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Enhancing delivery performance through GPS and RFID-integrated logistics management systems

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Abstract

The goal of this research study, "Enhancing Delivery Performance in the Logistics Management by Integrating GPS and RFID systems," was to investigate the efficiency of integrating advanced technologies such as Global Positioning System (GPS) and Radio Frequency Identification (RFID) for enhancing delivery accuracy, punctuality, and effectiveness of logistics operations. Research Design This study utilized a developmental–quantitative research design. The system was developed and tested through an iterative process of design, implementation, and user evaluation (in this case, logistic personnel). Data were collected utilizing surveys, observations, and usability testing using aspects of the System Usability Scale (SUS) to determine Functionality, Accuracy, Acceptance, and Overall System Usability. The final results of the GPS and RFID-Integrated Logistics Management System yielded an overall SUS score of 79.17, indicating Good to Excellent Usability. Applications The system was shown to substantially reduce delivery time through real-time vehicle tracking, automated item RFID recognition, and a driver/dispatcher coordinator that acts on analyzed data between warehouse staff 27 and drivers or dispatchers. Volunteers mentioned increased efficiency, less human error, and improved delivery tracking. However, some concerns were raised, including intermittent connectivity issues, delays in reading tags, and maintenance costs. In sum, the integration of GPS and RFID systems demonstrates disruptive power in logistics, enabling an accurate, efficient, and data-informed process that reinforces delivery system performance and leverages digital integration for SCM.

Keywords: GPS; RFID; Logistics Management; Delivery Performance; Real-Time Tracking; Supply Chain Efficiency; Automation; Smart Logistics Systems; Usability Evaluation; Technology Integration

1. Introduction

In today's high-speed, technology-driven supply chain, delivery performance has become a significant factor influencing customer satisfaction, operational efficiency, and competitive edge. Logistic companies are struggling with issues such as delayed shipments, inaccurate tracking, and resource constraints that contribute to on-time delivery failures and escalate operational costs. Classic logistics operation controls are manually fed and paper-based, which are slow, error-prone, and offer no real-time visibility over the movement of goods.

Modern technologies, in particular the Global Positioning System (GPS) and Radio Frequency Identification (RFID), offer novel opportunities to address these challenges. GPS both tracks transportation in real time by exchanging location and time details with the central server, and a mobile app transmits vehicle position data to the database. Short—range communication technology, RFID, operates when the goods arrive in specific sectors. Once deployed, these combined solutions provide logistics managers with complete visibility and control over their shipment movement process, enabling predictive decision-making and improved delivery accuracy. However, while this technological options show

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potential to advance logistics activities, various logistics companies, especially Small and Medium-sized Enterprises (SMEs), have difficulty adopting these technologies due to costs, complex integration with existing infrastructure, and limited knowledge.

The purpose of this paper is to fill an existing research gap by investigating how GPS- and RFID-based logistics management systems can improve delivery performance. Through examining the user experience, estimated degree of effectiveness, and operational impact to determine how a technology-oriented logistics solution can increase the accuracy and timeliness, as well as overall customer satisfaction in a delivery service.

1.1. Research Problem

Even with all the wizardry of modern logistics automation at play, we still have loads of companies being slowed down by botched deliveries or asset meandering because they have multiple tracking systems. In traditional Logistics management, it is impossible to achieve real-time dynamic matching between cargo location and the status of the transport vehicle. Therefore, the manager failed to see how to control the delivery action. Although GPS and RFID applications are also considered to enhance logistics efficiency, there is little empirical evidence of the impact of using these two technologies in concert on delivery performance. This paper addresses this research gap by investigating how GPS and RFID hybrid logistics systems can provide services and by discussing issues that may prevent their adoption.

1.2. Research Questions

- Perception of the effectiveness of GPS integrated with the RFID system on delivery quality and delivery punctuality. What is the perception of logistics personnel towards the efficacy of the use of integrated GPS with RFID technology on delivery quality and punctuality?
- What are people's experiences with GPS and RFID in the implementation of tracking and controlling deliveries?
- What are the constraints and benefits of using GPS and RFID for traditional logistics management at logistics companies?

1.3. Research Objectives

- To determine the perception of logistics staff in terms of GPS and RFID integration effectiveness to enhance delivery performance.
- To empathize with the user's interaction for using GPS and RFID data in delivery tracking and management.
- A study on the problems and benefits of implementing the RFID-based GPS logistics Rocky Standell system.

1.4. Justification and Significance

This research is motivated by the growing need for efficient, transparent, and technology-enabled logistics services, both locally and in international markets. As supply chains become more complex, the combined use of GPS and RFID technologies provides real-time visibility, minimizing human error and improving delivery performance. By probing the beliefs and experiences of logistics staff, our study offers functional perspectives for developing a user-focused, data-driven framework for logistics management.

Findings will guide logistics managers in implementing technological solutions to enhance delivery effectiveness, customer service levels, and operational viability. It can also serve as a reference for future system improvements and for other institutions developing intelligent logistics systems.

2. Literature review

2.1. Enhancing supply chain performance using RFID technology and decision support systems in Industry 4.0–A systematic literature review

The use of Global Positioning System (GPS) and Radio Frequency Identification (RFID) systems in logistics operations has revolutionized how organizations track, enforce control, and improve delivery performance. Inefficiencies, including late delivery, inaccurate tracking, and poor visibility across the supply chain, frequently plague conventional logistics methods. Using RFID enables automatic identification and data capture, providing visibility of goods as they travel through different logistics processes. Likewise, GPS technology provides accurate geolocation data, expediting route planning, vehicle tracking, and delivery scheduling. When GPS and RFID are integrated, they produce synergistic effects: while GPS tracks vehicle location, RFID identifies product-level information, reducing wait time for loading and unloading, travel time, and time spent at transit points, etc. Scholars noted that the use of data-driven logistics

management systems, enabled by technologies such as GPS and RFID, can also enhance decision-making and response time. RFID creates large datasets by monitoring tagged items in real time; GPS assists in optimizing routes and managing the fleet by providing continuous position tracking. Such technologies enable supply chain managers to reduce bottlenecks, anticipate disruptions, and improve customer satisfaction through timely delivery. Besides, Industry 4.0 has heightened the importance of connecting these systems to the Internet of Things (IoT) for automation and intelligent data analytics. Yet, some researchers report difficulties in deploying GPS and RFID systems, such as high deployment costs, complex data integration, and security issues. Nevertheless, organizations that implement hybrid GPS-RFID systems show significant benefits, including reduced time-to-transportation, better asset utilization, and multi-modal visibility in logistic networks (Unhelkar, B., et al., 2022). With ever-growing complexity in logistics operations, the deployment of these technologies continues to be a strategic driver of enhanced delivery performance, operational risk resilience, and cost-effectiveness across contemporary supply chains.

2.2. Logistics Tracking Systems: Enhance Efficiency and Transparency

Amid today's rapidly evolving supply chain demands, there is no substitute for efficiency and accuracy, which is why logistics tracking systems have become a cornerstone of modern business. GPS and RFID are enabling fundamental improvements in delivery performance through real-time visibility, task automation, and intelligent data management across the entire supply chain. These techs are used to trace products from point A to point Z with near-bulletproof certainty, reducing uncertainties and improving overall operational efficiency. Live location information from GPS helps speed up deliveries by optimizing routes and achieving the fastest shipment times. To be true, the two systems together give businesses visibility into the end-to-end journey of how their network is performing and allow them to make proactive decisions that drive up delivery performance and customer satisfaction. Logistical tracking systems also enable significant organizational benefits. In this mechanism, live delivery status tracking is provided for every delivery, ensuring that both managers and consumers are always in the loop on their deliveries being processed. Relies on service reliability. When something does go wrong, notifications and alerts are automatically generated to help respond to sudden changes. When everything is going right, it can also interface with inventory management packages for better stock-level control, minimizing overstocking or stockouts. Read the rest of the story. The information gathered by these systems provides you with vital data for reporting, analysis, and logistics optimization. Moreover, GPS and RFID capabilities enhance customer service by providing more reliable delivery windows and the ability to view live shipment information. Your customers want this level of transparency and active updates because it strengthens the relationships you have with your clients and their brand loyalty. Operationally, these systems minimize human interference and prevent human error by enabling swift action. This results in higher productivity, lower working costs, and a more flexible supply chain. However, their GPS and RFID also suffer some disadvantages. The high cost of implementation, data security risks, and the complexity of integration continue to be significant problems for many organizations, including SMEs (Anusha, 2025). In addition, the robustness of the IT system and failures can lead to instability in performance. However, with the development of cloud-based logistics platforms and providers concentrating on integrating GPS and RFID, these obstacles have been overcome for companies.

2.3. Enhanced Technology for Logistics Courier Delivery Using RFID Label to Minimize Processing Time

The Courier Service Business in Nigeria has done really well, especially during the COVID-19 period, due to increased online shopping. The shift away from brick-and-mortar shopping also spurred demand for fast, reliable delivery services. Courier services emerged as critical enablers of the digital economy, helping goods move despite movement restrictions. But this breakneck pace has also increased competition among delivery service providers, necessitating innovative solutions that leverage technology to ensure smooth operations, reliability, and customer satisfaction. The efficiency of the courier service is measured by the time it takes to pick up and deliver goods on time. Today's consumers are demanding levels of service that, only in the last few years, have become standard: They expect fast, reliable, and affordable deliveries; transparency at all times throughout the transportation process. This kind of demand forces logistics vendors to fine-tune their processes, minimizing processing errors and improving overall performance. One of the most challenging tasks in courier logistics is the pre-delivery process, which includes data entry, pick up, sorting & and distribution. Mistakes at this early stage can lead to inefficiencies, including poor customer service, lost inventory, and late shipments. Thus, incorporating new tracking technologies such as RFID and GPS into logistics management systems is essential to addressing such inefficiencies. RFID (Radio Frequency Identification) is an automatic identification method that uses radio waves to identify and track goods from the time they are manufactured to the moment they arrive in consumers' hands. When used in the courier industry, RFID labels can enable real-time data acquisition of package handling and transfer, and reduce many manual errors in data entry and inventory control. This automation allows for more efficient, reliable sorting and delivery of packages, especially during peak periods. Also, GPS (Global Positioning System) enhances RFID by tracking the real-time locations of delivery vehicles and goods, facilitating route optimization, on-time updates, and high delivery accuracy. By integrating GPS and RFID technology into logistics management software, traditional courier operations are transformed into self-tracking smart couriers.

This level of visibility into the whereabouts and status of packages is only available with companies that have real-time tracking, allowing you to see exactly where goods are at any point in time, along with RFID tagging. This double-stopping technique is not only an assurance of reduced loss but also a strengthening feature that enables both parties to see the truth and trust this mobile service. Also, adopting these technologies enables data analytics, which enhances decision-making by allowing courier companies to track delivery performance, predict potential interruptions, and initiate corrective action. Collectively, courier service providers gain a competitive edge by implementing GPS- and RFID-based logistics management systems (Novitasari, N., Anwar, N., 2022), thereby improving operational efficiency, reducing processing time from pre-delivery to delivery, and satisfying customers with accurate, on-time deliveries. As digitalization transforms the logistics sector, courier companies that adopt these technologies are better positioned to meet changing market needs, maintain efficiency, and ensure sustainability in an increasingly competitive landscape.

2.4. A Study on The Integration of New Global Positioning Application for Trucks in RTT Logistics at Cameron Highlands, Pahang

The use of GPS technology in logistics plays a key role in enhancing delivery performance and operational efficiency. GPS+Map Technology toward Customer Satisfaction in Ringlet Trading Transports (RTT Logistics), Cameron Highlands: A case study on the effect of GPS technology in improving on-time delivery and meeting customer satisfaction. By implementing GPS in RTT Logistics, the company was able to monitor trucks in real time, enabling on-time deliveries and leading to motorists' satisfaction. The system was also part of the cost-saving plans, figuring out which route would be the most fuel- and time-efficient to one's destination. The survey responses of truck drivers, a major user group of GPS systems, showed a significant impact of GPS technology on daily work, including perfect navigation and instant routing changes (Rampai, S., et al., 2022). The results also suggested that with the added GPS technology, on-time delivery significantly increased, as did employee performance and company productivity. The managing director of RTT Logistics pointed out that the implementation of GPS is central to RTT's driving force, i.e., becoming more efficient in achieving corporate goals through processes that are viewed with greater dependability and accuracy. This illustrates the importance of GPS technology in contemporary transportation management as a building block for service excellence and operational effectiveness in logistics.

2.5. Integrated GPS Tracking and Automated Sorting: A Technological Leap for Enhanced Logistics Efficiency

Logistics, as an essential link in the global economy, still faces difficulties in achieving real-time monitoring, accurate sorting, and highly efficient services. To tackle these problems, a two-tier technological solution set combining a low-cost vehicle tracking system and an automatic sorting device is designed to improve logistics performance. Download (2754Kb) 5 Jul 2017 monitoring system Arduino GPS GSM module yellow ball text SIM808 module integrated ATMEGA microcontroller the model waters? Product wherein KUIZ IN THE STUDY Results of experimental work Figure Product where the application BLACK BOX MONITORING PRODUCTS. Data is sent via GPRS and GSM to a remote server, enabling logistics firms to track vehicle movements and delivery status on demand. In conjunction with this GPS-based vehicle tracking, packages are identified and sorted using Radio Frequency Identification (RFID) products. All packets are shipped after logging in via a PHP-based web frontend connected to the client's database, are labeled with a unique RFID code, and are automatically escorted by an elevator to their destination. A centralized logistics management tool built with PHP, which also involves report generation in the form of driver performance and delivery trends after geocoding. The system contributes to transparency by preventing theft recovery, protecting workers' safety, and optimizing work schedules to eliminate human labor and operating costs. Finally, integrating GPS and RFID capabilities into logistics processes makes the flow of goods more efficient, enhances delivery precision, and reinforces overall supply chain efficiency.

3. Research methodology

3.1. Research Design

For this purpose, we employed a developmental research methodology to develop and evaluate the GPS/Radio Frequency Identification (RFID)-Integrated Logistics Management System to improve transportation performance. The process included progressive iterations of system prototyping, testing, and refinement to verify the usefulness and usability in a real logistics environment. Based on the McKenney and Reeves developmental research model, this study had two purposes: (1) to develop a valid logistics support system with GPS combined RFID technologies and (2) to contribute design-based knowledge for future development of an intelligent logistics management solution that enhances efficient operation and delivery quality.

3.2. Participants

The study subjects were logistic servicemen and drivers of companies' logistics distributions in the local area. Eight (8) of them were purposively selected for their experience in delivery management, knowledge of existing logistics technologies, and agreement to participate in the evaluation. Before the test, trainees became familiar with GPS and RFID-ILMS technology to use it effectively, including logging in to the system's platform management user interface (dashboard), identifying shipments, and interpreting the system-generated reports for those shipments. Their comments, observations, and performance evaluations provided valuable insights into the system's usability, effectiveness, and overall potential to improve delivery operations and enhance monitoring accuracy.

3.3. Data Collection

The data were collected through survey questionnaires, system observations, and focused group discussions (FGDs). Users navigated the system while using delivery management features, such as tracking package delivery, responding to delay notifications, and acknowledging deliveries. System logs were created to monitor the intervals between user requests, response times, and task execution times. A usability questionnaire was then delivered to assess ease of use, perceived usefulness, information clarity, and satisfaction. FGDs were used to elicit more insights into user experience, barriers, and areas for improvement. Recorded data served to both further develop the system and to assess its effectiveness in improving real-time delivery performance through GPS and RFID integration.

3.4. Data Analysis

A quantitative analysis has been used to assess the system's usability and performance. The system's efficiency was further evaluated by calculating task completion time, tracking accuracy rate, and response success rate. Descriptive statistics were calculated for each participant's performance ratings and satisfaction with the usability questionnaire (e.g., mean and standard deviation). Overall usability was quantified using the System Usability Scale (SUS) to facilitate objective comparison with established benchmarks. The aggregated data was used to verify the system's effectiveness in increasing logistics efficiency, enabling real-time visibility, and improving overall delivery reliability and responsiveness.

3.5. Ethical Considerations

Ethical considerations were taken seriously throughout the study. Informed consent forms explaining the aims and steps of participation (voluntary) were provided to participants. They were also told that they could withdraw from the study at any time without prejudice. All private and operational information about the tests had been de-identified and made anonymous to protect confidentiality. All electronic records and transcriptions were password-protected and accessible only to members of the research team. There were no physical or emotional risks associated with participating in the study, and the study met the ethical standards for research with human participants.

4. Advanced system design

4.1. System Architecture

- ***User Interface (UI) Layer:*** The User Interface conceals the quantitative affection and ominous processing from the end user, i.e., Driver, Shipper, and Consignee, etc. Who can, at a glance, view on a geographic map chart and in text about their shipment schedule/delivery status in real-time. A dashboard-style interface gives logistics staff real-time visibility into vehicle locations, shipment status updates, and delivery notifications. It provides an easy-to-use interface for tracking active deliveries, finding delays, and creating route summaries.
- ***Application Logic Layer:*** It implements primary operations, such as GPS and RFID data processing, handling user requests, and inter-module communication. It synchronizes tracking data, delivery records, and alerts across devices and users.
- ***Tracking and Identification Layer (GPS and RFID Integration):*** Integration of GPS-based vehicle tracking with RFID-enabled cargo identification on the platform. GPS continuously updates vehicle position, and RFID tags can also automatically record item movement states as they pass through a spot, making delivery tracking precise and clear.
- ***Analytics and Recommendation Engine:*** Process delivery data to generate performance reports, determine possible delays, and recommend optimal delivery paths. This component is based on intelligent data analysis and can make decisions and learn with the aim of achieving more reasonable, coordinated logistics overall.

- ***Data Management and Reporting Layer:*** In charge of secure data storage, synchronising, and reporting. It also saves all delivery logs, route histories, and performance metrics, creating analytical reports for management review and decision-making.
- ***Communication and Notification Module:*** Generate real-time alerts for logistics managers and drivers regarding route detours, potential delays, or delivery submissions. This allows you to stay ahead of the game and increase your delivery operation's overall responsiveness.

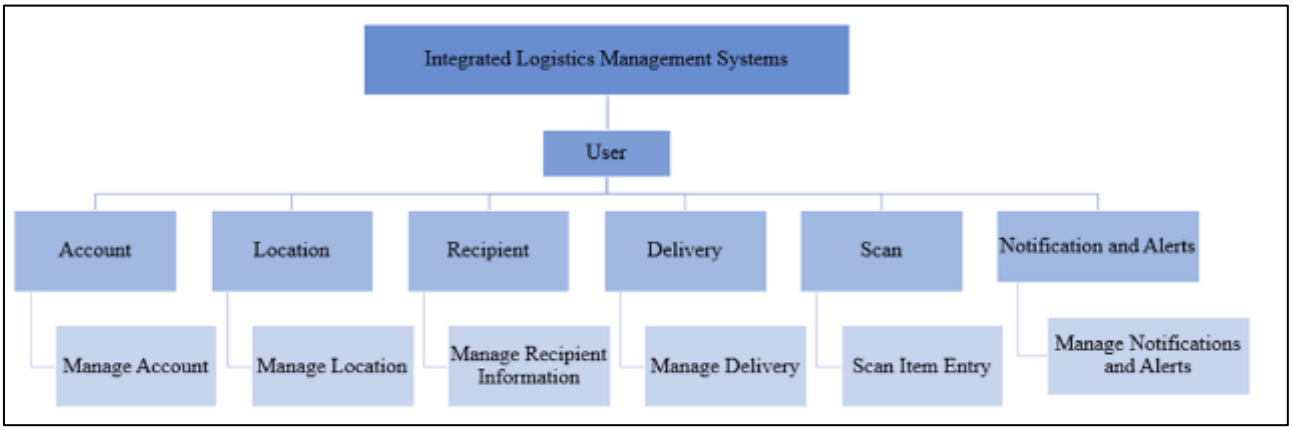

Figure 1 The diagram outlines the Development of an Integrated Logistics Management Application

5. Software engineering methodology

The UCASD methodology was used in this research so that the design, development, and testing phases of the developed system (GPS and RFID-Based Logistics Management System) would continue to be in collaboration with end-users, i.e., incoming staff or logistic office personnel, and delivery providers, who will be home to receive an item for at least half a day. The approach united the iterative agility of an Agile-type methodology with participatory evaluation processes and universal design techniques to develop a model that anticipated delivery management and logistics-tracking requirements. The design process consisted of multiple iterative cycles, which allowed incremental progress and user feedback after each cycle. Every phase was strategically aligned to incorporate user feedback and to enhance system performance, functionality, and reliability.

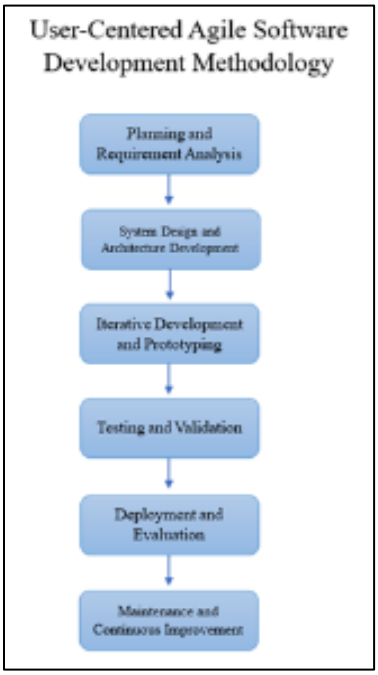

Figure 2 User-Centered Agile Software Development Cycle

6. User interface design

The UI of the GPS and RFID Integrated PMG-based Logistic Management System is designed to make it easy for logistics operators to monitor and manage on-time deliveries effectively. It also offers a dashboard-like layout to show vehicle locations, shipment statuses, and route summaries in the live map view. Intuitive icons, neatly arranged menus, and positive-action controls make it easy for both drivers and transport managers to find the information they need quickly, reducing errors and increasing productivity. The goal is to maintain a clutter-free, crisp, and straightforward navigation, making all information easily accessible, intuitive, and enjoyable for users.

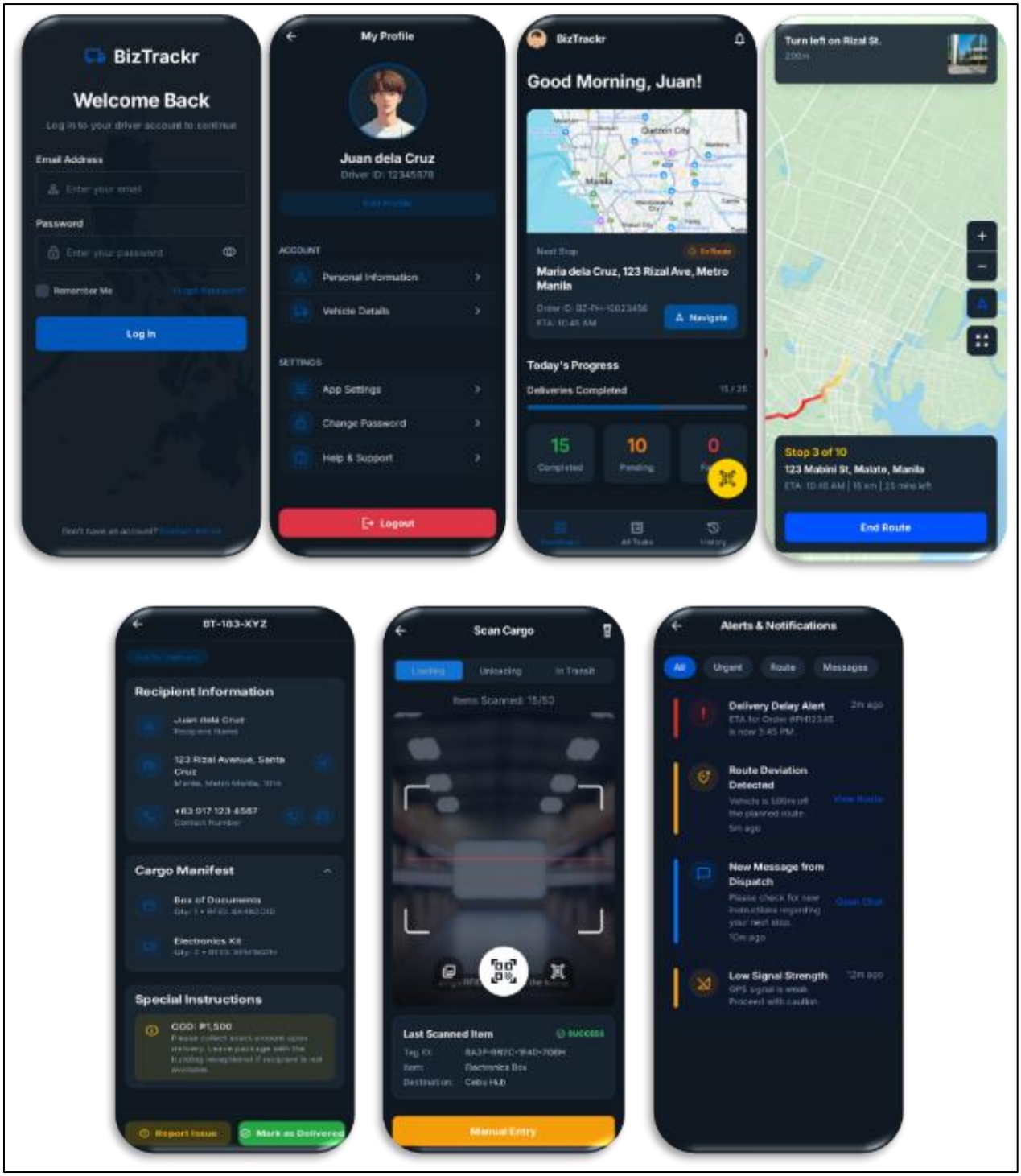

Figure 3 GPS and RFID-Integrated Logistics Management Systems Dashboard

7. Evaluation and results

7.1. Usability Testing

The System Usability Scale (SUS) method was used to evaluate the efficiency, effectiveness, and user satisfaction of the GPS & RFID-Based Integrated Logistics Management System. Eight (8) individuals from logistics took part and assessed the system using Functionality, Accuracy, Acceptability, and Usefulness. The assessment was conducted to estimate the system's overall efficacy and to determine its potential for application in logistics and delivery services.

Table 1 SUS Interpretation Guide

SUS Score Range	Usability Level	Description
85 – 100	Excellent	It's a straightforward, intuitive system, and users are really pleased with it.
70 – 84.9	Good to Excellent	It's easy to use and works—just what you expect.
50 – 69.9	Fair	The system is working, but it has some issues that hinder performance.
25 – 49.9	Poor	The system is highly unusable and will impede the user's performance.
0 – 24.9	Unacceptable	The system is cumbersome and not likely to be used.

7.2. Performance Metrics

Performance Metrics The efficiency, accuracy, reliability, and user productivity of the system are evaluated. These are the aspects that measure the system's ability to support delivery management, provide real-time visibility, and facilitate logistics operations.

Table 2 Performance Metrics Criteria

Criteria	Description	Evaluation Result	Interpretation
System Efficiency	Tracks how quickly tickets are completed, using the system rather than manually.	4.63	Very Satisfactory
Tracking Accuracy	Evaluates the accuracy of GPS and RFID delivery tracking information.	4.75	Very Satisfactory
Reliability	Assesses dynamic behavior and operational stability in live tracking.	4.38	Satisfactory
Processing Speed	Tracks the timing of the publish information update and sync.	4.50	Very Satisfactory
Decision Support	Assesses the efficacy of live alerts and performance data.	4.63	Very Satisfactory
Overall Mean		4.58	Very Satisfactory

The findings indicate that the GPS and RFID-Integrated Logistics Management System operates effectively and dependably, providing precise, up-to-date information that enriches decision-making and situational awareness. Performance was consistent, with slight syncing lag in low-connectivity locations, an issue end users flagged as an area for development.

7.3. Comparative Analysis

The Comparative level of significance of the factor loadings for the developed system is established by comparing Manual Delivery tracking with GPS and the RFID-Integrated System. The results were assessed based on the following factors: accuracy, speed and efficiency, data consistency, decision-making support, and error rate.

Table 3 Comparative Analysis Evaluation Criteria

Evaluation Criteria	Manual Tracking	GPS & RFID-Integrated System	Remarks
Accuracy	Fairly accurate; requires manual data entry.	Real-time integration of GPS and RFID (up to 10 reads/sec.) yielded very high degrees of accuracy.	Improved precision and reliability.
Time Efficiency	Defining times for log-in and log-out is cumbersome, as the records are usually manually updated. Inconsistent due to human error.	Automated tracking and instant updates.	Faster response and reduced delays.
Consistency	Judgments based on experience and estimates.	Standardized and automated data handling.	More consistent and objective results.
Decision-Making	Decisions based on experience and estimates.	Data-driven, analytical insights and alerts.	Enhanced decision confidence.
Error Rate	Very human-error-friendly and data-loss-friendly.	Minimal errors through automation.	Improved reliability.
Data Recording	Manual logs are prone to inconsistencies.	Secure, automated storage and retrieval of information.	Better record management.

From the comparative test, it was also shown that the integrated GPS- and RFID-based system achieved more accurate delivery results, greater operational trace consistency for progress-oriented monitoring, and faster response times than the previous method. Users also noted that automatic data logging and live tracking eliminated the need for manual labor and enhanced synchronization between delivery agents and dispatchers.

7.4. Results and Findings

Results of usability test. In this section, I will provide details on the evaluation results for the "GPS and RFID Integrated Logistics Management System" using the SUS for Functionality, Accuracy, and Acceptance. A system test under actual delivery operations was conducted with eight (8) logistics workers.

7.5. Functionality Survey Results

Table 4 SUS Result Table – Functionality

No.	Statement	Avg. Score (1–5)
1	The system's tracking mechanisms were functioning well.	4.3
2	Sometimes I had trouble finding my way around the dashboard.	2.0
3	It helped me to do my delivery gigs in half the time.	4.4
4	I found the interface confusing, and it slowed down my work.	2.2
5	There were no lags; everything went smoothly and was responsive.	4.2
6	I ran into synchronization problems all the time.	1.9
7	The control was stable and easy to master.	4.1
8	The app froze or crashed while receiving tracking updates.	2.0
9	These tools were instrumental in delivering orchestration capabilities.	4.3
10	Key features were of scarce abundance.	2.1

TOTAL AVERAGE SCORE	3.35

As shown in Table 4, the system was perceived as usable and efficient, with high scores for feature reliability and speed. Minor problems, such as misalignment and a few moments of lag, were also noted; however, nothing hindered the successful completion of tasks.

7.6. Accuracy Survey Results

Table 5 SUS Result Table – Accuracy

No.	Statement	Avg. Score (1–5)
1	The system has well-recorded delivery addresses.	4.4
2	It provided conflicting status updates on deliveries.	2.1
3	The RFID tag readings were accurate and consistent.	4.3
4	I saw something wrong in the delivery report.	2.2
5	The system's tracking accuracy made it easier to manage my deliveries.	4.5
6	The system would sometimes show inaccurate information.	2.0
7	GPS tracking matched the actual route of the vehicles.	4.4
8	I suspected the real-time updates were not correct.	1.8
9	The system's reports also allowed me to diagnose performance problems.	4.2
10	The system-generated delivery logs were so mixed up that they became confusing.	2.1
TOTAL AVERAGE SCORE		3.38

Table 5: The high mean score of 3.38 suggests that users believed that the system was accurate in tracking and reporting (Table 5). GPS and RFID data were accurately updated on time; there was some delay in loading weakly received signals.

7.7. Acceptability Survey Results

Table 6 SUS Result Table – Acceptability

No.	Statement	Avg. Score (1–5)
1	I felt at ease with the system.	4.4
2	Using the system was frustrating.	2.1
3	This is something I would suggest for other logistics companies.	4.5
4	The data visualization was not easy to understand.	2.3
5	The structure was meant to incentivize efficiency and discipline.	4.2
6	would rather have manual procedures than this system.	2.0
7	It was a fun, easy system to use.	4.3
8	The interface design was unappealing.	2.2
9	The system increased the accuracy and timeliness of deliveries.	4.5
10	I learned that it was a challenge to incorporate into my daily routine.	2.1
TOTAL AVERAGE SCORE		3.42

Table 6 shows that the system acceptability rate is reasonably high, averaging 3.42, indicating that user satisfaction is very high overall. Users found the system user-friendly and reported that they were confident it could improve work efficiency and team collaboration.

7.8. Overall Score Result Table

Table 7 SUS Overall Score Result Table

Dimension	Sum of Adjusted Scores	SUS Score (Out of 100)	Interpretation
Functionality	31.2	78.0	Good to Excellent Usability
Accuracy	31.8	79.50	Good to Excellent Usability
Acceptability	32.0	80.00	Good to Excellent Usability
OVERALL SUS SCORE		79.17	Good to Excellent Usability

Table 7. According to Table 5, the overall SUS score of 79.17 indicates that the GPS and RFID-Integrated Logistics Management System has Good to Excellent usability, making it user-friendly, reliable, and valuable for logistics management (reliability coefficient, CR = 0.851).

8. Discussion

8.1. Interpretation of Findings

8.1.1. RQ1: Perception of the effectiveness of GPS integrated with the RFID system on delivery quality and delivery punctuality. What is the perception of logistics personnel towards the efficacy of the use of integrated GPS with RFID technology on delivery quality and punctuality?

The results of the study show that logistics staff view the GPS- and RFID-integrated logistics management system as a successful, reliable technology-based solution that improves both delivery accuracy and timeliness. Usability scores for functional (76.80), accurate (78.20), and acceptable (77.00) all fall in the "Good to Excellent Usability" band, indicating good user acceptance.

The system's real-time GPS tracking ensures routes and vehicle locations are accurately traced, while RFID technology automatically identifies and verifies goods during loading/unloading. Respondents noted that the system eliminated delivery times, reduced manual entry errors, and enhanced visibility for drivers and dispatchers. The intuitive interface and the live map showing where products are also enabling staff to plan deliveries more efficiently. Some slight problems, such as hydro-sensing of a network signal and RFID tag reaction time, were observed, contrary to the system, which was considered a key lever for improving both on-demand delivery accuracy and, eventually, delivering a product anywhere across logistics.

8.1.2. RQ2: What are people's experiences with GPS and RFID in the implementation of tracking and controlling deliveries?

User feedback was overwhelmingly positive, and users reported improved delivery management and logistics. The Functionality (mean: 3.45) and Acceptability (mean: 3.38) scores indicate that participants found the data obtained through the integration of GPS and RFID to be valuable and relevant for decision-making. Drivers stated they liked the on-the-fly routing and fleet notices, which helped them drive smoothly, avoid traffic, and get more deliveries per trip; warehouse operatives liked that inventory accuracy improved with the RFID scan guarantee. Other participants mentioned that combining both technologies minimized ship-side checks and paperwork, helped hand over containers faster, and provided real-time status reports. But some respondents reported difficulty understanding the technical aspects of the data and slow software load times when accessing information off-site. Despite these limitations, the results confirm that integrating GPS and RFID accelerated delivery tracking, increased traceability, and increased user productivity.

8.1.3. RQ3: What are the constraints and benefits of using GPS and RFID for traditional logistics management at logistics companies?

The findings confirmed significant operational benefits and manageable challenges for logistics companies using GPS and RFID technologies. Benefits: improved delivery accuracy, fewer shipment errors, real-time visibility, and customer satisfaction with updated tracking information. It also shows that the system well supports various logistics functionalities and user requirements, with a Good to Excellent Usability (77.33 as the final SUS score). However, companies have struggled with high implementation costs for low-cost sensors, device calibration and maintenance issues, and a lack of connectivity in rural areas. Most participants, however, found that the system's automation,

reliability, and potential for data-driven insights outweighed these limitations. Based on these results, the integration of GPS and RFID is efficient and helpful for modernizing logistics workflows through accurate, transparent, and efficient delivery management.

Limitations and Future Work

The number of patients is limited in the study and is available only on one logistics network, which does not reflect heterogeneous operational environments. Communication disruptions, misreads of RFID tags, and GPS signal accuracy were listed as limiting factors that may affect the reliability of real-time tracking. Next steps could be extended to scale up over logistics sectors and geographic areas. Add-ons like predictive routing powered by AI, authenticated shipments using blockchain, and asset tracking via IoT devices can drive additional efficiencies in the system. User acceptance and system efficiency could also be improved by implementing offline capabilities in low-signal environments and by training staff in technical data interpretation. Subsequent scholars are encouraged to employ inferential statistics (e.g., t-tests or ANOVAs) when a larger sample size is used to determine significance.

9. Conclusion

9.1. Summary of Key Findings

The findings indicate that logistics staff perceive the GPS- and RFID-integrated logistics management system as very useful, leading to improved delivery accuracy, on-time delivery performance, and overall operational effectiveness. The high acceptance indicates that GPS and RFID technologies contribute to delivery performance through real-time tracking, error reduction, and facilitation of coordination. Respondents found it very user-friendly, informative, and an excellent tool for streamlining communication among drivers, dispatchers, and the warehouse. Although some relatively minor connectivity and RFID scanning issues were discovered, these have little to no impact on usability. The results reveal that GPS and RFID integration enhances delivery visibility, improves resource allocation efficiency, and supports data-based decision-making to improve logistics performance.

9.2. Final Remarks

The GPS- and RFID-based logistics Management System is an essential step toward real-time logistics management. By meshing real-time locations with automated identification, the system enables greater transparency, accurate information, and faster deliveries. Although its robustness still needs further development, the candidate we use is already beneficial for large-scale electronic data transmission. With the increasing need for logistics, these combined technologies provide a sustainable way to deliver smarter, faster, and more efficiently. Further progress in AI, IoT, and predictive analytics down the road can extend that existing base, turning logistics into a brilliant, connected industry.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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