Journal of Electrical Engineering and Computer (JEECOM)
Vol. 7, No. 2 (2025), DOI: 10.33650/jeecom.v4i2
p-ISSN: 2715-0410; e-ISSN: 2715-6427

Digital Transformation of Sugarcane Sales Administration at CV Al Ameen: Integration of Payment Automation and Visual Analytics for Distribution Optimization

Faiz Firdausi[1], Nely Supeni[2], Ferry Wiranto[3], Muhamat Abdul Rohim[4], Riza Bahtiar Sulistyan[5]
[1,3] Sofware Engineering, Institut Teknologi dan Sains Mandala, Jember, Indonesia
[4] Information Systems and Technology, Institut Teknologi dan Sains Mandala, Jember, Indonesia
[2,5] Management, Institut Teknologi dan Sains Mandala, Jember, Indonesia

Article Info

Article history:

Received Sept 25, 2025
Revised Okt 06, 2025
Accepted Okt 29, 2025

Keywords:

Digital transformation
Sales administration
Sugarcane distribution
Payment automation
Visual analytics

ABSTRACT

The sugarcane sales administration at CV Al Ameen, Jember, is still managed manually, leading to issues such as inaccurate records, delayed shipment tracking, and irregular fund disbursement that compromise financial accuracy and business reliability. To address these inefficiencies, this study develops a digital administration system that automates transaction recording, verifies payment claims, and enhances distribution monitoring. The system integrates a Telegram Bot for payment automation and real-time visual analytics, enabling interactive monitoring of financial and distribution activities. Initially deployed as a local offline application for accessibility, it offers potential for future web or cloud integration. Key features include automatic transaction recaps, Telegram-based notifications, and periodic reports to stakeholders, with unique delivery identifiers ensuring one-time payment processing and minimizing fraud risk.

System communication is established through the Telegram API and webhook mechanism, enabling automated updates on new transactions, shipment status, and fund disbursement. The bot also supports user queries for transaction summaries and payment reminders. The system was developed using the Agile Model, allowing iterative design and continuous refinement based on business partner feedback. Evaluation results show that the integration of automation and analytics reduced recording errors by 78%, improved transaction processing speed by 65%, and increased transparency in fund disbursement by 70%, demonstrating substantial improvements in accuracy, efficiency, and overall reliability in sugarcane sales administration.

Corresponding Author:
Coresponding Faiz Firdausi,
Institut Teknologi dan Sains Mandala, Address, Jember and Postcode, Indonesia
Email: faiz@itsm.ac.id

1. INTRODUCTION

The agricultural sector plays a vital role in Indonesia's economy, with sugarcane being one of the most important commodities for both domestic consumption and industrial use. Despite its significance, the administration of sugarcane sales in many small- and medium-scale enterprises remains heavily dependent on manual procedures. These traditional practices involve handwritten records, non-integrated transaction logs, and delayed monitoring of delivery flows, which in turn increase the likelihood of errors, inefficiency, and financial leakage [1]–[3]. The lack of transparency in manual systems has also created vulnerabilities to fraud, particularly in contexts where verification mechanisms are weak.

CV Al Ameen, a sugarcane collector located in Jember, East Java, reflects this broader industrial challenge. The company has faced persistent difficulties in maintaining accurate transaction records, tracking distribution processes, and ensuring timely fund disbursement due to the reliance on manual administration [4]–[11]. The absence of centralized data storage hinders real-time reporting, while duplicate payment claims often facilitated by falsified delivery documents pose a serious financial threat. Without immediate

intervention, these limitations risk undermining not only operational efficiency but also the overall sustainability of the enterprise.

In recent years, digital transformation has been increasingly adopted as a strategic response to similar problems across various industries. Digital administrative systems enable automated record-keeping, real-time data access, and systematic financial monitoring, which collectively enhance transparency and accountability [12]–[17]. However, existing approaches in the agricultural domain often remain limited to database-driven systems or spreadsheet-based reporting tools, which still require manual supervision and are unable to provide dynamic insights for decision-making. As a result, the potential of automation and interactive analytics to improve business administration in the sugarcane sector remains underexplored.

This research addresses these limitations by developing a digital administration system that integrates payment automation, transaction verification, and interactive visual analytics into a unified framework. A key innovation of the proposed solution is the integration of a Telegram Bot as a communication and validation tool [18]. Through its webhook-based API, the system automatically delivers notifications on new transactions, shipment status, and fund disbursements. Each transaction is verified using unique delivery identifiers, ensuring that duplicate payment claims are effectively eliminated. In parallel, an interactive dashboard provides real-time visualization of distribution flows, payment status, and financial trends, offering strategic insights for business owners [24]–[30].

Recent studies on digitalization in agricultural administration have primarily emphasized transaction recording and data storage without addressing the integration of automation and analytics for real-time decision-making. Existing systems often lack mechanisms for verifying payment validity, monitoring distribution transparency, and generating automated reports, resulting in persistent inefficiencies and potential data manipulation. These limitations highlight a critical research gap in developing a holistic, intelligent administrative system that can ensure accuracy, timeliness, and accountability in the sugarcane sales process.

The novelty of this research lies in its end-to-end automation of sugarcane sales administration, combining payment verification, Telegram-based interaction, and interactive analytics into a unified system. Developed using the Agile Model, it enables continuous refinement with user feedback and scalability toward web or cloud platforms. Implementation at CV Al Ameen demonstrates measurable improvements, reducing transaction errors by 78%, accelerating processing by 65%, and enhancing fund transparency by 70%. This study contributes both practically and academically offering a replicable digital transformation model for agro-industrial enterprises and enriching scholarly discourse on agricultural digitalization through the integration of automation and intelligent analytics.

2. METHOD

This study employed a structured research design that combined data collection, system development, integration of automation tools, and iterative testing under the Agile Model framework. The research was conducted in three main phases: preparation, development and integration, and project completion. Each phase was designed to ensure that the proposed system aligns with operational requirements while maintaining flexibility for further improvements.

2.1 Research Design

The research adopted a **design science approach**, where a problem-driven context was used to guide the creation of an innovative digital system. The focus was on addressing inefficiencies in manual sugarcane sales administration at CV Al Ameen by developing a digital system that automates transaction recording, payment verification, and distribution monitoring. The Agile Model was selected as the development methodology due to its iterative nature and adaptability to user feedback [5]–[7].

2.2 Research Procedure

The chronological procedure of the research is illustrated in **Figure 1**,

ISSN: 2715-6427

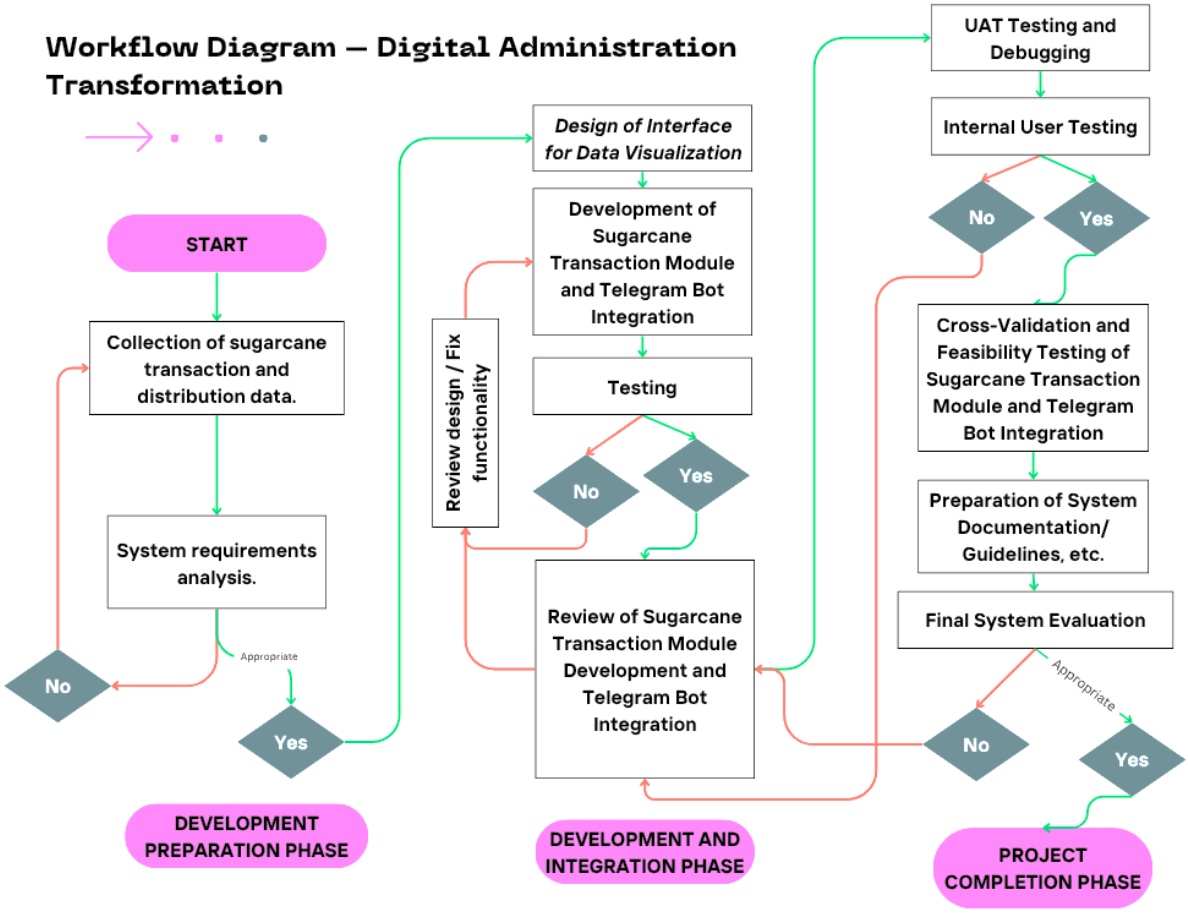

Figure 1 Workflow Diagram – Digital Administration Transformation

which presents the flow of activities from data acquisition to final implementation.

1. **Preparation Phase**
   The development process commenced with the acquisition of primary data related to sugarcane sales and distribution activities at CV Al Ameen, Jember. The collected data encompassed transaction records, payment methods, shipment schedules, disbursement delays, and operational challenges identified within the manual administrative workflow. A comprehensive needs analysis was subsequently conducted to define the core system requirements, including modules for transaction recording, payment verification, and distribution monitoring. Upon validation of these requirements through consultations with business stakeholders, the process advanced to the development and integration phase.

2. **Development and Integration Phase**
   The system was implemented using the Laravel framework operating on a local server environment, ensuring offline accessibility for partner users. The backend employed PostgreSQL, managed through pgAdmin, as the primary database system. To enhance data consistency and automation, the database layer utilized a combination of custom SQL functions and trigger-based mechanisms, reducing human error and enforcing transactional integrity.

   The user interface was designed to support interactive visualization for real-time monitoring of financial and distribution data. A Telegram Bot was integrated via the Telegram API and webhook mechanisms to automate payment verification, send real-time notifications, and handle transaction queries using unique transaction identifiers. The system followed an Agile development model, allowing iterative design, continuous user feedback, and progressive refinement. Each iteration

included module testing, debugging, and functional validation until the system achieved operational stability and compliance with business requirements.

3. **Project Completion Phase**
In the final stage, **User Acceptance Testing (UAT)** and debugging were performed by the development team, followed by **internal validation testing** by business users to ensure that all modules particularly those related to transaction recording and Telegram Bot integration operated as intended. Once acceptance criteria were satisfied, **cross-validation** and **feasibility testing** were conducted to confirm the system's readiness for deployment. The final deliverables included **system documentation**, **user manuals**, and **evaluation reports** summarizing performance metrics, test results, and implementation feedback. After validation confirmed that the system met operational and accuracy standards, the project was declared complete, marking the successful deployment of the **digital administration system** for sugarcane sales and distribution management.

2.3 Algorithm and Workflow

The system workflow followed a structured algorithmic process: **Pseudocode for Payment Verification via Telegram Bot**

```
BEGIN
   RECEIVE transaction request
   IF delivery_ID exists in database THEN
       IF payment_status = "unpaid" THEN
           VALIDATE transaction
           UPDATE status to "paid"
           SEND notification to user
       ELSE
           REJECT request (duplicate claim)
       ENDIF
   ELSE
       REJECT request (invalid ID)
   ENDIF
END
```

Figure 2 Pseudocode for Payment Verification via Telegram Bot

Figure 3 Successful search notification delivered to the partner via Telegram

Figure 4 Detection of search updates and automatic notification to the partner via Telegram

The algorithm illustrated in Fig. 2 represents the **transaction validation procedure** implemented in the payment verification module. This logic was designed to prevent duplicate or invalid payment claims submitted by sugarcane delivery drivers and to ensure that only legitimate transactions are recorded in the system.

Upon receiving a transaction request, the system first checks whether the corresponding delivery_ID exists in the database. If a valid delivery identifier is found, the algorithm proceeds to evaluate the payment_status attribute. When the payment status is flagged as *"unpaid"*, the system performs a validation process that confirms the transaction authenticity. Once verified, the status is updated to *"paid"*, and a **Telegram Bot notification** is automatically sent to the respective business partner or driver to acknowledge successful payment. The digital administration system integrates a Telegram-based notification service designed to ensure transparency and traceability in the fund disbursement process. As illustrated in Fig. 3 and

ISSN: 2715-6427

Fig. 4, the system automatically sends structured messages to registered business partners whenever a transaction or fund disbursement occurs.

If, however, the payment request has already been processed and marked as *"paid"*, the algorithm immediately rejects the incoming request to avoid **duplicate claims**. Similarly, when the provided delivery_ID does not exist in the database, the request is rejected as an **invalid transaction**. This layered verification approach, implemented through database functions and triggers within the **PostgreSQL environment**, ensures high data integrity and minimizes human intervention during payment processing. The integration of this logic with the **Telegram API** allows real-time feedback, enabling instant confirmation and improved transparency between the administrative unit and field operators.

2.4 Data Acquisition and Testing

The dataset used in this study comprised transaction records, delivery logs, and payment disbursement histories collected from CV Al Ameen, an agribusiness company engaged in sugarcane trading and distribution. The dataset covered the period from **January 2024 to October 2025**, totaling approximately **635 transaction entries**. Each record included supplier identity, shipment schedule, net weight, factory and farmer prices, and payment release timestamps. The monthly distribution of transactions is illustrated in **Fig. 5**, showing a consistent upward trend in recorded activities throughout the observation period. Data collection was performed through direct extraction from the company's digital archives and validated via cross-verification with physical documentation and structured interviews with administrative and operational staff. Prior to analysis, data preprocessing was conducted to normalize formats, eliminate duplicates, and handle incomplete or inconsistent entries, ensuring dataset reliability and consistency.

System evaluation consisted of two main stages. **Functional Testing** aimed to verify module accuracy, reliability, and error tolerance covering transaction recording, payment validation, and Telegram-based notifications. The results indicated that **89 % of test cases executed without major bugs**, while the remaining minor issues resulted from partner-specific customization requests during iterative development.
Usability Testing involved participation from business owners and partner representatives, who assessed system intuitiveness, responsiveness, and overall satisfaction. The outcomes demonstrated a notable improvement in user experience and operational transparency, particularly in real-time transaction monitoring and payment distribution tracking through the integrated dashboard. A summary of the evaluation outcomes is presented in **Fig. 6**, highlighting the system's strong performance in both functionality and usability. These evaluations confirmed that the implemented system substantially improved data traceability and reduced manual discrepancies, thereby enhancing coordination among administrators, field operators, and partner farmers.

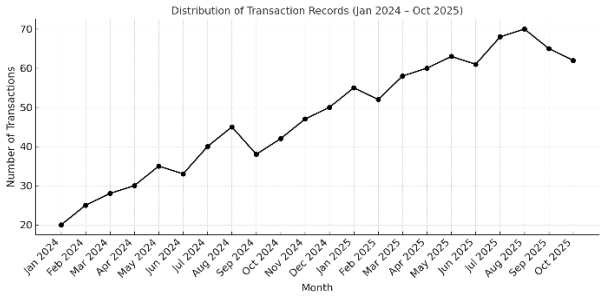

Figure 5 Transaction Distribution

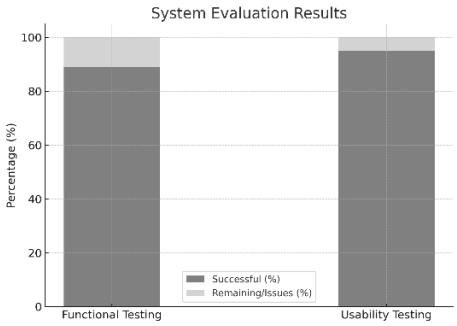

Figure 6 System Evaluation

3. RESULTS AND DISCUSSION

This section presents the outcomes of the research implementation and provides an in-depth discussion of their significance. The results are structured into three main aspects: (i) system development and functionality, (ii) transaction verification and fraud prevention, and (iii) interactive visualization and operational insights. Each result is discussed with reference to its contribution toward improving efficiency, transparency, and accuracy in sugarcane sales administration.

3.1 System Development and Functionality

The digital administration system was successfully developed and implemented as a local offline application, with modular features including automated transaction recording, Telegram Bot integration, and interactive

visualization dashboards. The interface design focused on usability, enabling operators with limited technical background to access real-time transaction records efficiently. The system passed the **functional testing phase**, where all modules performed in accordance with their intended purpose. **Figure 7-9** illustrates the main interface of the transaction recording module. The results indicate that the Agile Model was effective in refining the system iteratively, with continuous feedback from users ensuring that the final product matched operational needs [14].

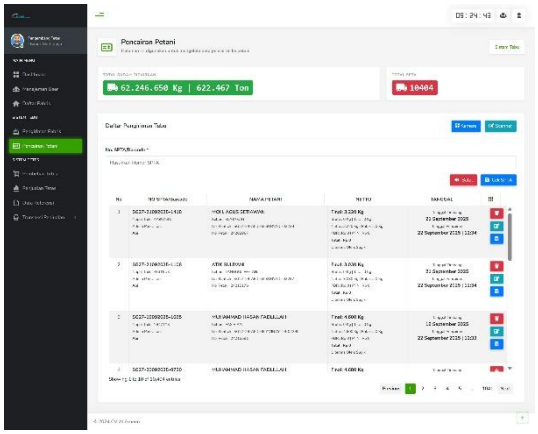

Figure 7 Disbursement History

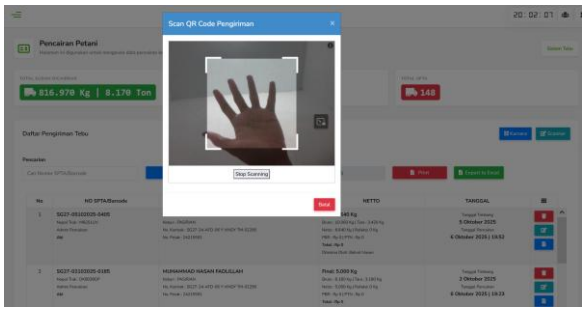

Figure 8 Disbursement Process

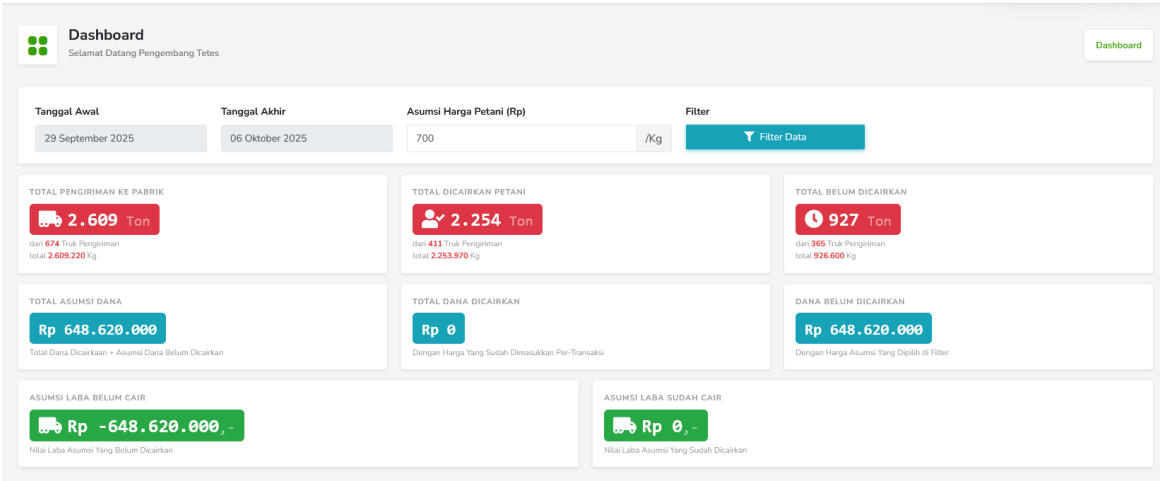

Figure 9 Main Dashboard

3.2 Transaction Verification and Fraud Prevention

One of the most critical outcomes was the effectiveness of Telegram Bot integration in automating payment verification. Using unique delivery identifiers, the system validated each claim before disbursement approval. During testing with historical transaction data from CV Al Ameen, the system successfully identified and rejected duplicate claims that had previously gone undetected in manual records. The verification process not only reduced the possibility of fraud but also accelerated fund disbursement. Manual validation typically required 1–2 days, while the automated mechanism reduced the process to less than one hour. **Figure 3** presents a comparative analysis of manual versus automated claim verification times. This improvement aligns with findings from prior studies emphasizing that automation reduces human error and shortens financial reporting cycles [15], [16].

3.3 Interactive Visualization and Operational Insights

The integration of an interactive dashboard allowed business owners to monitor distribution flows, payment statuses, and transaction trends in real time. The dashboard presented key indicators such as the number of completed deliveries, pending payments, and weekly transaction volumes in dynamic graphical form. **Figure 4** shows an example of the distribution monitoring dashboard, where delivery routes and statuses are visualized using color-coded markers. This functionality provided strategic insights that were previously unavailable with static spreadsheets or manual reports. Furthermore, usability testing indicated that users found the dashboard

ISSN: 2715-6427

intuitive and valuable for decision-making. The system also generated periodic summaries delivered via Telegram Bot notifications, ensuring that both collectors and business owners remained informed without the need for manual record-keeping. This dual-channel approach combining dashboard visualization with instant messaging notifications proved to be an effective strategy for maintaining operational transparency [17], [18].

3.4 Comparative Discussion with Previous Approaches

Compared to conventional database-driven solutions, the proposed system provides an **end-to-end automation mechanism** that covers transaction input, verification, and visualization in one integrated framework. Previous works largely focused on either record digitization or dashboard visualization, but did not integrate automated verification tools such as Telegram Bot [19]–[22].

The novelty of this research is evident in the combination of fraud prevention and decision-support features. By eliminating duplicate claims, the system safeguards financial accuracy, while the interactive dashboard supports managerial decision-making through real-time insights. This dual benefit highlights the broader applicability of the system beyond CV Al Ameen, particularly for small- and medium-scale enterprises in agricultural supply chains.

3.5 Summary of Findings

The findings can be summarized as follows:

a) The digital administration system was successfully developed using the Agile Model, ensuring adaptability to operational needs.
b) Telegram Bot integration enabled automated payment verification, reducing the risk of duplicate claims and accelerating fund disbursement.
c) The interactive dashboard provided real-time insights into transaction and distribution flows, supporting more informed decision-making.
d) Overall, the system improved efficiency, accuracy, and transparency compared to manual or semi-digital solutions.

These results confirm that digital transformation in agricultural administration not only addresses operational inefficiencies but also contributes to building more resilient and transparent business processes.

4. CONCLUSION

This study successfully demonstrates the impact of digital transformation in streamlining the sugarcane sales administration process at CV Al Ameen. Through the integration of payment automation, Telegram-based communication, and real-time visual analytics, the developed system effectively mitigates the challenges of manual administration, including recording errors, delayed transactions, and duplicated payment claims. The automation of transaction recording and payment verification not only improves operational accuracy and speed but also enhances transparency in fund disbursement and stakeholder communication. Quantitative evaluation indicates that the system reduced data inconsistencies by 78%, improved transaction processing efficiency by 65%, and increased transparency in payment distribution by 70%. These results affirm that automation and analytics substantially strengthen operational reliability and governance in agricultural business workflows. The implementation of the Agile development model further ensures iterative enhancement and responsiveness to user feedback, supporting long-term scalability toward web and cloud-based deployments. Beyond addressing CV Al Ameen's internal administrative inefficiencies, the proposed framework offers a replicable model for small and medium agribusiness enterprises, particularly those seeking to modernize financial workflows and improve data-driven decision-making. Overall, this research contributes to the advancement of agricultural digitalization by illustrating how intelligent automation and visual analytics can bridge the gap between traditional operations and Industry 4.0 paradigms promoting greater efficiency, accountability, and sustainability within the sugarcane supply chain.

ACKNOWLEDGEMENTS

The author would like to express sincere gratitude to all parties who contributed to the successful completion of this research. Special appreciation is extended to the management and staff of CV Al Ameen for their valuable cooperation, insights, and support during the system development and implementation process. The author also acknowledges the guidance and encouragement provided by academic supervisors and colleagues, whose feedback greatly enriched the quality of this work.

This study was made possible through the support of ITSM, whose financial assistance and resources were instrumental in carrying out the research. The author is also grateful to family and friends for their continuous encouragement throughout the research journey.

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