

# Analyzing the Transition from Traditional Methods to Digitalization and Automation in Construction Material Procurement

Kranti Kumar Myneni, Santheya A



**Abstract** The construction industry is experiencing a significant transformation as it shifts from traditional, manual procurement practices to digitalized and automated processes, driven by the demand for greater efficiency, accuracy, and cost-effectiveness. This paper aims to identify and analyze the evolution of procurement tools within the construction sector, highlighting key factors that have facilitated the successful implementation of digital solutions. Through a comprehensive examination of procurement practices across various company types, this study categorises procurement approaches and examines how each has adapted to technological advancements. The research focuses on understanding the drivers behind the step-by-step transition from conventional methods to digital and automated procurement, exploring the technological, organisational, and regulatory influences. The findings contribute to the growing body of knowledge on digital procurement by offering practical insights for industry stakeholders on optimising procurement practices. This research highlights the significance of digital transformation in enabling companies to remain competitive in an increasingly data-driven and technology-driven environment.

**Keywords:** Automation, Construction materials, Digitalisation, Industry 4.0, Procurement, Transition Methods.

## Abbreviation:

COINS: Construction Industry Solutions

VMI: Vendor Managed Inventory

HML: High-Cost Materials Like

## I. INTRODUCTION

Tools like the Kraljic Matrix and Pareto Analysis help categorize materials and optimize procurement processes. However, adoption remains limited despite the potential of Industry 4.0 technologies, such as Building Information Modeling, IoT, and automation, with only about 20% of firms fully integrating these advancements. Resistance to change and reliance on manual, non-strategic methods further hinder progress [1].

As globalization intensifies competition, construction companies are adopting Industry 4.0 and Industry 5.0

technologies to improve supply chain management. These innovations, including AI and robotics, ensure timely delivery, cost optimization, and schedule adherence. Yet, traditional procurement practices continue to dominate, underscoring the need for "Procurement 4.0," which leverages technologies like big data, IoT, and AI to enhance efficiency and transparency [2].

This paper examines the development and implementation of tools in construction material procurement, exploring the transition from traditional to digital methods and evaluating their impact on efficiency, cost, and accuracy. By focusing on material acquisition, this research aims to optimize procurement strategies in the construction industry.

## II. INITIAL STUDY

Interviews were conducted with professionals from various types of firms, including contracting companies, Real estate companies, Project Management Consultants, and Architectural firms. Upon examination, a similar pattern is observed in each category.

- **Contracting Companies:** Includes general contracting, subcontracting, project management, and sometimes design-build services. They manage the physical construction process, encompassing labour, materials, and equipment. Ex. L&T Constructions, TATA Projects, Shapoorji pallonji
- **Real Estate:** A business entity involved in development and construction. EX. Mahindra Life Spaces, Godrej, DLF, TVS, OPROY, L&T Reality
- **Project Management Consultants:** Project planning, scheduling, budgeting, risk management, and coordination among various stakeholders. They act as intermediaries between the client and other parties (contractors, architects, engineers). EX. Savills, CBRE, Colliers, Cushman & Wakefield
- **Architectural Firms:** Design services, including conceptual design, detailed architectural drawings, and project specifications. They may also be involved in project management and coordination, especially in the early stages. EX. Space Matrix, MACE, Studio 05 Architects, Design Den.

## III. METHODOLOGY

### A. Literature Review

- Research papers, Journals, books, industry reports, case studies, and other academic materials related to procurement, digital transformation, and

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construction supply chains will be gathered.

- Reviewing past studies on traditional procurement tools, digital/automated procurement systems, and their impact on the construction industry to identify gaps in current knowledge [3].

*i. Key Points to Explore*

- Evolution of procurement tools in the construction industry.
- Technology adoption frameworks, particularly in the construction industry.
- Factors influencing the digital transformation in procurement processes.
- Benefits and challenges of traditional vs. digital procurement systems.

**B. Initial Study**

- **Objective:** To have an idea of the practices followed in the procurement process in different types of companies.
- **Participants:** A small group of 5-10 procurement professionals within the construction industry will be selected for this phase.
- **Data Analysis:** Preliminary data from the study will be analysed to understand different types of procurement methods and tools.
- The review will organize findings under themes such as cost efficiency, accuracy, lead time, integration into construction processes, and potential barriers to digital adoption. This will help develop research questions and hypotheses.

**C. Data Collection**

Primary data will be collected from literature reviews and procurement professionals working within the construction industry to gain insights into the transition from traditional to digital tools.

*i. Sampling*

- **Target Sample:** Procurement managers, supply chain coordinators, and digital transformation experts in medium to large construction firms.
- **Sampling Technique:** Purposive sampling will select participants with relevant experience in traditional and digital procurement tools.

**D. Qualitative Analysis**

- **Thematic Analysis:** Qualitative data from interviews and open-ended survey questions will be analysed using a thematic approach to identify common themes and factors influencing the adoption of digital tools.
- **Key Themes:** Organizational culture, perceived benefits (e.g., increased accuracy, faster decision-making), barriers to adoption (e.g., resistance to change, upfront costs), and future possibilities.
- **Comparison of Traditional Vs. Digital Tools:** The qualitative analysis will also highlight the differences between traditional procurement tools (manual processes, paper-based systems) and digital approaches (automated ordering, data analytics), focusing on how they can be practically applied in the construction supply chain [4].

**E. Outcome**

The study aims to identify the factors that facilitate the transition from traditional to digital procurement tools in the construction supply chain. The expected outcomes include:

- **Key Transition Drivers:** Identifying technological, organizational, and industry-specific factors that make adopting digital tools more likely (e.g., cost efficiency, ease of use, regulatory compliance).
- **Challenges and Barriers:** Highlighting potential challenges (e.g., cost of implementation, lack of technical expertise, cultural resistance) that organizations face when transitioning to digital procurement.
- **Best Practices and Tool Integration:** Providing a range of potential digital procurement tools and practices that can be integrated into the construction industry to enhance procurement processes, focusing on practical application and scalability.
- **Cost-Benefit Insights:** Quantifying the cost implications of transitioning to digital systems and expected cost savings and operational improvements over time.

**IV. DIGITALISATION OF CONSTRUCTION MATERIAL PROCUREMENT**

**A. Contracting Companies**

Contracting firms focus heavily on managing materials, labour, subcontractors, and equipment, which makes cost tracking and supply chain management key features in their procurement software.

- **Procore:** Offers comprehensive tools for bidding, project management, and field productivity. Its procurement features include vendor management, purchase orders, and invoice tracking.
- **Oracle Aconex:** Provides document management, tendering, and contract management tailored for large-scale construction projects.
- **SAP Ariba:** Known for supply chain and procurement management, including vendor sourcing and procurement analytics. Ideal for managing complex, high-value contracts.
- **PlanHub:** Designed for subcontractors and general contractors, it enables project bidding, proposal management, and vendor tracking.
- **COINS (Construction Industry Solutions):** Offers an all-in-one solution with modules for procurement, supply chain management, and cost control.

**B. Consulting Companies**

Consulting firms, particularly in the construction and engineering sectors, require tools for managing project timelines, documentation, and stakeholder collaboration. These firms often act as intermediaries in the procurement process, focusing on cost estimation and tendering.

- **E-Builder:** A project management and procurement platform with features for bid management, contract management, and document management



control, ideal for consultants overseeing construction projects.

- Bentley Project Wise: Provides project collaboration tools, including document management, bid tracking, and contract management, designed for engineering and construction consultants.
- Deltek Avera: Common among architecture and engineering consulting firms for budgeting, contract tracking, and resource management.
- Accruent: Specializes in capital planning, contract management, and procurement processes, enabling consultants to ensure project alignment and compliance.
- InEight: Offers solutions for estimating, budgeting, and project controls, useful for consulting firms in project planning and procurement analysis.

### C. Architectural Firms

- Newforma: A project information management platform with procurement features tailored to architecture firms, including RFIs, submittals, and contract management [5].
- Autodesk Construction Cloud: Integrates design and construction management, providing tools for cost tracking, bid management, and contract documentation, helpful in coordinating procurement needs [5].
- Archdesk: A project management tool with procurement features such as vendor management, cost tracking, and budgeting, tailored to architectural firms.
- Core (Formerly BQE): Used by architects for project management, budgeting, and contract tracking, helping streamline procurement during the design and pre-construction phases.
- Monograph: A budget and resource management tool for architects that includes features for tracking project costs and procurement needs throughout the design process.

### D. Real Estate Companies

Real estate firms require procurement software that integrates vendor management, contract lifecycle management, and analytics to streamline property development, management, and acquisition processes [6].

- Yardi: A property management platform with procurement features for vendor management, expense tracking, and purchasing. It's popular for managing real estate assets and portfolios.
- MRI Software: Provides procurement solutions with budgeting, project tracking, and contract management for real estate firms managing multiple properties.
- Procurify: A spend management tool that includes procurement tracking, expense management, and approvals workflows, ideal for real estate firms focused on cost control.
- Buildium: Primarily a property management tool but includes procurement features for vendor tracking, contract management, and expense control.
- AvidXchange: Offers accounts payable automation and procurement solutions, helping real estate firms manage invoices, vendor payments, and purchase orders.

## V. AUTOMATION IN PROCUREMENT

The use of bots to automate the procurement process can be hard to visualize, especially since much of the activity takes place "behind the scenes" [7].

Some of the manual repetitive tasks are;

- reviewing and verifying data that has been entered into the system (like a purchase requisition)
- Copying information from one system to another
- Rekeying information
- Contacting other employees or suppliers for additional information
- Filling out spreadsheets drawing from multiple inputs

### A. These Activities Can Take a Large Percentage of a Worker's Day

- Basic bots are designed to take on these lower-level, rules-based, and repetitive tasks common within procurement organisations, allowing workers to focus on more strategic initiatives.
- More advanced bots can execute complex cognitive tasks by interpreting vast amounts of data from multiple structured and unstructured sources, including text, voice, images, and video. They evaluate using specific algorithms and ontologies to stimulate reasoning, making decisions based on a mix of evidence and reasoning, in a way that mimics human behaviour.
- These bots can take care of strategic activities like category management and supplier management.

### B. Examples Include

- Reviewing and Verifying Data (e.g., Purchase Requisitions); Example: An employee checks whether the items listed in a purchase requisition match the project's needs, verifies quantities and costs, and ensures the correct supplier has been selected.
- Copying Information from One System to Another; Example: After creating a purchase requisition in a project management tool, the exact details (e.g., material type, quantity, supplier name) are manually entered into a financial system for budgeting or payment processing.
- Rekeying Information; Example: When receiving supplier invoices, employees manually enter invoice details into the internal ERP system for tracking and payment approval.
- Contacting Employees or Suppliers for Additional Information; Example: A procurement officer contacts a supplier to confirm delivery timelines or clarify missing information in a quotation. Similarly, internal employees may be contacted to cross-check purchase orders against project requirements.
- Filling Out Spreadsheets Using Multiple Inputs; Example: Creating a material inventory spreadsheet by compiling data from warehouse records, supplier delivery notes, and on-site usage logs.

## VI. ANALYSIS

From the literature reviews and interactions with industry experts, it has been identified that;

The Drivers of the transition from traditional to digital procurement are:

- Complexity of Construction Projects: The increased scale



of projects has led to the adoption of integrated digital platforms for real-time collaboration.

- **Demand for Efficiency and Transparency:** Traditional methods are prone to errors, delays, and inefficiencies, pushing the need for automation.
- **Data Inaccuracy:** Manual processes frequently resulted in mismatches between orders and actual requirements.
- **Lack of Integration:** Disconnected systems made tracking and forecasting difficult.
- **Time Consumption:** Manual workflows slowed decision-making and order processing.
- **Technological Advancements:** The advent of ERP, AI, and cloud-based solutions has made digital tools more accessible and efficient with real-time analysis, improving forecasting and inventory management.
- **Compliance and Auditing Needs:** Strict legal and safety requirements demand accurate documentation and compliance, driving the shift.
- **Market Dynamics:** Globalization: Broader supply chains require systems capable of managing complexity and tracking global suppliers. The challenges that hinder the transition are;
  - Initial Investment
  - Maintenance Cost
  - Return on Investment
  - Skill Gaps
  - Training Requirements
  - Dependency on IT Support
  - Resistance to Change
  - Fear of Job Redundancy
  - Slow Adoption
  - Data Migration
  - Compatibility
  - Hardware Limitations
  - Cybersecurity Risks
  - Uneven Digital Maturity
  - Onboarding Cost

Despite the Challenges, the factors that facilitated the change:

**Phased Implementation:** Gradually rolling out digital tools to allow time for adaptation.

**Comprehensive Training:** Investing in user-friendly tools and robust training programs.

**Pilot Projects:** Testing digital systems on a smaller scale before full implementation.

**Stakeholder Engagement**

**Supplier Engagement:** Collaborating with suppliers to ensure mutual readiness and alignment.

**Shared Platforms:** Collaboration platforms are introduced to enhance supplier communication and transparency.

**Training for Suppliers:** Suppliers are also trained on how to use the organisation’s digital procurement tools.

**Market Research:** available digital tools and solutions.

**Customisation:** tailored to align with company-specific requirements

**Training Programs:** Comprehensive training is provided to employees to help them understand and effectively operate the new digital tools.

**Hybrid Approach:** Some organizations maintain traditional methods alongside digital tools during the transition to ease the change.

**Feedback Mechanisms:** Regular feedback is collected from users to identify issues and make improvements.

**Performance Metrics:** To measure the system's impact, key performance indicators (KPIs) such as cost savings, procurement cycle time, and supplier performance are tracked.

**Updates and Enhancements:** Continuous system updates and training ensure the tools remain relevant and effective.

Grouping the transitional factors that were applied before, during and after the transition:

*Before Transition:*

- Market Research
- Stakeholder Engagement
- Supplier Engagement

*During Transition:*

- Pilot Projects
- Phased Implementation
- Hybrid Approach
- Comprehensive Training
- Shared Platforms

*After Transition:*

- Feedback Mechanisms
- Performance Metrics
- Updates and Enhancements

**Table-II: Summing up the Procurement Methods and Tools Used by Different Companies**

Company Type	Procurement Tools	Procurement Methods	Focus
Contracting Companies	Procore, Oracle Aconex, SAP Ariba, PlanHub, COINS, ERP	Centralized procurement, Direct Purchase, Bulk Purchase, JIT, VMI, Framework Agreement	Cost tracking, supply chain management, Timely delivery, quality, and cost control
Consulting Companies	E builder, Bentley project wise, Deltek Ajeria, Accurent, InEight	Framework Agreement, Indirect Procurement, Centralized Procurement, Consignment	Bid management, Timelines, documentation control, stakeholder collaboration
Architectural Firms	Procuria, Newforma, Autodesk Construction Cloud, Archdesk, Core(BQE), Monograph.	Direct Purchase, Consignment, JIT, VMI	Budgeting, project management, vendor coordination, and resource tracking
Real Estate Companies	Yardi, MRI software, Procurify, Buildium, AvidXchange	Bulk Purchase, Centralized Procurement, Framework Agreement, Indirect Procurement	Property-specific procurement, vendor management, and budgeting.

Table-II: Efficiency Achieved: (Input from Industry Experts)

Company Type	Contracting Companies	Consulting Companies	Architectural Firms	Real Estate Companies
Procurement Methods	Direct Purchase Bulk Purchase Vendor Managed Inventory (VMI) Framework Agreement	Indirect Procurement Centralized Procurement Framework Agreement	Direct Purchase JIT Procurement Consignment Procurement	Bulk Purchase Centralized Procurement Indirect Procurement
Material Inventory Types	FSN (Fast-moving materials like cement and steel) ABC (Critical materials like structural steel: A category) JIT (Concrete, reinforcement bars)	VED (Vital materials for immediate project needs) MCIC (Multi-criteria classification for balancing cost, time, and vendor reliability)	ABC (High-priority design materials like facade glass: A category) SDE (Difficult-to-source items like specialty finishes)	HML (High-cost materials like elevators: H category) ABC (Frequently required items like doors/windows: B category) PPB (Balancing procurement over multiple projects)
Tools Used	Procore Oracle Aconex SAP Ariba COINS	E-Builder Bentley ProjectWise InEight	Autodesk Construction Cloud Newforma Archdesk	Yardi MRI Software AvidXchange
Time Savings	20–30%: Reduced delays with streamlined delivery tracking and automated procurement.	25–35%: Streamlined documentation and timeline tracking.	20–30%: Real-time project management tools improve delivery scheduling.	25–40%: Long-term vendor agreements ensure timely availability.
Cost Savings	15–25%: Economies of scale and reduction in material wastage with JIT and bulk procurement.	10–20%: Vendor alignment through framework agreements.	15–20%: Cost-effective sourcing and vendor coordination.	15–25%: Discounted rates for bulk and centralized purchases.

## VII. CONCLUSION

The analysis of procurement methods across diverse company types underscores the importance of tailoring approaches to meet organisational needs. The findings underscore the coexistence of traditional and digital procurement systems, each with distinct advantages and challenges. While serving as the bedrock of procurement practices, traditional methods exhibit inefficiencies such as delays, inaccuracies, and constraints in scalability, which often limit their effectiveness in today's fast-paced construction industry.

The shift toward digital procurement is not merely the adoption of new tools, but represents a strategic transformation. This evolution responds to heightened market competition, the intricate demands of modern supply chains, and the pressing need for precision and cost optimization. Digital tools have revolutionised procurement processes by automating routine tasks, optimising resource allocation, and facilitating more informed decision-making based on real-time data. These advancements have improved efficiency, led to cost savings, and enhanced accuracy.

Moreover, the study emphasizes that this transition requires more than technology implementation; it demands adaptability, a willingness to innovate, and a cultural shift within organizations. The rapid changes in the business environment necessitate a proactive approach, as companies must align their strategies with emerging trends such as Industry 4.0 and sustainability goals. Ultimately, the move toward digital procurement exemplifies the construction sector's commitment to staying relevant and competitive in an evolving economic landscape. This reinforces the need for ongoing evaluation and innovation to maximize the benefits of procurement advancements and ensure alignment with organizational and industry objectives.

## DECLARATION STATEMENT

After aggregating input from all authors, I must verify the accuracy of the following information as the article's author.

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- **Author's Contributions:** The authorship of this article is contributed equally to all participating individuals.

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