A Digital Delivery Order System for Construction Materials: System Design and Development

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ABSTRACT

Inefficient management of construction material deliveries remained a significant operational issue due to continued reliance on manual, paper-based processes, leading to poor traceability, data inaccuracies, and delayed decisionmaking. Although digital technologies for logistics management were widely available, a practical, integrated delivery order system tailored to on-site construction workflows remained underutilized, creating a gap between technological capability and actual practice. To address this gap, this study adopted a system development approach to design and develop a Digital Delivery and Inventory Management System (DDIMS) that supports real-time tracking, automated data capture, and centralized information management. The system was developed based on an analysis of existing delivery workflows involving site supervisors, procurement staff, suppliers, and delivery personnel, and its effectiveness was evaluated through functional testing and process comparison with the current manual system. The results demonstrated improved delivery visibility, reduced human error, and faster material verification. The main contribution of this study was the development of a practical digital delivery order system that enhances efficiency, transparency, and coordination in construction material management.

Keywords: Digital System; Construction Materials; Delivery Management; Inventory Tracking; Workflow Improvement, Built Environment, Construction Digital

INTRODUCTION

Efficient management of construction material delivery is important for project timely execution, cost management, and construction site productivity. Despite technological advances, many construction project sites today resort to manual systems such as hard-copy delivery orders, manual record-keeping, and disconnected communication among suppliers, site managers, and administration regarding construction material delivery. These systems are known to result in lost documents, record inaccuracies, delayed confirmations, and a lack of visibility into the status of construction material deliveries, thereby adversely impacting project planning and decisionmaking. Various studies have shown that manual construction documentation increases the likelihood of human error and reduces the efficiency of construction material delivery on construction sites, due to negative impacts on the construction supply chain (Alaloul et al., 2020; Li et al., 2022).

Although several digital solutions are available to support logistics and inventory processes, their adoption in construction material delivery remains limited. Solutions proposed and available in the market have also been found wanting in terms of their complexity and relevance for daily implementation at construction sites. In this way, there is a need for a specific system to address specific problems and issues in the context of delivery orders.

Thus, the purpose of this research is to conceptualize and assess the efficiency and feasibility of the Digital Delivery and Inventory Management System (DDIMS). The objectives of this research are to analyze the current weaknesses of the existing manual material delivery system and to conceptualize an effective digital material delivery order system with ongoing tracking capabilities. The objectives aim to ensure the efficiency of the conceptualized DDIMS.

Problems Statement

In most projects, material delivery management still relied on manual handling of delivery orders. The material

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receipts were recorded and verified using paper-based records and spreadsheet entries. Such an approach led to slow processing of delivery information, low material traceability, and delays in updating delivery status. Without real-time tracking, site teams and management had limited ability to confirm delivery status, identify discrepancies promptly, or liaise effectively with suppliers. Manual data entry also increased the risk of recording errors, further reducing the accuracy of inventory records and payment verification.

These issues directly impacted project performance by extending verification time, disrupting site coordination, and increasing the likelihood of material shortages or over-ordering. Delays in obtaining reliable delivery information hindered timely decisionmaking, leading to inefficient work planning and higher operational costs. In other words, construction projects involved multiple stakeholders and frequent material movements, for which a lack of centralized automated delivery order management led to inefficiencies that affected productivity and cost control. Therefore, a digital solution was needed to streamline delivery order management, improve tracking accuracy, and support efficient coordination across construction sites.

Review Of The Current Approach

Currently, construction sites rely on manual procedures for recording material deliveries, where Delivery Orders are still received in paper form, signed by the on-site person in charge, and then stored physically in folders and cabinets.

DELIVERY ORDER
GST Reg No. 200106604K
QOP-04-04 R2

PanUnited
Pan-United Concrete Pte Ltd

D/O Date : 12/08/2025
D/O No. : 62030178
Customer Name : CHINA STATE CONSTRUCTION ENGINEERING CORPORATION LIMITED SINGAPORE BRANCH
Deliver To : BULIM DRIVE LP19 (SLIP ROAD)

Plant Code/Name	Plant Address	Plant Contact/Fax	Truck Number
62/TENGAH PLANT	JALAN LEKAR		995

Total Load	This Load	Progressive Load
85.0	9.0	21.0

Product Code	Product Description
AEN9542T28	GR 40 SRBFC38 SL 100-150MM PILE 28C

Concrete Class/Specifications
Strength : C32/40
Consistence : S3
Density Class :
Min Cement :
Max W/C :
DC-Class :
Chloride : CL0.10

Material Class/Specifications
Cement Type : CEM IIB + SR
Cement Class : 42.5 N
Cementitious :
Agg Type : Granite,Dmax(20mm
Admix Type 1 : R
Admix Type 2 : S
Admix Type 3 :
Admix Type 4 :

Slump
0.0
Temperature
29.0
Waterproof Applicator

Technical Info
R - Retarder MR - Mid-range water reducing S - Superplasticizer

Batch Time	Arrival Time	Discharge Time Start	Discharge Time End
02:32	03:11	03:12	07:06

Seal Number	QT Name
	Sivakavi

Customer Remarks
Mr Denish 83147350 SECTION I ROOF SLAB
IPad Comments
Portal/App Comments

Received By
See Conditions Overleaf

Pan-United Concrete Pte Ltd Co Reg No. 200106604K
12 Kaki Bukit Crescent, Kaki Bukit Techpark 1, Singapore 416243
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Figure 1: Paper-Based Delivery Order Form

A DO is a document that contains complete information about the release and delivery of any particular product or materials. It highlights the person to whom the delivery will be made, how it will be delivered, the specifications to include, and the date of delivery.

Figure 1 presents a specimen concrete delivery order form currently used by the ready-mixed concrete supplier. The form captures important information about delivery orders, including customer name, delivery location, batching plant code, truck number, concrete specification, mixing time, arrival time, unloading time, and site remarks. All of this information must be manually entered on the computer, printed, and then distributed to personnel at the site for signature to mark the delivery.

This process, though utilized for years, is inadequate in the current technological setting. The delivery order form involves multiple stages of manual typing and handwriting. Humans can make errors, particularly when working on several projects at the same time and with less time; thus, mistakes are more likely. In a manual system, inefficiency can arise from re-entering data across various forms without automatic validation, cross-checking, or mis-checking.

In addition, the manual delivery order system creates challenges in keeping and retrieving records. When materials arrive on site, the person in charge must interpret the DO form and verify the delivery by signing the document. If the materials are incorrect, they may need to be returned without synchronization with the supplier (Hasim, 2023). Furthermore, the method of storing signed DO forms is inefficient; forms may go missing on the way to the site office for filing or entering into data spreadsheets. Paper-based DOs may also be bypassed by some on-site personnel, increasing the likelihood of misplacement, and additional time is wasted filing and organizing them into the correct files, making the process uncertain and time-consuming (Setayesh, 2021).

Additionally, construction sites entail many tasks that involve the delivery of several materials every day; it becomes inefficient to misplace and retrieve them, and to determine the order in which they were delivered. Delays in delivery verification may also delay verification to the supplier's advantage. Any mistakes in the manual process, therefore, can result in delay and cost overruns. The flows involved require continuous follow-up, frequent manual document searches, and manual supervision, making the system highly reliant on the individual's accuracy and ongoing human monitoring.

Several acceptable weaknesses can be related to the manual delivery record system. Planning or organized formats when creating records for material delivery lead to uniformity, making monitoring or follow-ups difficult. Moreover, transcriptional or calculation inaccuracies are more likely due to human intervention, as there are no automated systems for approval, which slows updates to material status (Ahmad, 2025). A lack of proper document management systems may affect document tracing, which often becomes lost due to poor management, making retrievals during project assessments or audits difficult, especially when tracing past delivery information for materials (Aleixo, 2021). Since coordination is required when handling multiple delivery suppliers for materials, along with work sections, this increases inefficiency in material flows, ultimately influencing project planning and purchasing operations.

Introducing a digital delivery order record system provides a strong rationale for improvement, as it can significantly enhance data accuracy, reduce repetitive administrative tasks, and shorten the verification process (Alumbugu, 2022) The task of automating the identification and tracking of building materials can also provide managers with timely and accurate information on available materials (Sardroud, 2012)Standardized digital processes also ensure clearer documentation and improved material traceability, strengthening transparency and enabling better-informed decisionmaking regarding material planning, payment verification, and site scheduling.

Technological Solution And Available Tools

Several technologies can address the inefficiencies and errors in the manual Delivery Order (DO) recording and tracking process. Table 1 lists tools that streamline DO management, improve delivery accuracy, and provide real-time visibility.

Table 1: Available tools that improve DO management

Technology	**Overview**	**Pros**	**Cons**
BrickControl	Cloud-based construction management software tailored for project planning, procurement, and logistics.	• Strong support for stock management • Real-time reporting and analytics • Mobile access for site teams • Integration with accounting	• It may be costly for small sites • Requires training • Needs a good internet connection • Data migration from paper records can be tedious
Linkoper	Logistics platform for concrete plants, delivery fleets, and order management.	• Real-time fleet tracking (GPS) • Digital order management • Proof of delivery through the mobile app. Optimise routes and schedules. •	• Specialized for concrete or similar products • Subscription cost
Detrack	Delivery management system focused on proof of delivery, tracking, and route optimization.	• Electronic Proof of Delivery with signature, photos, location, timestamps • Live vehicle tracking via GPS • Route optimization saves time and cost Unlimited sub-users •	• May not integrate well with construction management • Require mobile devices for drivers
Zigaflow	Construction management software supporting quoting, eForms, job	• Highly flexible Forms • Link delivery to job costing and material tracking	• Require training • Maybe expensive for smaller operations
	tracking, inventory, and workflows.	• Automated workflows and alerts • Integration with the accounting system	• Offline functionality may be limited depending on the plan

Construction tools in the cloud. Project management and task control using various tools available on the market to improve efficiency. Examples of tools for improving DO management include BrickControl, Linkoper, Detrack, and Zigaflow. BrickControl is a web application that helps efficiently manage shipping orders. This tool requires no investment and only a web browser. It supports inventory management, real-time reporting, mobile access for on-site teams, and accounting integration. It is suitable for large construction sites with diverse material and shipping needs, but may be less ideal for projects in remote areas, as it requires an internet connection.

Linkoper focuses on logistics management for concrete plants, delivery fleets, and order tracking. It provides real-time fleet tracking, digital order management, and proof of delivery through a mobile app. This tool is particularly useful for projects involving frequent concrete deliveries. However, it is specialized for concrete or similar products. Detrack focuses on the following targets for improvement: delivery verification, live vehicle locationing, and optimized routing. The software features electronic signature capture, image verification, GPS locationing, and an endless number of subs. This product would best serve construction projects that require comprehensive delivery locationing and in-location verification; integration with construction management software could be limited.

Finally, Zigaflow, which offers overall management solutions for the construction industry, including quotation, electronic forms, job management, inventory management, workflow, and alert management, and can interface with accounting packages. Zigaflow will work well for the construction project, which requires high functionality for automating workflows and managing materials. Disadvantages include the potential for higher costs on smaller projects, the need for training, and offline usage, depending on the package selected.

With management systems like BrickControl or Zigaflow for cloud management, all delivery orders can be electronically documented, automatically archived, and organized. Employees can easily access all necessary documents whenever needed on mobile phones or tablets, eliminating the difficulties of paper loss and manual documentation. In terms of payments, capabilities like e-POD from Detrack or Linkoper for signature capture can immediately document receipting, complete with signatures, photos, timestamps, and GPS details. The system can also connect directly to finance or suppliers, thereby accelerating payment approvals and eliminating delays caused by missing documents or confirmations.

Enhancement of Data-Driven Decisionmaking

Digital delivery order management system technologies like BrickControl, Zigaflow, Detrack, and Linkoper reduce human error and ensure the accuracy and reliability of delivery order information through automated data entry and verification. On the other hand, electronic storage of data can never result in the loss or misplacement of paper documents, enabling site personnel to access needed documents at any time. With real-time tracking and signature capabilities, there will be no errors confirming material delivery, with signatures, photos, timestamps, and location details, ensuring payments and settlements are confirmed. In addition, analytics enable management to monitor supplier performance, material consumption, and delivery issues, with statistical support for planning, inventory, and supplier selection. In a nutshell, digital DO management system technology can efficiently enhance efficiency, accuracy, and site transparency to address problems with the loss or misplacement of paper documentation.

Proposed System Development

The Digital Delivery and Inventory Management System (DDIMS) was created to address the gap between the material-handling process and the digital capabilities increasingly available to the construction industry. The creation of this new digital platform was the result of a problem-solving process that began by scrutinizing issues with the use of paper documents and communication. The main issues that emerged and served as the basis for determining the basic characteristics the new platform needed to have included the loss of delivery documents, delayed verification, and a lack of real-time visibility.

When developing the DDIMS, it was crucial to ensure that the system's workflow mimicked what actually happens on the site while improving the accuracy and efficiency of the process. With this, the automated system includes features such as QR/barcode scanning, automated submission of delivery requests, and storage of all collected data, all of which are easily accessible to both site and office employees. This ensures that it not only automates the delivery process but also does so in a practical way.

The system's architecture consisted of three core components: data capture, real-time processing, and automated reporting. Data capture tools included mobile scanning and digital forms to reduce manual data entry. Real-time processing enabled immediate updates on material status, facilitating prompt decisions when delays or discrepancies were detected. Finally, automated reporting tools provide daily, weekly, or monthly summaries, reducing administrative work and enhancing transparency among project stakeholders.

By grounding the system’s development in real site challenges rather than theoretical ideals, DDIMS offers a practical, scalable solution suitable for projects of varying sizes. The system is adaptable to different types of materials, supplier arrangements, and site conditions, making it a more versatile alternative than highly specialized or overly complex commercial software. Ultimately, the design philosophy behind DDIMS ensures that digital transformation becomes achievable for construction environments that have historically depended on manual processes.

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Comparison Between The Current Process And The New Process

Material delivery records are still handled manually in the current construction-site workflow, using paper-based delivery order forms. Supervisors or site managers handwrite delivery details, and the quantity of goods or materials must be checked manually. Not only that, but all records and documents are physically stored for future reference. This method will take a long time, thus increasing the risk of lost delivery records, human errors such as missing items, incorrect quantity of goods, incorrect amounts, and damaged documents due to careless handling. In addition, the less standardized format and storage methods will slow down and complicate the search for old records required, as well as the preparation of reports, thereby affecting the decision-making process. These factors will directly affect the effectiveness of logistics management due to delays and uncertainties in delivery details and information. This also leads to ineffective work planning and resource utilization, which will affect the smooth running of the entire construction project.

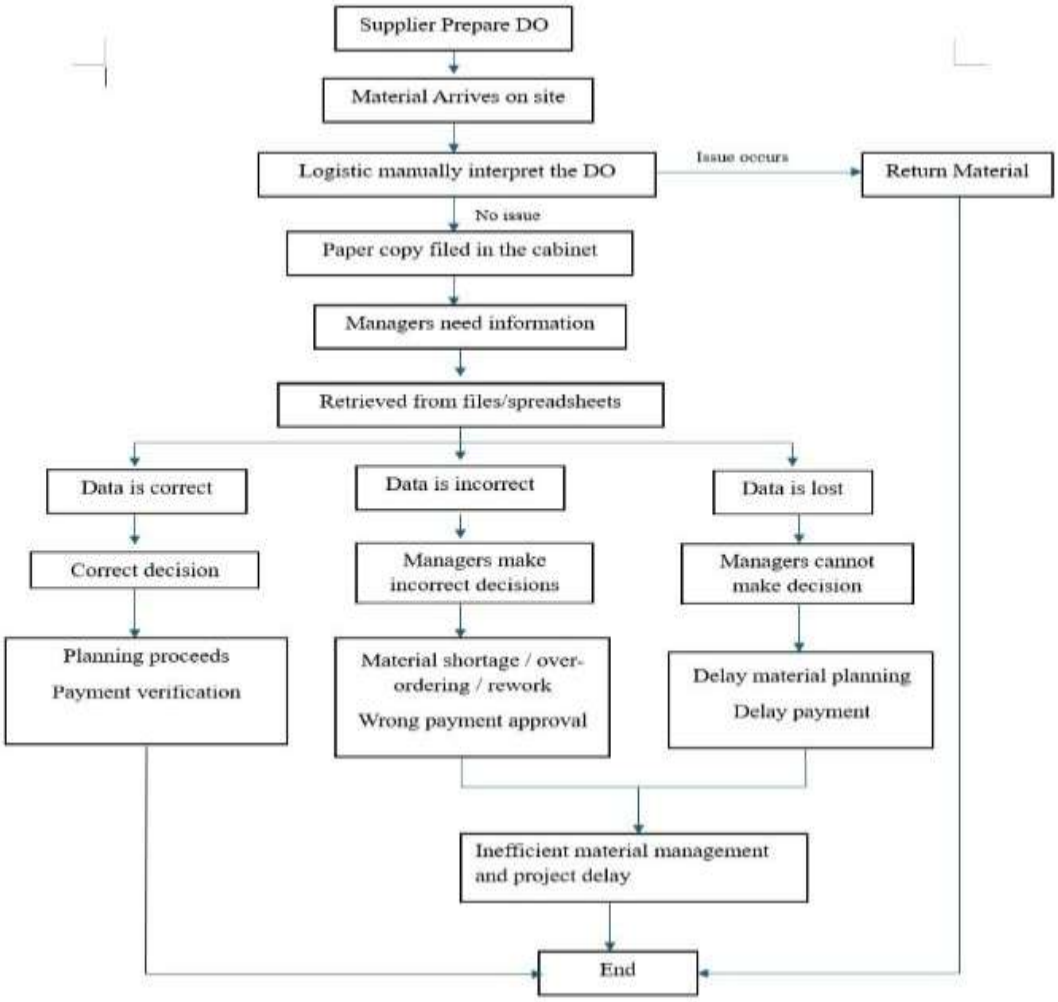

Figure 2: Flowchart for existing system

The proposed digital order record system provides a systematic workflow, making work easier than relying on inefficient paper-based manual methods. In terms of accuracy, this system is very helpful at the entry-level of information. The system eliminates the risk of human error, such as hard-to-read information, quantity errors, or document damage, by replacing written logs with digital requests made via the app or web by simply scanning QR or barcodes. Information scanned from each item received will be automatically verified and uploaded directly to a central database to ensure that physical stock records are always up to date. This automatic data synchronization resolves common slow-downs in manual filing systems. This system also works to ensure that information and data are always safe and avoid the risk of records being damaged or lost due to careless handling.

From a work coordination perspective, this system can bridge the communication gap between suppliers, site managers, and central offices by providing real-time tracking, unlike the manual method, where delivery status is only known when the truck arrives. The supplier's updated application also allows logistics planning to be completed more quickly and accurately. With this transparent system, every needed resource can be carefully and effectively planned and organized, without wasting time waiting. In addition, the use of a modern, fast, real-time dashboard system that automatically displays data such as delivery status and the latest resource inventory allows management to make decisions quickly and efficiently, compared to the old method, which required manual searches of data and records in physical archives. When all stakeholders have direct access to key delivery records, such as the latest status and delivery history, confusion and information inaccuracies can be avoided, ensuring the project can be carried out on schedule.

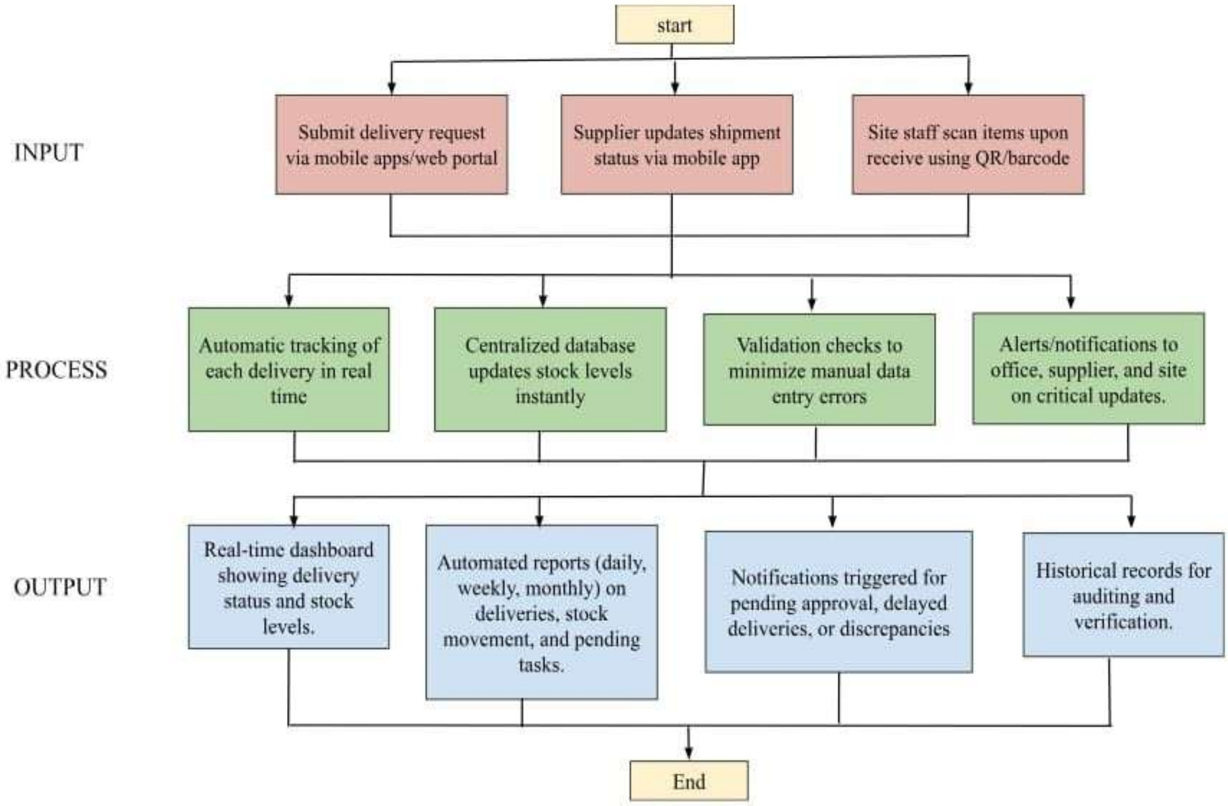

Figure 3: Delivery order system flowchart for the new system

Development Framework, System Architecture and Performance Evaluation Strategy

To enhance the technical robustness and academic rigour of the Digital Delivery and Inventory Management System (DDIMS), the system development process can be structured using a systematic development framework combined with measurable performance evaluation methods. The development of DDIMS follows a simplified System Development Life Cycle (SDLC) approach comprising problem identification, system requirements analysis, system design, prototype development, and functional evaluation. This structured development approach ensures that the system design aligns with the operational workflow for construction material delivery management and supports iterative improvement of the platform based on user requirements and operational constraints.

From a technical perspective, the DDIMS architecture is designed around three key layers: data acquisition, processing, and information management. The data acquisition layer consists of mobile devices or web-based interfaces that enable delivery personnel and site supervisors to capture delivery information through QR or barcode scanning and digital forms. The processing layer manages real-time validation and synchronization of delivery records in a centralized database environment. The information management layer provides dashboards, reporting tools, and delivery verification interfaces that enable stakeholders to monitor material deliveries, verify quantities, and generate logistics reports. A structured database schema supports storage of delivery order records, supplier information, material specifications, delivery timestamps, verification status, and digital proof-of-delivery data such as signatures and images. This architecture allows the system to automate verification processes while ensuring traceability and data integrity across the construction supply chain.

To assess the operational impact of DDIMS, a pilot implementation strategy can be conducted in an active construction project environment. The pilot implementation would allow a comparative analysis between the traditional paper-based delivery order workflow and the proposed digital workflow. Time–motion analysis may be used to quantify workflow performance indicators such as delivery verification time, frequency of recording errors, administrative processing time, and document retrieval duration. For example, the verification process in manual systems typically involves several stages, including document checking, manual recording, and filing, whereas the digital system allows immediate verification through automated data capture and synchronized updates. A quantitative comparison of these processes can provide measurable indicators of the efficiency improvements achieved through digitalization.

In addition, the implementation of DDIMS can be positioned within the broader context of Construction 4.0 and digital supply chain integration. Construction 4.0 emphasizes the use of digital technologies, automation, and real-time information exchange to improve project coordination and operational efficiency (Alaloul et al., 2020). Within this framework, DDIMS contributes to the digitalization of construction logistics by enabling real-time delivery monitoring, automated data collection, and centralized information management. The system can also complement Building Information Modelling (BIM)-enabled supply chain management by linking material-delivery data with project information models, enabling stakeholders to track material flows and delivery status in alignment with project schedules and procurement plans.

Through the integration of a structured development framework, system architecture design, and quantitative workflow evaluation, the DDIMS concept demonstrates its potential to improve construction material delivery management and contribute to the broader transformation of construction logistics toward data-driven, digitally integrated operations.

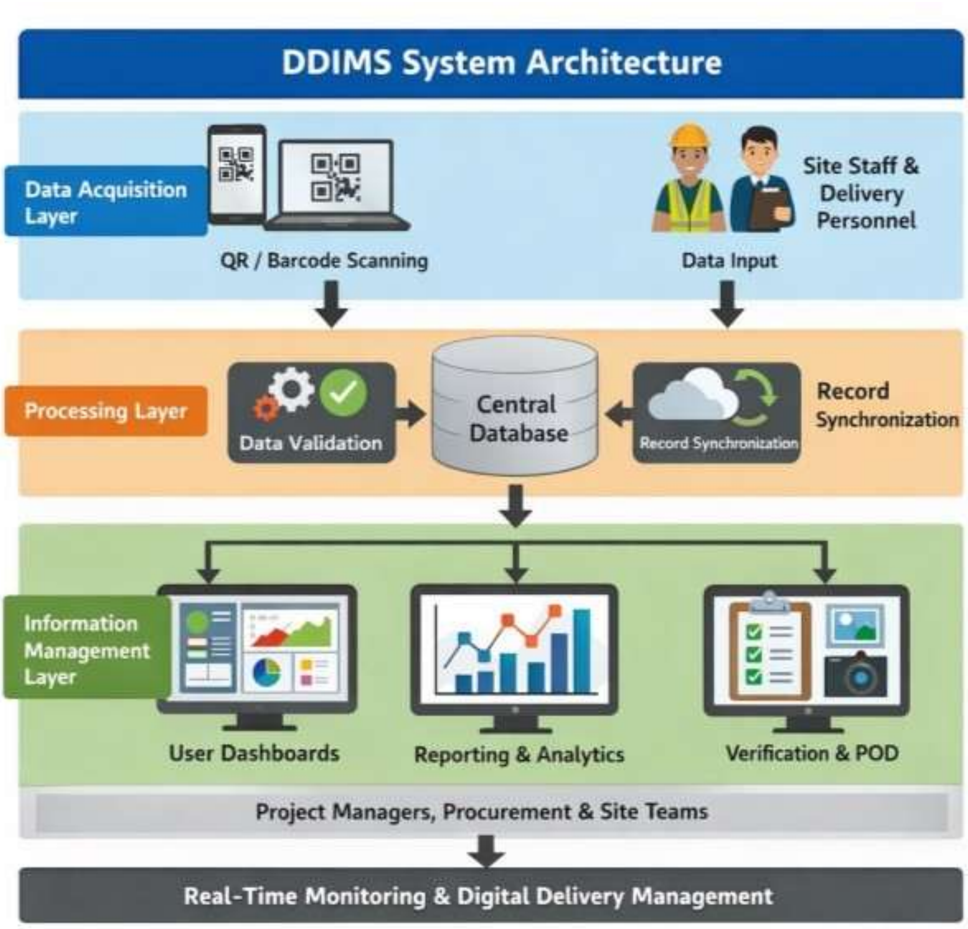

Figure 4: System architecture of the Digital Delivery and Inventory Management System (DDIMS) showing a three-layer structure comprising the Data Acquisition Layer, Processing Layer, and Information Management Layer.

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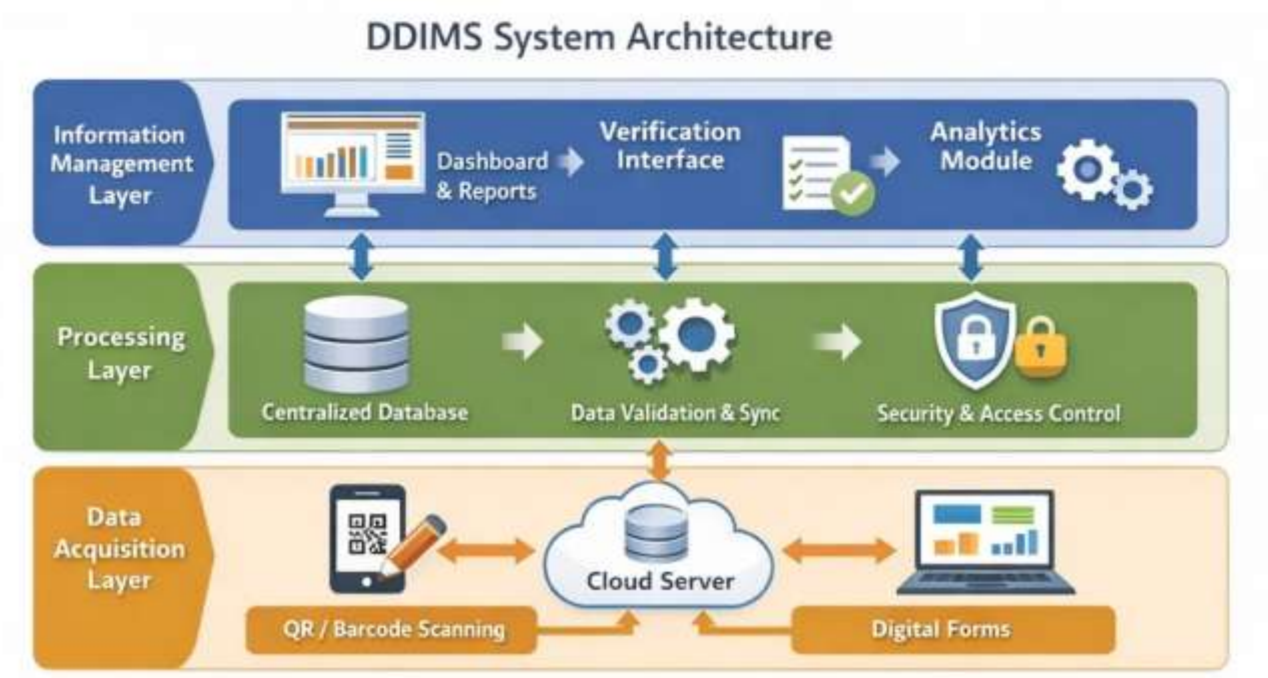
Figure 4 illustrates the overall system architecture of the Digital Delivery and Inventory Management System (DDIMS). The architecture follows a three-layer design consisting of the data acquisition layer, processing layer, and information management layer. The data acquisition layer captures delivery information via QR code or barcode scanning and digital forms on mobile devices. The processing layer performs data validation, synchronization, and secure storage in a centralized database. The information management layer provides dashboards, reporting modules, and verification interfaces that allow project managers, procurement teams, and site personnel to monitor delivery status and generate logistics reports in real time. This layered architecture ensures data consistency, efficient processing, and transparent information access across construction stakeholders.



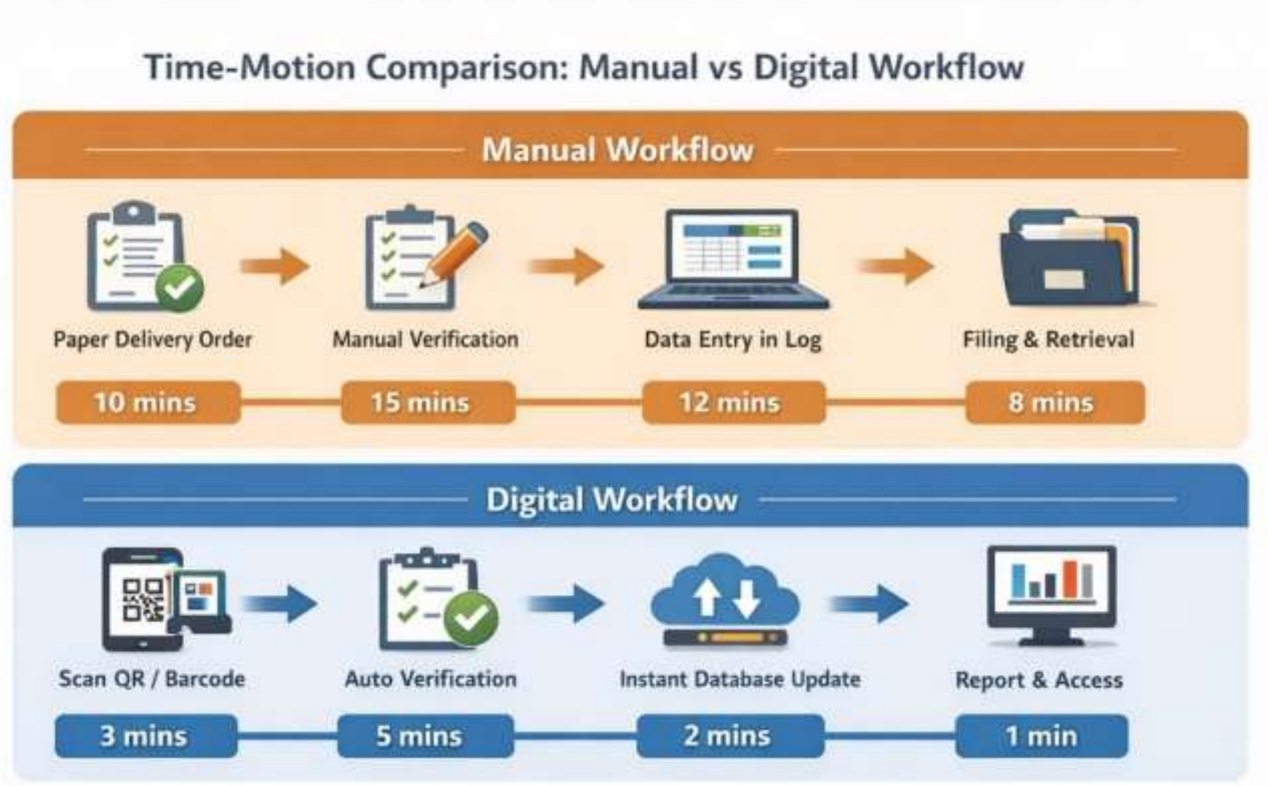


Figure 5: Time–motion comparison between the conventional manual delivery order workflow and the proposed DDIMS digital workflow.

Figure 5 presents a conceptual time–motion comparison between the conventional manual workflow and the proposed digital workflow supported by DDIMS. In the manual process, delivery verification involves multiple sequential tasks, including checking paper delivery orders, performing manual verification, entering data into logs or spreadsheets, and filing documents. These tasks collectively require approximately 45 minutes per delivery transaction. In contrast, the digital workflow enables automated verification via QR or barcode scanning, real-time database updates, and instant access to reports, reducing the total processing time to approximately 11 minutes. This comparison demonstrates the potential efficiency gains from digitalization, particularly in reducing administrative overhead and verification time.

Benefits of the Proposed System

Systematic material management plays a very important role in construction implementation because it affects the standardization of work, the oversight of expenses and costs, and the outcomes of construction site work. Manual methods, such as paper forms for data storage and recording the entry and withdrawal of materials, can lead to delays, inconsistencies, and obstacles to monitoring the movement of materials. Therefore, the use of digital systems and technology is one of the most effective approaches to date to overcome the problem.

One of the systems that helps in Material Management is Zigaflow. The system supports material delivery management by digitally collecting delivery notes in standard formats. This alignment of documentation can minimize data recording errors and maximize information accuracy. Furthermore, the real-time tracking aspect helps the site monitor shipment status and identify risks, such as delays, early. The automatic notification function makes it easy for project teams and clients to stay informed about materials and on-site deliveries.

In addition, the BrickControl system focuses heavily on information management. This is because it consolidates information on purchase order records, expense estimates, project workflows, and progress reports, enabling access to current information. This integration also supports decision-making based on available data, making decisions clearer and easier to understand. Furthermore, the system supports information collaboration between contractors and subcontractors, enabling effective resource planning and task coordination. In this context, the use of digital technologies such as HTML5 and Progressive Web Application (PWA) helps the system access a variety of devices with an easy-to-use interface.

Furthermore, the Detract system offers real-time tracking and digital delivery of evidence, including e-POD and electronic Proof of Delivery, which display the recipient's photo and signature. This element reinforces the ability to communicate and to provide records that can be recognized in the event of differences of view. Furthermore, studies and delivery-related reports generated by the system help management assess work efficiency and identify logistics-related issues. Not only that, but using this system can minimize reliance on manual methods that are prone to loss or damage.

In addition, the system that also helps with this is Linkoper, which supports the digital management of delivery Orders (DO) from the order phase through delivery of materials to the construction site. Linkoper automatically notifies when goods arrive, provides real-time GPS tracking, and records the vehicle's location, on-site waiting time, and shipment status. With this information, the site can identify causes of delays earlier and develop strategies to address these weaknesses through better site logistics planning. Digital-based data storage helps deliver records on-site faster than manual processes.

In conclusion, the use of digital systems such as Zigaflow, BrickControl, Detrack, and Linkoper provides many benefits and a systematic approach to material delivery management compared to traditional methods. However, the effectiveness of this system depends on the skills and competence of users on the construction site. This system can support construction implementation management more systematically, efficiently, and accurately by leveraging available data.

Limitations Of The Proposed System

While DDIMS has many benefits that could make it an effective tool for enhancing material delivery management through technological innovation, it also has limitations. A fair academic analysis of DDIMS must consider the constraints and limitations of the innovation. The first limitation of DDIMS is that it has not been used in real-life testing for a building construction project. Therefore, DDIMS was developed and assessed solely through a combination of workflow analysis, literature reviews, and conceptual system designs. So, the performance of DDIMS in real-world conditions, with many variables dependent on site conditions, cannot be fully assessed. The DDIMS must accurately capture all information, including high-volume deliveries, time-sensitive deliveries, and the coordination of multiple suppliers to deliver the best solution. Additionally, assessing long-term effectiveness, user behaviour, and real-world operational impacts in active project environments will be difficult.

The second limitation of DDIMS is its reliance on internet connectivity. Many construction sites are in areas with unreliable or nonexistent network coverage. This situation may hinder the real-time exchange of information among all parties involved, including delivery tracking and notification features. While offline data collection methods may be used to capture data, synchronization would be delayed until a connection to the Internet is possible. To make it worse, what if the delay takes several days to update online, and the teams are already using the old data? This will negatively affect the timeliness of reporting and decision-making during deliveries.

The third limitation of DDIMS is user training and acceptance of the new system. Changing from traditional paper-based processes to a digital process requires changes in habits and mindsets among site workers. These changes must involve top management and executives. If top management does not enforce it properly, the possibility of adopting new systems will crumble. Unless adequate training and technical support are provided to the teams, along with a strong commitment to changing the way things are done from the management level down to site personnel, resistance to change is very likely. If resistance occurs, it is likely to cause site users to fail to consistently use the system, thereby reducing the reliability of the collected data.

Overall, while DDIMS offers a structured, technology-driven approach to managing material delivery, it is limited by its lack of real-world testing. The system's reliability is limited by the availability of reliable internet connections and by users' willingness to adopt digital systems.

CONCLUSION

The current research focuses on long-term inefficiencies in the management of construction material delivery and examines the limitations of manual handling of delivery orders, proposing a digital solution. It was observed that manual handling of delivery orders delays verification, and there is poor traceability and coordination among the different project stakeholders, which has implications for time efficiency, cost control, and site operations. The study, which developed and evaluated the system, showed that a centralized digital delivery order system greatly enhances visibility, data accuracy, and workflow coordination compared to traditional paper-based methods.

The main value of this research is to bridge the gap between existing digital technologies and practical on-site application by presenting a system specifically designed around real construction workflows. On the contrary, prior studies have predominantly focused on theoretical benefits or on isolated technologies; this research offers a structured, problem-driven approach to digitizing order delivery that integrates tracking, verification, and reporting into a single workflow. The study thus contributes to the literature by demonstrating how digital delivery order management can be practically aligned with construction site operations to improve efficiency and support better decision-making.

Despite these contributions, the study's limitations include the lack of adoption and performance evaluation in actual project environments at full-scale and active project sites. In addition, various factors, including internet connectivity and acceptance rate, may affect the system's efficiency. Future work could then focus on testing the adoption and performance efficiency of the system at actual project sites, including measuring the degree of user acceptance and quantitative performance metrics for time and cost gains and reduced errors. Other improvements could lie in adopting and adapting current project management or financial systems to enhance overall logistics management of the constructed project sites.

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