiency and managerial oversight justify the transition.

3. Integration models of digital construction procurement systems: Digitalization in the construction supply chain requires more than the implementation of various software solutions; an integrated digital architecture is necessary, ensuring seamless data flow within one single environment among all parties involved. Integration of the ERP system, EDI platform, and BIM technologies allows for the creation of a common digital space connecting business processes of planning, procurement, logistics, and documentation in real time.

Integration models vary depending on IT maturity and organizational complexity. The most frequent solution is the ERP system as an operational core, surrounded by EDI modules for external document exchange, and the BIM model as a source of material quantities and delivery schedules. A modular architecture considers each system-ERP, EDI, or BIM-as a separate service integrated using middleware, APIs, or message brokers. For large-scale enterprises, service-oriented or microservice-based architectures have also been employed, relying on the ESB to facilitate scalable and agile component communication.

The choice of integration architecture for ERP, EDI, and BIM has a significant impact on the effectiveness of a digital procurement system in construction. In particular, the degree of connectivity between components determines the speed of information exchange, the coordination among stakeholders, and the overall transparency and manageability of supply chains [13]. The comparative table 4 outlines the key characteristics of possible integration models for digital components in construction procurement.

Table 4: Comparative overview of integration models for ERP, EDI, and BIM in construction procurement

Integration model	Structure	Advantages	Limitations / risks
Centralized (ERP core)	ERP (e.g., 1C) serves as the main control platform, with EDI and BIM connected via interfaces.	Unified data repository, simplified management, reduced manual operations.	Limited flexibility, high ERP load, challenging scalability.
Modular (middleware-based)	ERP, EDI, and BIM operate as separate modules connected through APIs, middleware, or message brokers.	High flexibility, phased deployment possible, scalable architecture.	Requires strict standardization, increased integration and maintenance costs.
Microservice / SOA (via ESB)	Each component is implemented as an independent service integrated via an enterprise service bus (ESB).	Fault tolerance, parallel processing, high scalability.	Technically complex, demands advanced IT infrastructure and governance.

A well-designed integration model enables continuous data flow from design to execution. BIM defines material needs, which are transferred to ERP for planning and procurement, while EDI handles external document exchange. Feedback such as delivery confirmations updates ERP and BIM, ensuring synchronized supply chain operations: BIM initiates, ERP manages, EDI connects.

Successful integration depends upon data interoperability-precise interchange among platforms. Standard formats guarantee this: IFC for BIM data, XML for EDI documents, Excel/CSV for transitional exchange, and APIs (REST, SOAP, JSON) for real-time system interaction. Unified directories, coding standards, and security protocols guarantee data consistency along the procurement chain.

Overall, an integrated architecture will not only remove the information gaps but also make the whole supply chain more manageable. The continued integration of ERP, EDI, and BIM technologies will eventually lay a foundation for procurement in construction projects that is efficient, transparent, and adaptable.

Managerial impact of an integrated digital procurement system: The implementation of an integrated digital environment that combines ERP, EDI, and BIM leads not only to operational automation but also to qualitative changes in construction project management. One of the most significant effects is the transition from linear, fragmented departmental interaction to end-to-end process-oriented management, where information is neither lost nor duplicated across project stages. Each participant - from engineering to accounting operates within a shared informational context, based on synchronized and consistent data.

Empirical studies confirm that such integration has a measurable managerial impact. The 2023 “Optimizing Digital Project Management” SmartMarket Brief by Dodge Construction Network shows that general contractors with higher levels of process automation and an integrated platform approach report markedly better outcomes: 86% of digitally advanced firms experience notable value from their technology stack compared with 58% among less digitalized peers, with the main benefits being improved schedule and cost performance, better data collection from jobsites, higher profitability, and increased labor productivity. Similarly, the 2025 “Business Value of Autodesk Construction Cloud” report, based on data from 211 companies, indicates that users of integrated construction platforms achieve 41% fewer defects, 36% less rework, a 31% increase in productivity, and a 50% improvement in on-time completion rates relative to their previous toolsets. The findings indicate how end-to-end digital environments reinforce managerial control over quality, time, and costs.

This solution increases transparency of responsibility: at any given time, it is obvious which department started a request, who approved it, and where it currently is. So, internal conflicts are lessened, and the processes of approval speed up, creating a culture of digital accountability. Moreover, digital modeling of material needs (via BIM) and automated deviation tracking (via ERP and EDI) enable managers to identify risks in advance - such as delays or cost overruns before they materialize on site.

Integration also converts the role of managerial staff: from performing manual control and coordination tasks, they switch to analytical and strategic activities. Managers will be able to see real-time consolidated data, which will enable them to identify bottlenecks, manage priorities, and allocate resources more effectively. This will become a critical factor in improving the adaptability and resilience of an organization in the dynamic environment of modern construction.

In short, digital integration does not simply affect the level of costs or time of processing. It significantly contributes to raising the maturity of management processes, resulting in a more transparent, predictable, and controllable environment for cross-functional collaboration - particularly vital for complex, multi-site construction projects operating under tight schedules and limited resources.

4. Conclusion

Integration of ERP, EDI, and BIM within construction procurement systems provides a holistic digital environment that enables end-to-end automation: from demand planning to document-supported delivery. This architecture enhances procurement transparency, accelerates interdepartmental coordination, and reduces management overhead, especially in multi-project and geographically distributed contexts. In order to create the desired effect, it is highly recommended to implement such systems in stages, starting with the alignment of reference data structures and intersystem workflows. It can be assumed that in the future, the development of openBIM standards, advanced API integrations, and data-driven analytics will enable not only the automation but also the prediction of procurement needs, further optimizing supply chain performance across the full construction lifecycle.

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