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Web-Based ERP System Prototype for Enhanced Inventory and Supply Chain Management in the Logistics Industry

Valdy Beniah Hadikin[1], Jansen Wiratama[2*]
[1] Information System Study Program, Universitas Multimedia Nusantara, Tangerang, Indonesia
valdy.hadikin@student.umn.ac.id
[2] Information System Study Program, Universitas Multimedia Nusantara, Tangerang, Indonesia
jansen.wiratama@umn.ac.id

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***Abstract*— Technological advancements have driven companies to adopt innovative solutions to improve efficiency and streamline operations. PT Kesuma Express, a logistics company in Indonesia, faced inefficiencies and frequent errors due to its reliance on manual processes such as transaction recording, document management, and income reporting. This research developed a web-based Enterprise Resource Planning (ERP) system prototype to address these challenges, focusing on Inventory and Supply Chain Management (SCM) modules. The prototype uses the Rapid Application Development (RAD) model and the Laravel framework and includes key features such as transaction recording, customer data management, and financial reporting. The inventory module enhances truck data management, monitors truck availability, and alerts users about data discrepancies, ensuring accuracy and timely actions. The SCM module supports the delivery process by providing real-time delivery status tracking that is accessible to both warehouse staff and administrators, enabling transparency and efficiency in goods distribution. The system replaced PT Kesuma Express manual processes, significantly improving operational efficiency and reducing errors. By integrating inventory and SCM capabilities, the ERP system has streamlined operations, enhanced data accuracy, and improved customer service quality. This research demonstrates the transformative potential of ERP systems for logistics companies aiming to modernize their operations.**

***Index Terms*— ERP system, Inventory; RAD; Supply Chain Management; Web-based.**

I. INTRODUCTION

An information system is a formal system designed sociotechnically and organizationally to collect, process, store, and distribute information, especially in addressing management accounting problems [1]. Information systems comprise hardware, software, and telecommunications networks that collect, create, and distribute valuable information [2]. Over time, information systems have evolved from simple tools to essential and strategic elements integral to modern organizational structures. The optimization of information systems has led to integrated developments, such as Enterprise Resource Planning (ERP) [3].

ERP systems have become a critical tool for companies worldwide, from startups to large enterprises, enabling them to manage resources more effectively and efficiently [4]. ERP integrates hardware and software with various functions, including data coordination, process integration, decision-making support, and timely reporting [5], [6]. By unifying diverse business activities—such as sales, marketing, manufacturing, logistics, and accounting—ERP systems streamline operations and enhance business process efficiency [7], [8].

Advancements in ERP technology have also introduced new functionalities, including cloud-based systems, modular approaches, and real-time analytics, making ERP more accessible and flexible for businesses of all sizes. Recent developments in application development methods, such as Rapid Application Development (RAD), emphasize speed and adaptability in creating ERP solutions. These methodologies ensure systems are developed efficiently while aligning with user requirements, reducing project risks, and enabling iterative improvements.

Previous studies have shown the effectiveness of ERP systems in improving operational efficiency across industries, such as inventory optimization in manufacturing [9] and enhanced delivery accuracy in retail supply chains [10]. However, these studies primarily focused on large enterprises with established digital infrastructures and often used traditional development methods. In contrast, this research targets PT Kesuma Express, a medium-sized logistics company reliant on manual processes, presenting unique challenges like document mismanagement and communication delays. By adopting the Rapid Application Development (RAD) model, this study

develops a web-based ERP system with tailored inventory and supply chain management (SCM) modules, addressing gaps in existing research and offering a practical solution for companies transitioning from manual to digital operations.

Despite these advancements, some companies still face challenges due to manual processes. For instance, at PT Kesuma Express, logistics operations rely heavily on outdated methods for transaction recording, truck availability checks, and communication during goods delivery. These processes often lead to inefficiencies, errors, and delays in decision-making.

Manual record-keeping leads to various inefficiencies, including misplaced documents, redundant data entry, and inaccurate inventory counts, which disrupt operations and increase the risk of errors. It also causes delivery delays due to miscommunication and inconsistent tracking methods, while manual financial reporting often results in calculation mistakes, leading to inaccurate decision-making. Additionally, the time-consuming nature of retrieving and compiling information manually slows down overall processes, further highlighting the need for automated systems like ERP to streamline operations, improve accuracy, and enhance efficiency [11].

This research aims to develop a web-based ERP prototype featuring inventory and supply chain management (SCM) modules to address these issues. Utilizing the RAD model, the prototype incorporates transaction recording, customer data management, income reporting, and real-time delivery tracking features [12], [13]. The system's CMS-based interface allows users to create, manage, and store data while automating key tasks to improve operational efficiency. Testing demonstrated significant improvements in data accuracy, workflow efficiency, and decision-making, providing a practical ERP model for small- to medium-sized logistics companies aiming to modernize their operations.

II. METHODS

The Rapid Application Development (RAD) model is a software development approach that is very suited to the dynamics of modern technology projects, including website development. Compared to traditional methodologies that are more rigid and focus on detailed planning before starting coding, RAD prioritizes fast and iterative development, making it ideal for projects that require speed and flexibility [14]. The flexibility advantage of the Rapid Application Development (RAD) model becomes very significant in a development environment that is fast-paced and full of changes, such as when creating applications or websites [15]. RAD's flexibility allows development teams to adapt to changing needs, leverage the latest technologies, and effectively meet user expectations. With RAD, testing does not just happen at the end of the development phase but is an integral part of every iteration [16]. Every aspect of the website or application is tested and assessed continuously, reducing the risk of major problems at product launches [17]. This flexibility in testing also allows for immediate adjustments based on feedback, ensuring that the final product is the best it can be under existing conditions. Overall, the flexibility of RAD provides a powerful framework for software development that is effective in addressing challenges and change and optimal in proactively exploiting new opportunities and innovation [18]. This method ensures that the developed product adapts to user needs and changing market conditions [19].

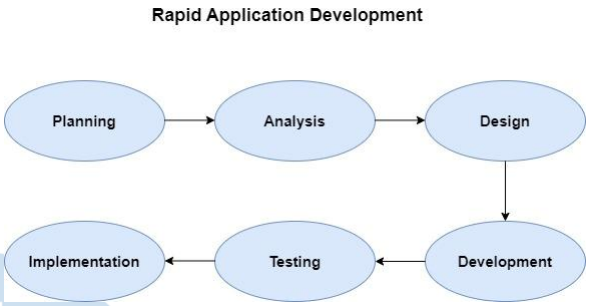

Fig. 1. RAD Model

A. *Planning*

This part of the planning stage is the initial stage in designing a website using the RAD model. The first step in this planning stage is to determine and identify the purpose of creating and designing this website by addressing the problems within the company through detailed discussions. PT XYZ, a logistics company, currently relies on manual processes for transaction recording, truck availability checks, and communication during goods delivery. These manual methods have resulted in various inefficiencies, such as misplaced documents, inventory records errors, delivery delays, and communication breakdowns between staff and drivers. These issues hinder operational efficiency, increase the likelihood of human errors, and negatively impact customer satisfaction.

By clearly defining these problems during the planning phase, the system to be developed will be designed to address these specific challenges, ultimately creating an automated solution that streamlines operations, reduces errors, and enhances overall productivity. Additionally, identifying the intended users of this technology system, such as administrators, warehouse staff, and drivers, ensures that the system meets their needs and supports seamless adoption.

B. *Analysis*

The analysis stage was the most critical phase in the development of this project, particularly in the context of Rapid Application Development (RAD). This stage focused on gathering detailed data from users to understand their specific challenges fully. User

involvement was central at this point, as their input provided valuable insights into the problems encountered in their daily operations, such as manual errors and inefficiencies. Through direct interviews and feedback sessions, users contributed detailed information that shaped the system's functional requirements [20]. This process allowed for a clear understanding of the essential features the system needed to include, such as transaction tracking, inventory management, and delivery status updates. By deeply involving users in this stage, we ensured that the system's design directly addressed their pain points, laying the groundwork for a solution aligned with their operational needs. The insights from users guided the creation of system features and helped identify potential obstacles early, ensuring a smoother design and development process moving forward [21].

C. Design

This design stage is where the design of the system you want to create has begun. The technique used to model the development of this system is to use Unified Modeling Language (UML) modeling [24]. UML is a visual language used to model and design software systems graphically. UML allows software developers to describe software systems' structure, behavior, and interactions clearly and structured. A UML Diagram is a graphical representation of various aspects of a software system described using UML. UML diagrams describe various concepts and elements in software systems, including class structure, relationships between classes, system behavior, and interactions between objects in the system [25]. The specifics of this stage are designing a UI/UX design for the website using existing tools such as Figma to simplify the UI/UX design process [22]. The purpose of creating this UI/UX design is to facilitate future development activities so that from this design stage, you can get an idea of the website's appearance, which will be created later by programming. This design needs to pay attention to design arts and design rules so that the appearance of this website looks interactive and comfortable for users who use it.

D. Development

This development stage is where the actual website design has been carried out. A programming activity is carried out so that the website system can run according to the previous stages discussed, including creating features in the web system to be used by future users [23]. The programming carried out, of course, uses a programming language that supports the creation of this website. The programming language used in this research is PHP using a framework, namely Laravel, followed by a CSS library, namely Bootstrap; where this CSS library can simplify design activities for the web you want to create and also a framework that can simplify many activities such as connecting code. With a database, logic can be created so that features can run according to the plan that was discussed previously.

E. Testing

The testing phase takes place after the development stage is complete. At this stage, the system and its features are tested in detail to ensure they function as intended. If any issues, such as errors or bugs, are identified, the system will be corrected to ensure the features meet user requirements. This research employs the User Acceptance Testing (UAT) method combined with black-box testing, which focuses on testing the system's functionality without examining its internal structures or code.

Users are actively involved in this process to provide feedback on the system's usability and effectiveness. Testing is crucial because a system that does not run well can lead to user dissatisfaction and fail to address their needs. By involving users directly in the testing process, this stage ensures that the final system resolves the problems it was designed to address while meeting user expectations for functionality and reliability.

F. Implementation

The implementation stage is the final stage of the RAD model, where the system has been implemented, and users can interact with this system directly.

III. Results And Discussions

The result of this research is the development of a web-based prototype at PT Kesuma Express by utilizing ERP modules, namely supply chain management and inventory modules. This web prototype was also created using the Laravel framework. Some of the displays on this website are a dashboard for the admin and warehouse, and there are also various features available, such as adding transaction data, transaction reports, checking truck availability, printing a waybill for each existing transaction, and editing the tracking status of goods.

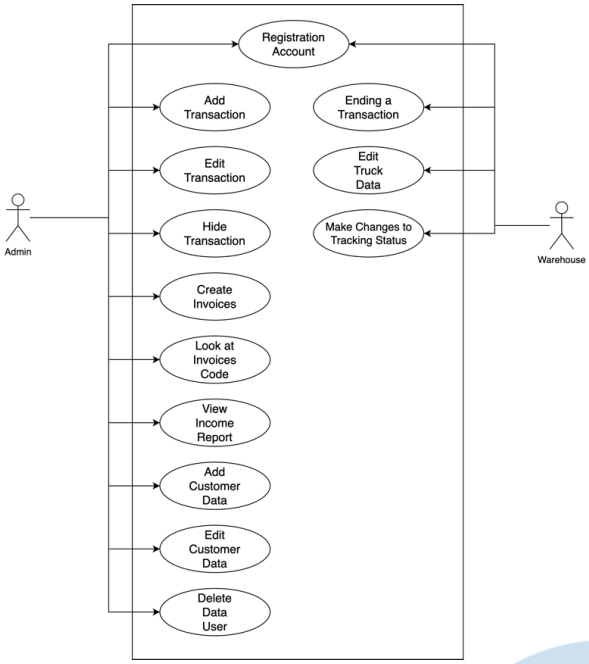

Fig. 2. Use case diagram of inventory and SCM

From the Fig 2. Use case diagram, there are two actors: admin and warehouse. In the admin actor section, the admin can perform various actions such as adding, editing, deleting transactions, viewing and printing travel documents, viewing income reports, adding customer data, and editing and deleting user data. Next, there is another actor, namely the warehouse actor, who has access to ending a transaction, editing the status of tracking trucks and the number of truck data in the warehouse.

Activity diagrams are visual tools used in modeling business processes or system workflows. It provides a graphical representation of the steps involved in a process, often showing the sequence of activities, decisions, and conditions that may occur [26].

The activity diagram based on the use case diagram highlights three key processes in the system: the **transaction process**, which automates recording and managing transactions; the **invoice process**, which handles invoice generation and management; and the **tracking process**, which enables real-time monitoring of delivery status. These processes are essential to the system's functionality, focusing on improving efficiency, reducing errors, and ensuring accurate and timely updates for users:

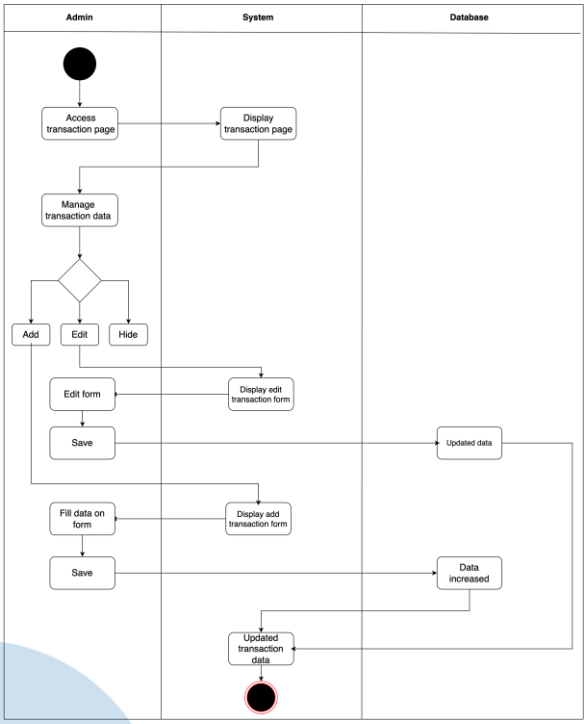

Fig. 3. Activity diagram of transaction process

Figure 3 explains an activity diagram from the admin side, where the admin can add transaction data, edit transaction data, and delete transaction data. The admin will connect with the systems and the database. These data flow will be start with the initial node and terminated with the final node.

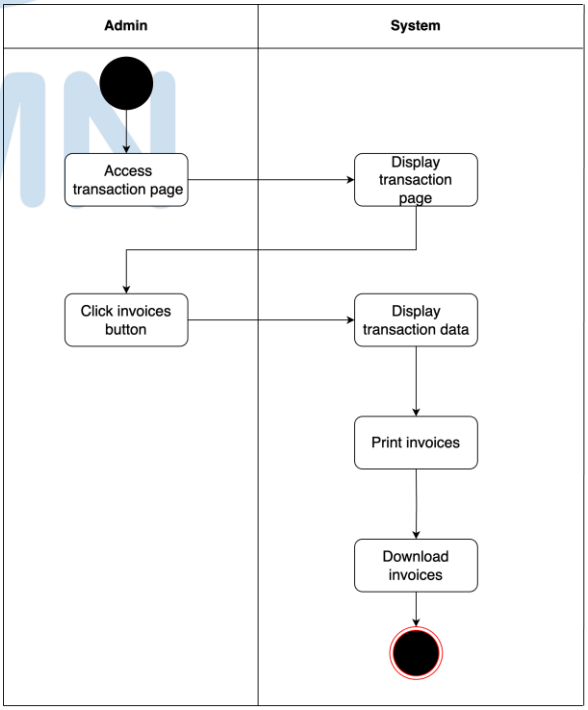

Fig. 4. Activity diargram of invoice process

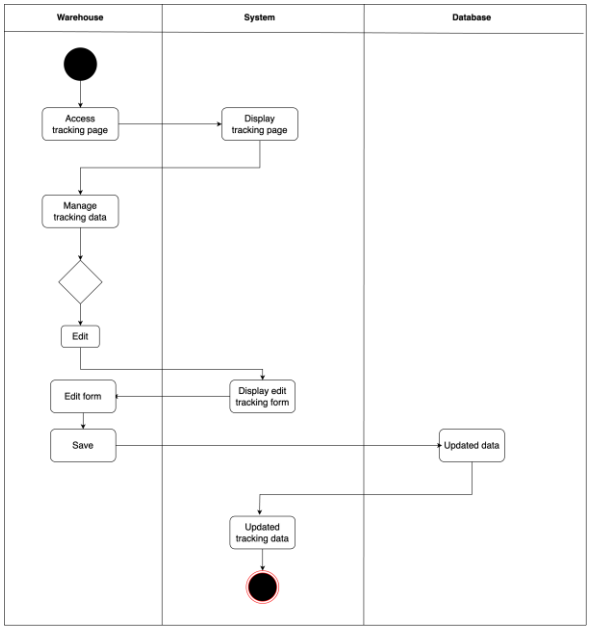

Fig. 5. Activity diagram of tracking process

Figures 4 and 5 are activity diagrams from the admin for printing travel documents. The admin can select transactions whose data will be printed in PDF format so that the results can be exported later. Next is an activity diagram from the warehouse side to edit the status of each transaction tracking. The warehouse can press a button to display a form, and in that form, the warehouse can change the status of tracking the goods.

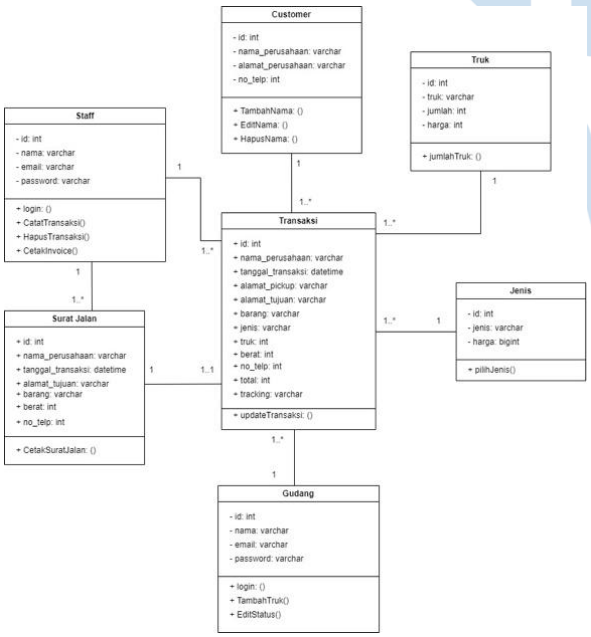

Fig. 6. Class diagram of web-based ERP system

Class diagrams are a type of diagram used in software modeling to describe the static structure of a system or application. This diagram displays the classes in the system along with the relationships and attributes possessed by each class [27]. Figure 6 is a class diagram in this research and there are 7 classes, namely: Transaction, Travel Document, Customer, Staff, Warehouse, Truck, and Type.

The result of this research is the development of a web-based prototype at PT Kesuma Express by utilizing ERP modules, namely supply chain management and inventory modules. This web prototype was also created using the Laravel framework. Some of the displays on this website are a dashboard for the admin and warehouse, and there are also various features available, such as adding transaction data, transaction reports, checking truck availability, printing a waybill for each existing transaction, and editing the tracking status of goods.

A. Dashboard

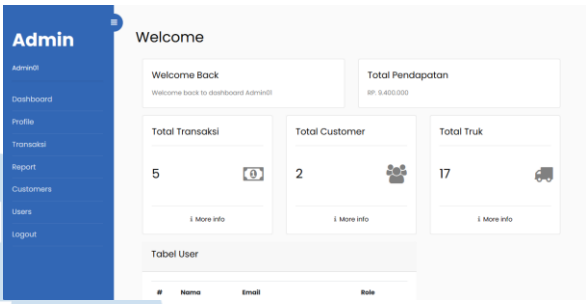

Fig. 7. Dashboard view of web-based ERP system

The system will display this after the user registers an account and logs in using the previously registered account. Figure 7 shows a display of the admin dashboard menu. This display shows data and information related to the transaction, customer, and truck data on this dashboard page so that the admin can find the amount of data from these three data. This dashboard display also displays the total income from each transaction that occurs.

B. Transaction

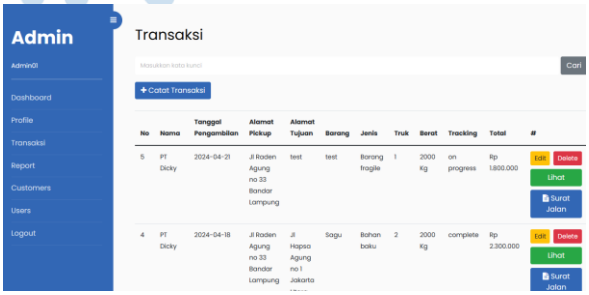

Fig. 8. Add transaction simulation

Figure 8 shows a display of the admin section of the transaction page, where this display displays all transaction data that has occurred and has been made previously. This data is taken from tables in the database so that all the data is displayed in a table after it is taken. In the table, there are various columns, namely number, name, pickup date, pickup address, destination address, goods, type, truck, weight,

tracking, and total, and there are four buttons, namely edit, delete, view, and travel documents.

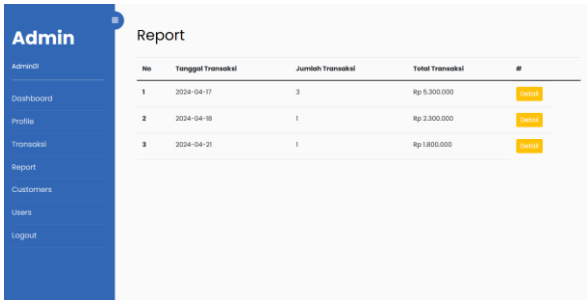

Fig. 9. Transaction report simulation

Figure 9 shows a display of the transaction report, where this display will display all transactions that have occurred and grouped according to the date the transaction occurred. This display also automatically calculates the transaction income according to the date. There is also a button to view detailed transactions that occur on each date in more detail.

C. Logistics and Administration

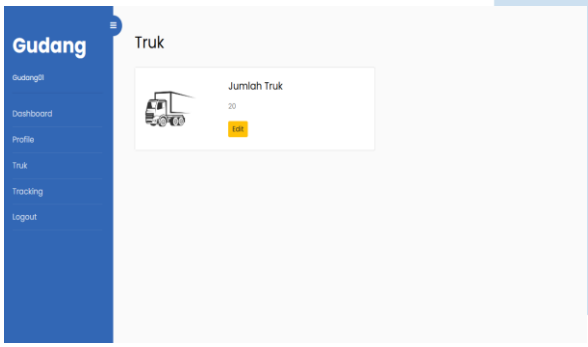

Fig. 10. Checking logistics vehicle availability

Figure 10 shows a display to display the number of trucks in the database. This display displays the number of trucks available in real-time and an edit button to change the number of trucks. The following interfaces display the process of invoice, delivery order, and tracing goods delivery.

Fig. 11. Create invoice

Fig. 12. Generated delivery order letter

Figure 12 shows a display of one of the transactions that the admin has input, and the transaction data results are displayed in a table. In this part of the table are two buttons, the "View" button and the "Travel Document" button, where two buttons run the feature for creating travel documents for each transaction. The "View" button itself will direct you to a new display that displays all the data from the transaction and also creates a code for each waybill, where this code is unique and will be created for each existing transaction so that the code will continue to be there. Each transaction and the code will not change. The "Travel Letter" button is a button that prints a travel letter for each transaction that occurs. Figure 12 also shows a display in PDF form of the travel document, which will later be downloaded or printed by the user to send the goods. This display will appear after the user saves new data and the unique code for each transaction. Then, the user presses the "Travel Letter" button, leading to a new display that displays all the data as a PDF file ready to be downloaded or printed.

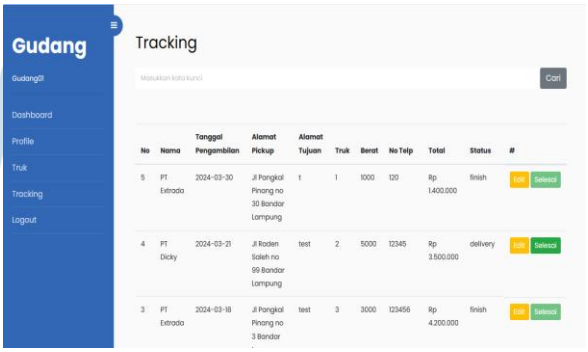

Fig. 13. Tracking goods delivery

Figure 13 shows the tracking status from the warehouse side. This view generally displays a table containing data from transactions input from the admin side. In this view, the warehouse has access to make changes to the status or tracking of each existing transaction; the warehouse can only change the status of the transaction so that from the admin side, it will get information in the form of status changes that occur from each transaction. There is also a "finish" button where the truck database automatically increases the number of trucks used if the transaction is complete.

D. User Acceptance Test (UAT)

After completing the development of a web-based system prototype, the system will be tested to determine its readiness and suitability. Testing is carried out with the company so that the company knows whether the system that has been created is suitable for use in the company. Table 1 shows the results of the user acceptance test.

TABLE I. UAT RESULT

No	Features	Descriptions	Status
1	Add transaction	User presses the "Record Transaction" button to enter transaction data in a form.	Pass
2	Displays detailed transaction reports	Users press a "Detail" button to see more details of the transaction.	Pass
3	Display data and edit truck data	Users open the truck menu in the sidebar of the warehouse page then press the "Edit" button to make data changes.	Pass
4	View and save travel letter codes	The user presses a "View" button to view the travel letter code.	Pass
5	Print invoices	The user presses the "Travel Letter" button to print the travel document in PDF format.	Pass
6	Carry out the tracking status editing process	The user presses an "Edit" button to change the tracking status in a form.	Pass

The inventory management module enabled real-time tracking of truck availability and flagged discrepancies, enhancing accuracy and fleet management. In contrast, the supply chain management (SCM) module allowed warehouse and admin staff to monitor delivery statuses, increasing transparency and coordination. These improvements directly addressed human error and inefficiency issues, ultimately leading to better customer service. However, the system has limitations, such as its basic functionality and lack of mobile support, which could be addressed in future updates to optimize operations further. Compared to larger-scale ERP systems, this prototype offers a cost-effective, tailored solution, though it lacks advanced analytics seen in more complex systems. Unexpectedly, the system revealed inefficiencies in PT Kesuma Express's existing workflows, prompting procedural improvements beyond the system's initial goals. This ERP system.

E. Discussion

The findings of this research demonstrate that implementing a web-based ERP system with inventory and supply chain management (SCM) modules significantly enhances operational efficiency for PT Kesuma Express. These results align with previous studies [9], which highlighted the role of ERP systems in optimizing inventory management through real-time data tracking [10] which emphasized improved delivery accuracy and transparency in supply chain operations. However, unlike these studies, which often focused on large enterprises with advanced digital infrastructures, this research addresses the challenges faced by medium-sized companies transitioning from manual to digital processes, providing practical insights for similar organizations.

In the Indonesian context, ERP adoption is still emerging, particularly among small- to medium-sized enterprises (SMEs), which often struggle with resource constraints and resistance to change. Implementing the ERP system in PT XYZ highlights the potential of ERP to bridge this gap by streamlining manual processes, reducing human error, and improving overall efficiency. The research also underscores the importance of tailoring ERP solutions to the specific needs of Indonesian businesses, considering their operational scale and challenges.

The successful integration of inventory and SCM modules in this study demonstrates the ability of ERP systems to address operational inefficiencies while enhancing customer service quality, providing a strong case for broader adoption of ERP technology in Indonesia's logistics and other SME-dominated sectors.

IV. CONCLUSION

This research succeeded in creating a web-based ERP system prototype that significantly increased the operational efficiency of PT Kesuma Express. This prototype has various features like transaction recording, customer data management, and financial reports. Implementing this system replaced the company's manual recording method, significantly improving work efficiency. The developed inventory module facilitates effective management of truck data, providing the ability to monitor truck availability and alert users if data discrepancies occur during transactions. This ensures the accuracy of information and efficiency in delivery. The supply chain management (SCM) module that was created supports the delivery of goods by providing a delivery status tracking function that users from the warehouse and admin can access. This allows both parties to monitor and update delivery status, ensuring transparency and effectiveness in the goods distribution process. This research shows that by integrating an ERP system equipped with inventory and supply chain management (SCM) modules, PT Kesuma Express can operate more efficiently and effectively and improve customer service quality.

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REFERENCES

[1] Chrisjunianti, D. Olivian, and Jennifer, "Analisis Manfaat Perancangan ERP Payroll Pada Kinerja Perusahaan," *J. Manajemen, Ekon. Keuang. dan Akunt.*, vol. 3, no. 1, pp. 327–333, 2022.

[2] N. E. P. Aji, U. Y. K. S. Hediyanto, and M. Saputra, "Perancangan Sistem ERP Smart UKM pada Proses Warehouse Management untuk Pengelolaan Stok Barang Menggunakan Metode Service Oriented Architecture Smart ERP System Design in The Warehouse Management Process for Management of Stock Items Using Service-Orient," *eProceeding Eng.*, vol. 7, no. 2, pp. 7479–7486, 2020.

[3] B. W. Suhanjoyo and N. Aryo, "Perancangan Aplikasi Gugus Penjualan Terintegrasi Erp," *Conf. Innov. Appl. Sci. Technol. (CIASTECH 2020)*, no. Ciastech, pp. 461–470, 2020.

[4] I. Milojević and D. Rejman-Petrović, "The impact of Enterprise Resource Planning (ERP) on business process outcomes in tourism companies," *Menadzment u Hotel. i Tur.*, vol. 11, no. 2, pp. 89–101, 2023, doi: 10.5937/menhottur2302089m.

[5] F. Rahmadan, Y. T. Mursityo, and N. H. Wardani, "Evaluation of User Acceptance of Enterprise Resource Planning System at Material Resource Planning Division of PT. Xacti Indonesia," *INTENSIF J. Ilm. Penelit. dan Penerapan Teknol. Sist. Inf.*, vol. 5, no. 1, pp. 27–42, 2021, doi: 10.29407/intensif.v5i1.14590.

[6] E. Prasetyaningrum and B. Setyawan, "Pengembangan Sistem ERP Modul Inventory Management Pada Kantor Perwakilan PT. BGA Group," *Smatika J.*, vol. 13, no. 01, pp. 106–116, 2023, doi: 10.32664/smatika.v13i01.749.

[7] L. Meilani, F. Adinda, and V. Lilya Kevin, "Jurnal Mirai Management Pengaruh Penerapan Sistem Manajemen Sumber Daya Perusahaan (ERP) dalam Meningkatkan Kinerja PT. Belfoods," *J. Mirai Manag.*, vol. 8, no. 2, pp. 53–57, 2023.

[8] H. A. Rizkyah and D. Herwanto, "Pengembangan Sistem Informasi Enterprise Resource Planning untuk PT . ABC dengan Metode Waterfall di PT . Hashmicro Solusi Indonesia," vol. VIII, no. 3, pp. 6062–6069, 2023.

[9] I. Madanhire and C. Mbohwa, "Enterprise Resource Planning (ERP) in Improving Operational Efficiency: Case Study☆," *Procedia CIRP*, vol. 40, pp. 225–229, 2016, doi: 10.1016/J.PROCIR.2016.01.108.

[10] V. Pasupuleti, B. Thuraka, C. S. Kodete, and S. Malisetty, "Enhancing Supply Chain Agility and Sustainability through Machine Learning: Optimization Techniques for Logistics and Inventory Management," *Logistics*, 2024, doi: 10.3390/logistics8030073.

[11] W. Y. AlHayek and R. A. A. Odeh, "Exploring the Impact of ERP Systems on Business Efficiency...," *Benha J. Appl. Sci.*, 2024, doi: 10.21608/bjas.2024.318158.1491.

[12] D. Hariyanto *et al.*, "IMPLEMENTASI TEKNOLOGI BARCODE PADA PENDATAAN BARANG DENGAN METODE RAD," *J. Al-ilmi*, vol. 13, no. 1, pp. 110–117, 2021.

[13] B. Rudianto and Y. E. Achyani, "Penerapan Metode Rapid Application Development pada Sistem Informasi Persediaan Barang berbasis Web," *Bianglala Inform.*, vol. 8, no. 2, pp. 117–122, 2020, doi: 10.31294/bi.v8i2.8930.

[14] R. T. Aldisa, "Penerapan Metode RAD (Rapid Application Development) Pada Sistem Informasi Promosi dan Pemesanan Makanan Berbasis Website Studi Kasus Restoran Waroenk Anak Kuliahan," *Build. Informatics, Technol. Sci.*, vol. 3, no. 3, pp. 446–452, 2021, doi: 10.47065/bits.v3i3.1137.

[15] T. Prihati and S. Fauziah, "Implementasi Motode Rapid Application Development (Rad)Pada Sistem Informasi Penggajian Guru Honor," *JUTIM (Jurnal Tek. Inform. Musirawas)*, vol. 5, no. 1, pp. 25–34, 2020, doi: 10.32767/jutim.v5i1.782.

[16] H. Wibiksana, M. M. Mutoffar, S. N. Fauziah, and Y. Anggrianti, "IMPLEMENTASI METODE RAPID APPLICATION DEVELOPMENT (RAD) PADA SISTEM INFORMASI PURCHASE ORDER (STUDI KASUS : PT . BATTLEXS ANUGERAH ABADI)," 2021.

[17] F. T. Riyandi, H. T. Utomo, and H. Syabana, "Implementasi QR Code Pada Perpustakan Dengan Metode RAD," *J. Digit. Lit. Volunt.*, vol. 1, no. 1, pp. 16–25, 2023, doi: 10.57119/ict.v1i1.16.

[18] M. N. Ihsan, A. Yudhana, and R. Umar, "Implementasi Perangkat Lunak Penjaminan Mutu Menggunakan Metode Rapid Application Development (RAD)," *Techno (Jurnal Fak. Tek. Univ. Muhammadiyah Purwokerto)*, vol. 23, no. 2, p. 69, 2022, doi: 10.30595/techno.v23i2.10427.

[19] Z. Fahma, I. Gorby, C. Ramdani, and K. N. Meiah, "WEBSITE-BASED COMPETENCE CERTIFICATION INFORMATION SYSTEM USING RAPID APPLICATION DEVELOPMENT (RAD) METHOD SISTEM INFORMASI SERTIFIKASI KOMPETENSI BERBASIS WEBSITE MENGGUNAKAN METODE RAPID APPLICATION DEVELOPMENT (RAD)," vol. 3, no. 2, 2022.

[20] M. Susanto, M. E. Johan, A. Sulaiman, and M. I. Fianty, "Web-Based Assignment Information System Serves to Improve Economic Research at Universities and Public Services," *J. Inform. Ekon. Bisnis*, vol. 6, no. 1, pp. 171–176, 2024, doi: 10.37034/infeb.v6i1.824.

[21] A. Syamsudin, "Implementasi Metode RAD Pada Sistem Informasi Dashboard," *Seminar Nasional Inovasi Teknologi*. 2020.

[22] Tian Ahmad Setiawan, Wiyanto Wiyanto, and Agus Suwarno, "Penerapan Metode Rad Dalam Implementasi E-Commerce Berbasis Web Pada Cv. Tenda Teduh Abadi," *J. Inform. Teknol. dan Sains*, vol. 5, no. 3, pp. 373–382, 2023, doi: 10.51401/jinteks.v5i3.3140.

[23] Y. Kusnadi, E. Irfiani, and A. Suandi, "Rancang Bangun Sistem Informasi Manajemen Rantai Pasok Air Minum Implementasi Metode Rapid Aplication Development (RAD)," *J. Teknol. Inform. dan Komput.*, vol. 9, no. 1, pp. 384–396, 2023, doi: 10.37012/jtik.v9i1.1472.

[24] M. S. P, Muhammad Dedi Irawan, and Ahyat Perdana Utama, "Implementasi RAD (Rapid Aplication Development) dan Uji Black Box pada Administrasi E-Arsip," *sudo J. Tek. Inform.*, vol. 1, no. 2, pp. 60–71, 2022, doi: 10.56211/sudo.v1i2.19.

[25] B. H. Rambe *et al.*, "UML Modeling and Black Box Testing Methods in the School Payment Information System," *J. Mantik*, vol. 4, no. 3, pp. 1634–1640, 2020, [Online]. Available: https://iocscience.org/ejournal/index.php/mantik

[26] N. Nuris and D. Nowan Sutiyono, "Implementasi Metode Rad Pada Sistem Jasa Pengiriman Ekspedisi Pt. Bina Karya Majujaya," *J. Ilm. Rekayasa dan Manaj. Sist. Inf.*, vol. 9, no. 2, pp. 103–109, 2023.

[27] Y. C. H. Siki, M. C. Talo, and N. M. R. Mamulak, "Implementasi Model Rapid Application Development (RAD) dalam Pengembangan Website Penjualan Produk UMKM Bikomi Utara," *J. Penelit. Inov.*, vol. 4, no. 1, pp. 177–184, 2024, doi: 10.54082/jupin.264.