

# Digital Inventory Tracking Systems in Construction

Afiq Syazwan Bin Mohd Adzrul, Emily Liong Jia Wen, Lee Xin Jie, Muhammad Hazim Shah Bin Mohd Nadzmi, Muhammad Luqman Nurhakim Bin Shamsudin, Nurshikin Mohamad Shukery, Norhazren Izatie Mohd

Faculty of Built Environment and Surveying, Universiti Teknologi Malaysia, 81300 Johor Bahru, Johor, Malaysia

DOI: <https://dx.doi.org/10.47772/IJRISS.2026.1014MG0044>

Received: 16 February 2026; Accepted: 21 February 2026; Published: 07 March 2026

## ABSTRACT

Manual inventory management practices in the Malaysian construction industry contribute substantially to project inefficiencies, resulting in approximately 17.3% of project delays due to material shortages and stock record errors, with errors reaching up to 35%. These challenges limit real-time visibility and hinder effective decision-making, particularly as the Construction Industry Development Board (CIDB) advances the Construction 4.0 digitalisation agenda. This study aims to develop an integrated System Development Life Cycle (SDLC) framework specifically designed to support the implementation of Digital Inventory Tracking Systems (DITS), such as SmartStock Builder, addressing the absence of construction-specific system development frameworks. The proposed SDLC framework encompasses problem identification, user requirements analysis, system design, development, testing, implementation, and post-deployment maintenance. Comparative process analysis provides theoretical support for potential reductions of up to 30% in inventory errors and 30% in operational costs through the adoption of digital technologies, including barcodes, QR codes, RFID, and cloud-based platforms for real-time monitoring. The implementation of DITS enhances inventory accuracy, improves communication through centralised data access, enables real-time material tracking, and reduces operational inefficiencies. Overall, the framework supports the transition from manual inventory practices to automated, data-driven systems that enable more informed, proactive resource management in construction projects.

**Keywords:** Digital Inventory Tracking, Real-Time Monitoring, SDLC Framework, Construction Materials, RFID/Barcode Systems, Inventory Accuracy, Construction Digital, Built Environment

## INTRODUCTION

In Malaysia, the construction sector suffers from perpetual inventory mismanagement due to its dependence on manual systems. Nearly 17.36% of construction projects are delayed by more than three months because of material shortages, while as much as 35% of construction material inventory is miscounted because of human error. Many of the previous studies about RFID and barcode technology have focused on them in isolation without addressing the core issue of a lack of established comprehensive Software Development Life Cycle (SDLC) frameworks for Digital Inventory Tracking Systems (DITS) throughout the multi-site operations of the Malaysian Construction Industry Development Board (CIDB) under the Construction 4.0 Initiative (e.g., Kasim et al., 2019; Khan et al., 2024). To move beyond purely conceptual contributions, this study recognises that the anticipated performance improvements of DITS must ultimately be validated through empirical pilot implementations or case studies within Malaysian construction firms.

Moreover, according to recent research, the architecture, engineering, and construction (AEC) industry has been among the slowest to digitise and innovate, with annual productivity increases of only 1% over the past two decades (Whatfix, 2024). In most construction companies, inventory management continues to rely heavily on manual processes involving physical forms, logbooks, stock cards, and spreadsheets, with site staff manually recording material usage, storekeepers updating records by hand, and project managers reviewing reports that are often days or weeks out of date. This fragmented system generates numerous failure points, information silos, data inconsistencies, and distinct records for different entities involved (site staff,

storekeepers, procurement teams, project managers, suppliers, and administrative personnel) to track material requests through to receipt for multi-stakeholder digital documentation logistics (Elrayah & Mirzaliev, 2024). To address these shortcomings, the proposed SDLC-based DITS framework is explicitly tailored to construction workflows, including procurement approval and reordering cycles, subcontractor material requests, and multi-site logistics coordination across different projects and storage locations.

The issues mentioned here will be resolved by examining how Smart stock builder provides a DITS Framework based on SDLC. It will allow us to identify the areas where manual inventory management suffers most by analyzing a case study of the construction industry in Malaysia. After finding out this gap, we will create a DITS Framework based on the SDLC designing a way to integrate Barcode/QR/RFID into Cloud Technology specifically for Construction where we intend to develop a DITS solution that will allow the stakeholders in the construction sector to have a product that can assist them with identifying the proper materials to use at the correct time, reducing the amount of time and money spent on materials by up to 30%, while also providing the user with real-time visibility of the materials used during the lifecycle. These projected reductions in inventory errors and operational costs are derived from comparative process analysis and will require subsequent empirical testing on real projects to confirm their magnitude in practice. In line with this, the study also positions SmartStock Builder alongside alternative platforms. It later evaluates candidate systems not only on functional suitability but also on cost–benefit, implementation time, and scalability to guide practitioners in system selection.

Digital Transformation has been identified as the best way for the Construction Industry, both Researchers and Practitioners, to leverage emerging technologies to enhance their Performance and Inventory Management. New technologies such as Barcodes/QR codes/RFID and Cloud Integration provide a foundation for revolutionizing the way materials are managed in the construction sector (Lotfi & Karakouzian, 2025). In Malaysia, the use of technology has been identified as an important part of the construction industry's competitive strategy. The Construction Industry Development Board (CIDB) have developed the Construction 4.0 Strategic Plan (2021-2025) and the National Construction Policy 2030 to ensure that the construction sector provides its clients with high levels of productivity, while at the same time utilizing the latest technologies and best practices for managing their inventory and Production Efficiency (Fauzi et al., 2018). The gap between these identified industry needs and the lack of digital technology adoption represents a significant opportunity to improve how materials are tracked and managed. While the study is anchored in the Malaysian construction context and CIDB's Construction 4.0 agenda, it also draws on regional and international experiences with digital inventory systems to benchmark best practices and identify lessons that can be adapted locally. Beyond initial deployment, the long-term sustainability, cybersecurity, data governance, and interoperability of DITS with other Construction 4.0 technologies are recognized as critical themes warranting further investigation in future research.

Therefore, the purpose of this paper is to identify areas of concern for the manual inventory methods used in construction projects in Malaysia. Additionally, it will produce an SDLC (Software Development Life Cycle)-based methodology for the creation of Digital Inventory Tracking Systems, covering the SDLC principles from initial problem identification through the system's operation and maintenance phases. Furthermore, this methodology will highlight the ability of merging digital technologies to provide real-time visibility into materials on site, improve operational accuracy, increase the time and effort devoted to planning and managing resources, reduce project delays and costs, and enhance organizational competitiveness within Malaysia's construction industry. As part of this objective, the framework explicitly incorporates construction-specific processes and stakeholder roles so that technical design, implementation, and change management activities are aligned with actual site, procurement, and project control practices.

## Problems Statement

In Malaysia's construction industry, manually controlled inventory systems (using paper records and spreadsheets) produce inaccurate records (35% inaccuracy rate) due to the possibility of human error during data entry, such as misreading or failure to record (Raman et al., 2001; Khan et al., 2024). Workers at the sites write down delivery orders. At the same time, storekeepers must ensure that what is recorded matches what should be on site through physical inventories, which can result in delays in reporting material shortages (by

many days). This "first-order" error creates a "chronic shortage" of materials, causing construction crews to be idle for extended periods without access to steel and cement, which is documented to push 17.3% of construction project completions out by three months (Ali et al 2009). So, the operational impact of using inaccurate manual inventory systems can create inefficiencies in the project's schedule and affect the efficient utilization of financial resources. Material shortages are among the leading causes of construction project delays, with commercial construction projects in Malaysia identifying them as a key factor (Ali et al., 2009).

In addition, the loss of live data has consequences on many levels. For example, no contractors know accurate stock levels, where equipment is located, or when equipment will arrive, as they can only make decisions based on a general view of inventory levels from the previous week. This loss of live data also contributes to increased duplicative purchase orders (purchasing supplies that will rust on the ground) and additional costs of shamelessly renting expensive machines scattered across multiple job sites (Khan et al., 2024). As a result of the above, schedules are slowed when contractors must purchase supplies at inflated prices due to emergencies, causing what were once only small disruptions to the flow of work; the result is an increase in time lost as emergency procurements are delayed. As an extension of this, different contractor teams have been working on the same job using separate accounting books, resulting in increased misunderstandings and the creation of false orders. These false orders will undermine contractors' decision-making, leading to projects that remain in a state of constant crisis, contrary to CIDB's vision for the Construction 4.0 program. These operational issues are compounded when inventory and equipment data must be reconciled across multiple sites, subcontractors, and suppliers, making manual coordination increasingly unmanageable as project portfolios scale.

Recent supply chain disruptions globally and increased government regulation of technology in Malaysia's construction sector have heightened the need to address weaknesses in inventory management. Post-pandemic disruptions increased inventory management issues. Shortages in materials and delays in deliveries have become systemic rather than isolated occurrences (Determinants of Increasing Costs for Construction Materials, 2024; Lam et al., 2022). Many construction firms' continued use of manual systems is driven by inertia, reluctance to adapt to change, and unawareness of technology solutions, despite regulatory pressure to adopt technology and clear ROI for doing so (Nawi et al., 2019; Fauzi et al., 2018). In practice, this reluctance often reflects limited staff training, resistance to adopting new digital tools, and concerns about integrating DITS with existing enterprise resource planning (ERP), accounting, and project management systems. Without explicit support for these change-management aspects, even technically sound inventory solutions may fail to be adopted or sustained in contractor organizations. The gap between problems identified and the practices being implemented is a major strategic opportunity for organizations still using manual inventory management systems, as they risk a competitive disadvantage against those using technology to deliver better project results and unnecessarily incur costs from wasted materials, project delays, and poor resource use. Consequently, there is a clear need for a structured SDLC-based framework that not only specifies system functions but also guides integration, user adoption, and staged implementation of DITS in Malaysia's construction industry.

## Review Of The Current Approach

Currently, in most construction organizations, inventory and equipment tracking is still managed using manual or semi-digital systems, such as logbooks, spreadsheets, delivery order forms, and basic office software. These methods have been widely used for a long time due to their affordability, functionality, and familiarity, particularly in construction settings (Kasim, N., Sarpin, N., & Noh, H. M., 2019). While such systems offer basic functionality and have been widely adopted, they are no longer sufficient for managing modern construction operations characterized by multi-site projects, complex logistics, high material turnover, and increased pressure on time and cost efficiency. For instance, research by Kasim et al. (2019) and Lee (2021) emphasizes that many construction companies still rely on hardcopy reports, which contribute to inefficiency, human error, and delayed updates in material tracking.

On the other hand, digital solutions for inventory tracking, such as barcodes, QR codes, RFID, and cloud-based platforms, enable automated data entry and real-time updates across locations and platforms. This will lead to more accurate, proactive actions regarding materials and equipment compared to traditional methods. The disadvantage of the current approach is that it relies on human entry and can delay record updates, leading

to inaccuracies in the data inventory. Material deliveries and usage are often recorded after work has commenced, increasing the risk of discrepancies between recorded and actual data. These discrepancies will then cause latency, leading to reactive decision-making, where issues such as material shortages or critical equipment unavailability are only discovered after they cause disruptions.

By contrast, RFID and barcode-based systems will enable automated data collection of movement, reducing human intervention and enabling scanning of high volumes, thereby significantly improving inventory accuracy and reducing time spent on auditing stock and material searches. Tracking of construction machinery is also often informal. Equipment movements are recorded manually via logs, phone calls, or messaging, making real-time asset utilization nearly impossible. This will lead to underutilized machinery, long idle time, and even the loss or misplacement of assets. Research by Zulkifli, Malek & Nurshahida (2016) on RFID in industrial environments highlights that the absence of automated tracking results in weak control over materials and delays in detecting location changes across workflow processes.

Although several past studies have highlighted the weaknesses of manual or conventional material tracking while promoting digital solutions, important gaps remain in the literature. Many past papers focused on identifying problems or on the technical practicality of digital solutions. However, they provide limited empirical evidence on their implementation, including the integration of workflows, user roles, cost implications, and the change management challenges faced in construction settings. In short, there are still shortcomings in studies evaluating digital inventory solutions. Finally, the combination of delayed reporting, insufficient data and human error leads to management and financial inefficiencies. Studies on cloud collaboration and RFID-enabled systems highlight that digital transformation is a route to improving accuracy, enabling proactive procurement, and reducing material waste in construction workflows (Abedi et al., 2014; Lee, 2021).

## **Technological Solution And Available Tools**

### **Technology Used**

The digital inventory-tracking system used in this study is SmartStock Builder. This type of system was chosen based on the operational issues common on construction sites in Malaysia (delays in inventory updates, incorrect stock records, broken communication channels, and a lack of real-time physical visibility). In contrast to previous studies that assessed the product based on commercial factors, this study focuses on the technological characteristics that address construction industry-specific needs.

By nature, construction projects experience a high rate of material turnover. Materials are moved frequently from storage locations to work areas, and the process involves multiple people at different levels. Inventory methods cannot effectively handle these types of projects, since both rely on delayed reporting and manual data entry by humans. The selected system addresses these issues by using automatic data capture during transport, eliminating the need to manually enter data into a record book and the risk of data inaccuracy due to human behaviour.

SmartStock Builder is an online inventory management platform that connects to mobile devices. The mobile-enabled nature of SmartStock Builder is important for construction sites, enabling people to have flexible access to the information they need across multiple sites, rather than just from traditional stationary machines. With mobile-enabled access, users can receive, issue, and transfer materials in real time at the construction site. This ensures that the company's inventory records accurately reflect actual inventory conditions rather than relying on handwritten notes and delayed reporting.

From a database management perspective, SmartStock Builder relies on a cloud-based relational database to store structured data on material quantities, transaction history, and material locations. This type of centralized database architecture provides a single point of reference, enabling the teams supporting multiple construction projects to maintain an accurate inventory. Additionally, as information is added to and changed within the SmartStock Builder application, the system's cloud-based nature will enable any team managing a project to

immediately access up-to-date information in real time, which is critical to the planning and allocation of materials.

The selection of barcode and QR code technologies for construction site identification, based on their usefulness and practicality, is documented in the literature. With barcode and QR code technologies, materials can be identified and recorded using a tag and a scan with minimal interruption to the workflow. Scanning items eliminates errors that can occur when inventory information is manually entered into a database and reduces delays in updating inventory for materials. When materials are scanned, the time and date of the scan are recorded as a transaction, enhancing the traceability and accountability of materials throughout their lifespans.

The selected technological solution meets the objectives of this study by directly addressing all identified weaknesses in current inventory management methods. The way the selected solution is configured facilitates real-time data capture, enhances data capture consistency, and improves collaboration among all project stakeholders, which is very important for effective management of materials in construction projects.

### Comparative Analysis

In this portion of the overall comparison, SmartStock Builder is compared to Sortly and the Tactive Inventory Module. This comparison includes both the strengths and weaknesses of the three systems; however, we will focus only on their usability, suitability for Construction, ability to integrate, and real-time tracking capabilities.

Table 1: Comparative Analysis of the Three Systems

System	SmartStock Builder	Sortly	Tactive Inventory Module
<b>Construction Suitability</b>	Moderately suitable for construction sites. Supports barcode tracking and multi-location material monitoring, but not fully construction-specific.	Limited suitability. Designed for general inventory use and lacks construction workflow integration.	Highly suitable. Specifically designed for construction projects with integration to procurement and project costing.
<b>Core Strength</b>	Real-time material visibility, barcode automation, accurate stock tracking, and multi-location support.	Simple interface, strong mobile application, supports photos and QR codes.	Integrated system covering material requisition notes, stock issue, procurement, and project costing.
<b>System Complexity</b>	Moderate complexity. Requires configuration but does not demand full enterprise integration.	Low complexity. Minimal setup and easy user adoption.	High complexity. Requires full enterprise configuration and structured workflow setup.
<b>Implementation Time</b>	Short to moderate. Can be deployed within weeks, depending on site size.	Very short. Can be implemented within days.	Long. May require several months, including training and system customization.
<b>Initial Cost Setup</b>	Moderate. Lower than enterprise systems but higher than basic inventory apps.	Low. Subscription-based and affordable for small businesses.	High. Requires enterprise subscription and implementation investment.
<b>Operational Cost</b>	Moderate and manageable for small and medium contractors.	Low ongoing subscription cost.	High ongoing subscription and maintenance costs.
<b>Cost Benefits Consideration</b>	Balanced cost benefit. Improves tracking accuracy and reduces manual errors without high enterprise cost.	Good cost-benefit for small projects, but limited value for complex projects.	Strong long-term benefits for large companies, but the high upfront investment reduces short-term cost efficiency.
<b>Scability</b>	Can support multiple sites but may require additional integration for financial reporting.	Limited scalability. Not ideal for large projects with heavy material movement.	Highly scalable. Suitable for large organizations managing multiple concurrent projects.

<b>Workflow Integration</b>	Partial integration. May require linkage with ERP for bill of quantities and reporting.	Minimal workflow integration. Standalone inventory focus.	Full workflow integration within the enterprise system.
<b>Suitability by Company Size</b>	Suitable for small to medium contractors seeking structured digital tracking.	Suitable for small contractors or simple inventory environments.	Suitable for medium to large contractors with structured management systems.

A comparison of the proposed system with commonly used inventory systems such as Sortly and the Tactive Inventory Module has been performed to quantify construction suitability, system complexity, integration with operational workflow, and operational practicality, rather than just the number of features. SmartStock Builder has delivered strong results in scenarios where both Real-Time Visibility to Materials and Multi-Location Tracking are required. SmartStock Builder was created specifically to identify Bar Code-Based Automation and Real-Time Updates and therefore has been developed to be a Fast Replacement for manual methods of Storekeeping found on Construction Sites; however, it was not developed specifically for Construction and therefore has a reasonably adaptable Structure that allows user to use it within a Workflow unique to each site, without the requirement to install a complete enterprise system.

In contrast, the Tactive Inventory Module has limited support for Medium Business Users due to a lack of mobile accessibility features and limited support for construction workflows, making it less effective for larger projects with multiple locations, heavy material movement, and frequent inventory changes. Hence, this module will not address the coordination or reporting needs specific to the construction process.

On the other hand, the SmartStock Builder was designed specifically for the construction industry; thus, it is an effective integrated application for both the computer program and the user. Thus, while it does require complete integration to achieve maximum effectiveness, it is not as complex as the Tactive Inventory module, hence making it easier and more cost-effective to implement and operate within the organization. Therefore, SmartStock Builder was selected for this study, as it offers a balance between required functionality and ease of implementation. It provides sufficient automation and real-time inventory tracking to help address the problems identified at each site without the high costs and complexities of fully integrated enterprise systems.

### Conceptual Diagram

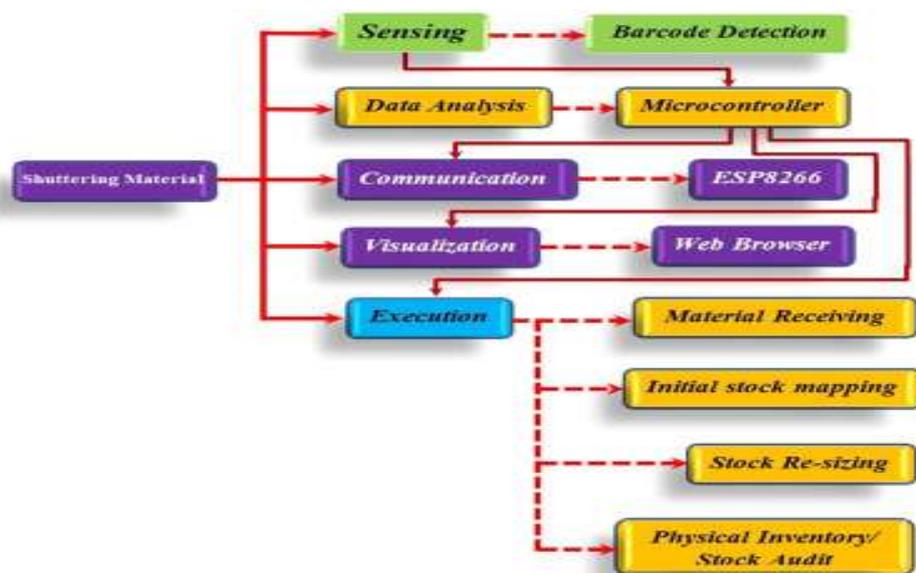


Diagram 2: Flow of information in the digital inventory tracking system

The conceptual system diagram shows how information travels through the digital inventory and tracking process from when materials enter the facility to when management makes decisions about that material. The first step is for the site personnel to verify the arrival of the materials and their condition; from there, each item

is assigned an identifier (barcode, RFID, or QR code) that uniquely identifies it within the system. When materials are scanned using a mobile device (such as a barcode scanner), the transaction is immediately recorded and updated in the central database in real time, eliminating lag time from paper documentation and improving the accuracy of stock counting and tracking at the moment of scan. Any subsequent movements of that material will remain accurately tracked, including the item(s) being issued to work zones or transferred between different locations (satellite stock).

Inventory requests made by site personnel to the inventory tracking program are sent to be processed; the inventory program checks real-time availability against the tracking database for those items and lets inventory managers and storekeepers review electronically all inventory requests before approval, which reduces any additional paper documentation and provides for greater transparency about stock usage and transaction history and trends; furthermore, the management dashboards will provide only a summation of material usage and stock current levels, trends, transaction history; this allows for both timely and informed decisions to be made by management. Additionally, it shows that each stakeholder has access to a shared database, enabling them to collaborate to avoid duplicate records and miscommunication. The diagram shows each system's functional evolution across the project's information lifecycle, clearly visualizing how each piece of data is generated and processed.

Finally, the new flow structure will convert inventory management from entirely reactive, paper-based, and disjointed to a collaborative system in which all materials are organized and managed electronically, thereby providing an efficient means to manage the workflow and all operations associated with a construction project.

### **Proposed System Development**

The proposed implementation of SmartStock Builder meets the goals of the CIDB Construction 4.0 Strategic Plan. It does this by digitizing on-site material management and supporting data-driven project control. The system not only addresses issues with current manual inventory practices, such as inaccurate records and delayed reporting, but also accounts for change management. Training modules, user-friendly mobile interfaces, and phased onboarding can help site practitioners gradually adjust to the new platform. This approach reduces resistance to adopting new technology. Integration features, like API connectivity with existing enterprise resource planning or procurement systems, ensure that SmartStock Builder complements current workflows rather than disrupts them. By automatically capturing data upon receipt of materials and replacing paper-based records, the system improves data integrity. It also supports wider goals of digital integration and real-time information flow.

Operationally, SmartStock Builder can enhance decision-making by offering better real-time visibility into project resources, including material availability. To ensure successful adoption, implementation plans should include structured training sessions, technical support, and feedback channels. These elements address user concerns and encourage ongoing improvement. Such measures can help build confidence in the system, increase accountability through trackable audit records, and improve coordination between project teams. These operational enhancements optimize resource use and project performance while supporting digital transformation efforts in the Malaysian construction sector, provided organizations focus on readiness and develop staff capabilities.

SmartStock Builder uses barcode, QR code, and RFID scanning to increase data entry efficiency and reduce human errors. However, the success of these technologies depends on proper staff training, clear operational guidelines, and compatibility with existing site procedures. Real-time approval processes and reporting via mobile or web apps can enhance accuracy and communication. However, they require adequate user training, robust technical infrastructure, and integration with enterprise systems to ensure smooth adoption. By merging technological innovation with effective change management strategies, SmartStock Builder can boost productivity, improve inventory control practices, and create a practical path toward sustainable digital transformation in construction operations.

## Comparison between the current process and the new process

According to Figure 1, the inventory management system currently in use relies heavily on paperwork, resends it, reconfirms with other employees to determine whether inventory is received, and manually enters data into an application across multiple tiers of an organization. Upon receipt of the material, the employees must enter the delivery into the system and later provide the values to the storekeeper, who will then update the inventory with the values from the handwritten notes prepared by the receiving employees. Inventory reconciliation can occur only on a limited basis, with managers using information from compiled physical reports that document the overall condition of stock and often include data identifying problems such as material shortages, material discrepancies, or excess inventory. Problems are typically only discovered after a manager reviews the report, leading to delayed, reactive decision-making. This is because managers cannot respond to problems on time; they may be late in procuring new materials, may start without materials being delivered to the job site, or, because they are relying on outdated figures, may over-order materials.

According to a written research study by Malik et al. (2022), inefficient material tracking and delayed receipt of accurate inventory data have been among the leading contributors to poor material control and slowdowns on construction projects. Because construction projects require an efficient materials management process, effective tracking and management of materials are essential for maintaining momentum while controlling associated costs.

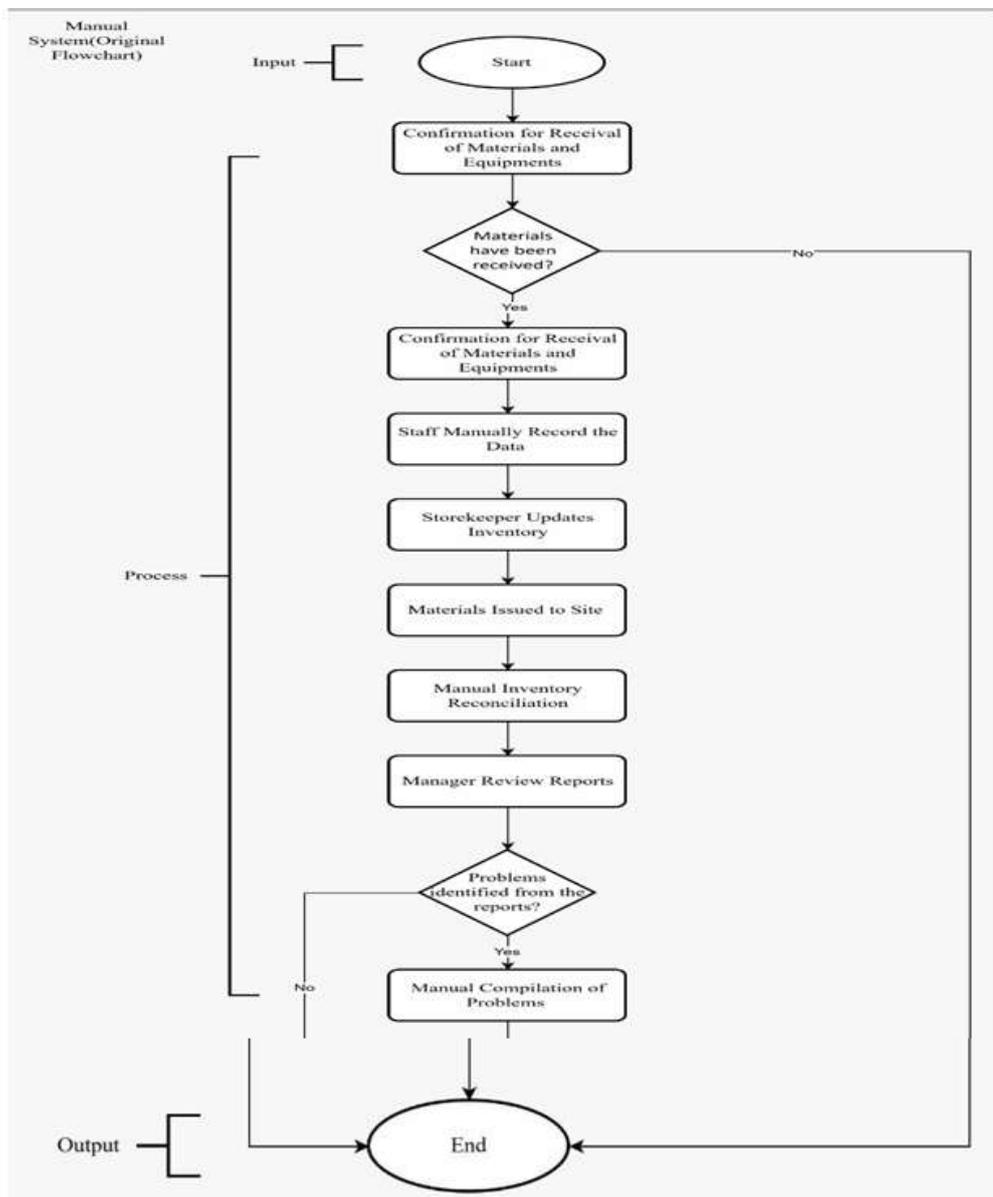


Figure 1: Current Process Flow

With digital inventory management, as illustrated in Figure 2, real-time, data-driven decisions can be made through the automated tracking and approval of materials. When materials are received, they are scanned into the system using barcodes, QR codes or RFID. The inventory record in the system is then updated immediately. When a user places a request for materials, the system automatically compares the requested quantity against the quantity currently in stock. It provides an alert if the requested quantity exceeds the available quantity. Digital approval of material requests will be based on accurate, up-to-date information. In comparison, the manager has access to real-time dashboards and reports showing inventory levels, material movements, and potential issues. All of these factors enable the manager to make quicker, better-informed decisions about scheduling timely reorders, moving materials between locations, and avoiding future stock shortages that impact site operations.

Therefore, digital inventory management replaces decisions made after the fact, through the use of reports and other documentation, with real-time monitoring and proactive control, thereby increasing the efficiency and reliability of inventory management. Digital inventory management also speeds up the handling of goods, reduces the likelihood of stockouts, enhances customer service, and lowers operational costs (Istiqomah and Others, 2020). By using barcode systems, warehouses can track items more effectively, enabling a more streamlined process for racking and picking.

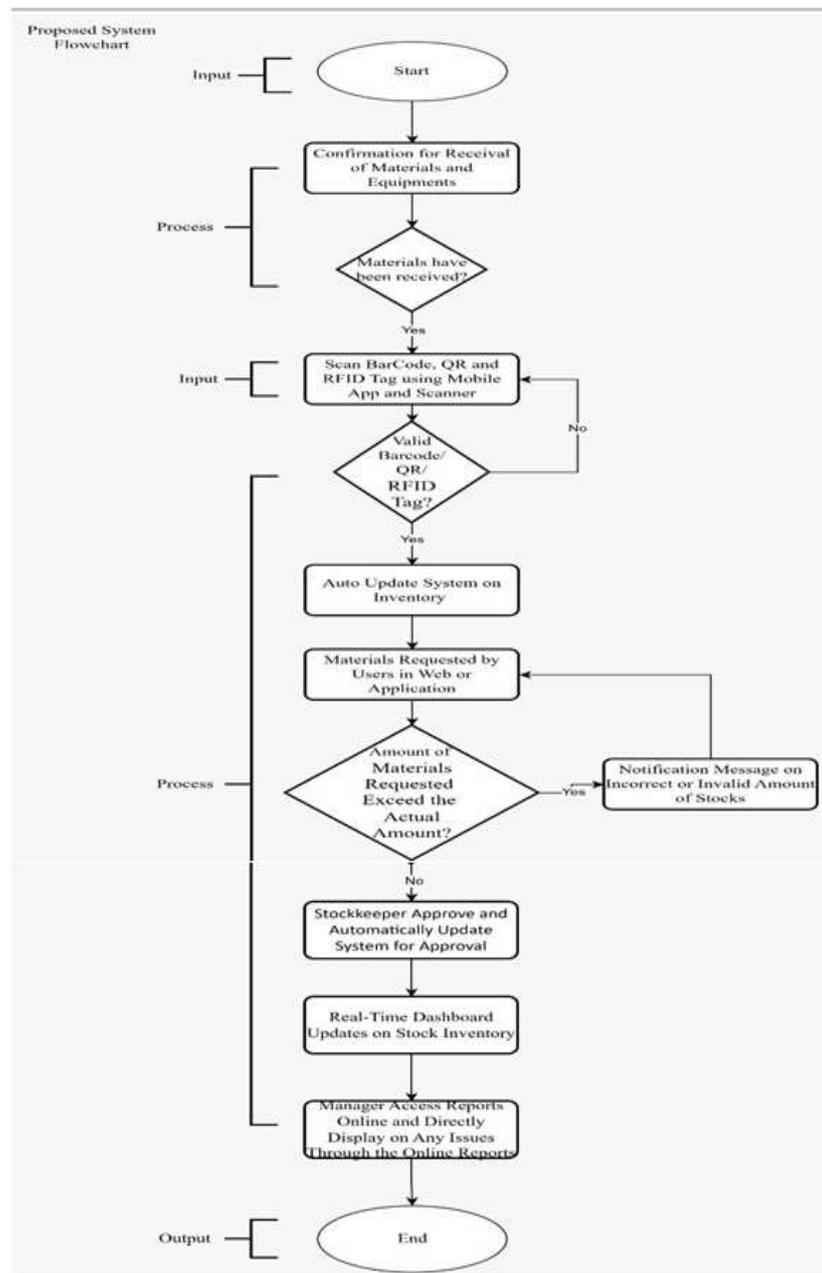


Figure 2: Proposed Process Flow

## **Benefits of the proposed system**

Implementing the proposed system offers several important benefits for construction operations. First, SmartStock Builder uses technologies such as barcodes, QR codes, and RFID tags on the materials to speed up tracking. These automated identification techniques reduce the need for manual data entry by enabling automatic recording of material movement. As a result, data is more consistent and reliable because human error is reduced.

Second, the proposed system supports coordination and real-time information sharing. By using a centralized cloud-based platform, site staff, storekeepers, and management teams can communicate more effectively, avoiding the need to use multiple platforms and ensuring important information reaches the right person. Real-time functionality allows them to make decisions more easily, as all stock levels, equipment availability, and material usage are updated in real time.

Third, the system helps improve cost control by enhancing visibility into material usage and inventory levels. This is because the system automatically records the entry and exit of materials or inventory. With accurate, up-to-date records, the purchasing team can predict how much stock will be needed for future purchases and avoid duplicate purchases or renting unnecessary equipment. Such organized documentation facilitates better resource planning and helps project managers maintain tighter control over construction costs.

## **Limitations of the Proposed System**

Despite its benefits, the proposed system has several limitations. First, this system has not been implemented or launched in any construction industry. The proposed system is based on a conceptual design and simulated workflows rather than an actual on-site implementation. The purpose of this system is to eliminate problems that usually occur at the site, such as user behaviour and site limitations.

Second, long-term testing or monitoring of the system was not carried out. The system's performance over extended project durations has not been thoroughly evaluated. Variables such as the system's longevity, maintenance requirements, user adaptation, and data accuracy over time remain unknown. This matters because construction projects are typically long-term and are prone to changing site conditions.

Third, cost and system complexity can be major challenges when adopting the system. Due to the investment in RFID, a cloud-based software solution, and staff training, the initial setup cost can be quite substantial. Therefore, this system is not a very viable option for small and medium-sized construction companies. When projects grow in size or expand across multiple countries, the system may also require a more complex configuration and integration with existing project management systems. If there is inadequate training and support in the technical aspects, this extra complexity can make the process of getting acquainted with the new system very slow, and the level of operational errors can be high.

Fourth, the effectiveness of change management is also one of the challenges in adopting the system. The implementation phase of the system should be accompanied by comprehensive employee training so that they become comfortable and gain confidence in using the new system. However, employees may be reluctant to use digital tools for reasons such as a lack of knowledge, fear that such tools might make their jobs redundant, or simply because they are used to the traditional manual way of working.

## **CONCLUSION**

This study examines the challenges associated with manual inventory and equipment tracking practices currently used in the construction industry. It evaluates how adopting a digital inventory tracking system can enhance material accuracy, improve operational efficiency, and reduce the likelihood of project delays. Researchers found that standard data recording methods, including paper records and inventory spreadsheets, often lead to errors that prevent accurate inventory tracking and real-time visibility. These errors can create problems, including slow, wasteful decision-making about what to purchase, excessive waste from unused materials, misallocation of equipment, and higher operating costs.

In addition, this study has developed and provided a systematic method for implementing a Digital Tracking System in a Manufacturing Environment, rather than merely listing digital solutions. The research conducted before this project demonstrated that through Manual Inventories, digital systems are now viewed as an effective strategic tool to assist construction companies in making decisions about project performance based on real-time data, thus improving the management of currently available resources.

The study had two main objectives: one was to identify the weaknesses of existing inventory-tracking methods. This was accomplished through a critical evaluation of prior research that demonstrated the negative impact of poor tracking on accuracy, reaction times and project delays. The second objective was to investigate the most effective technologies for digitally tracking an item; as such, several options were evaluated against one another, including barcodes, QR codes, RFID, and cloud-based technology.

Although the digital application offers numerous advantages, this study also recognizes its limitations. This research was primarily theoretical, used secondary sources to evaluate the proposed options, and did not involve evaluating an actual project's success through empirical testing. Furthermore, some of the technologies offered may require a significant upfront investment to acquire the technology, train personnel to use it, and maintain a sufficiently robust system, which may prove difficult for many small- to mid-sized construction companies.

Further research can evaluate the capabilities of digital inventories through pilot testing in live projects, as well as their performance across projects of varying sizes or types. In addition to these areas of pilot testing, further research should examine integrating digital inventory into existing technological systems, improving users' willingness to adopt digital inventory, conducting cost-benefit analyses, and determining which systems work best with current construction management software programs. Finally, future research should explore the long-term sustainability and scalability of digital inventory systems, including cybersecurity risks, data governance, and interoperability with other construction technologies under the Construction 4.0 agenda. In addition to these areas of pilot testing, it is important to remember that implementing digital inventory-tracking solutions is a major step towards improving the reliability of inventory management in the construction industry, increasing overall efficiency, and facilitating the ongoing digital transformation of the construction sector.

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