Journal of Industrial Engineering
Scientific Journal on Research and Application of Industrial System
Volume 10 No 1 – March 2025
http://e-journal.president.ac.id/presunivojs/index.php/journalofIndustrialEngineerin
ISSN 2527-4139 (*online*) – ISSN 2503-3670 (*print*)

Designing Delivery Entry Ticket System for Optimizing Transport Logistic Data Recording and Report At Pharmaceutical Company, Cikarang, West Java

Hery Hamdi Azwir [1], Nicko Fernando [1], Herwan Yusmira[1]
[1)] Faculty of Engineering, Industrial Engineering Department, President University
Jl. Ki Hajar Dewantara
Kota Jababeka,Cikarang, Bekasi - Indonesia 17550
Email: hery.azwir@president.ac.id, nicko.fernando@student.president.ac.id, herwan.yusmira@president.ac.id

ABSTRACT

This study details the planning, development until deployment phase of a system designed to enhance the efficiency and practicality of data recording, monitoring, and monthly report generation within a pharmaceutical company. The current problem faced by the company is the inefficiency in monthly report creation process. The existing method required over five working days to complete all monthly reports due to the reliance on manual report compilation. There are 34 gates spanning across the warehouse side allowing for 34 simultaneous product movement process. It is very challenging to find out which process is happening at which gate without a single interface showing the information. The root cause analysis finds that the source problem is individual document storage and the data input method causes many incomplete and inconsistent data records resulting in a long time needed to check or validate data that will be reported. This research aims to make improvements in process efficiency and data completeness using System Development Life Cycle (SDLC) method, from planning, analysis, design to development, testing, deployment, and maintenance As a result, this new system which utilizes Microsoft Excel VBA for automation and data manipulation has succeeded in optimizing loading and unloading data recording, resulting in more complete and consistent data records. This allows the user to create monthly report more efficiently which needs less time and recheck. Also, the creation of a truck activity dashboard, allows warehouse personnels and the transport manager to monitor all the truck and gate activity practically and even remotely.

Keywords: System Analysis, Development, Data, Input, Output, Transport, Inbound, Outbound, Report.

ABSTRAK

Laporan penelitian ini merinci tahap perencanaan, pengembangan hingga penerapan sistem yang dirancang untuk meningkatkan efisiensi dan kepraktisan pencatatan data, pemantauan, dan pembuatan laporan bulanan dalam sebuah perusahaan farmasi. Permasalahan yang dihadapi perusahaan saat ini adalah tidak efisiennya proses pembuatan laporan bulanan. Metode yang ada saat ini memerlukan waktu lima hari kerja untuk menyelesaikan seluruh laporan bulanan karena ketergantungan pada penyusunan laporan secara manual. Terdapat 34 gerbang truck sepanjang sisi gudang yang memungkinkan 34 proses bongkar-muat berjalan secara bersamaan. Sulit untuk mengetahui proses mana yang terjadi di gerbang berapa tanpa adanya suatu layar untuk menampilkan informasinya. Analisis masalah menemukan bahwa sumber permasalahannya adalah penyimpanan dokumen secara individual dan cara penginputan data yang menyebabkan banyak pencatatan data tidak lengkap dan tidak konsisten mengakibatkan perlunya waktu yang lama untuk memeriksa atau memvalidasi data yang akan dilaporkan. Penelitian ini bertujuan untuk memperbaiki efisiensi proses dan kelengkapan data dengan menggunakan metode System Development Life Cycle (SDLC), mulai dari tahap perencanaan, analisis, desain hingga pengembangan, pengujian, penerapan, dan pemeliharaan. Hasilnya, sistem baru yang memanfaatkan Microsoft Excel VBA untuk otomatisasi dan manipulasi data ini berhasil mengoptimalkan pencatatan data bongkar dan muat sehingga menghasilkan catatan data yang lebih lengkap dan konsisten. Hal ini memungkinkan pengguna untuk membuat laporan bulanan dengan lebih efisien yang membutuhkan lebih sedikit waktu dan pemeriksaan ulang. Selain itu, adanya *dashboard* aktivitas truk memungkinkan personel gudang dan manajer transportasi memantau semua aktivitas truk dan gerbang secara praktis dan bahkan dari jarak jauh.

Keywords: System Analysis, Development, Data, Input, Output, Transport, Inbound, Outbound, Report.

1. Introduction

Automation plays a critical role in modern information systems by streamlining operations, reducing manual errors, and improving overall efficiency. Using Information System Analysis and Design (ISAD), organizations can develop systems that are meticulously tailored to their specific needs (Zhou, 2023). Information System Analysis and Design (ISAD) is a structured process for examining, modeling, improving, and implementing an information system (Parhi et al., 2022). It involves understanding and specifying in detail what an information system should accomplish and then designing the components to meet those specifications. Automation ensures that tasks previously requiring significant human intervention can now be performed more swiftly and accurately, saving both time and resource (Gershon et al., 2021). This approach is beneficial across various fields, including healthcare, finance, manufacturing, and more (Casola et al., 2024). The importance of automation lies in its ability to enhance accuracy and efficiency, allowing organizations to focus on more strategic activities and ultimately drive better outcomes (Sampaio et al., 2023).

The pharmaceutical company currently serves more than 60,000 health facilities spread across 434 cities and collaborates with more than 60 clients and operates 1 sophisticated National Distribution Center (NDC) and 25 pharmaceutical standard warehouses. The National Distribution Center itself, serves as the main product provider to all the branches across Indonesia. The warehouse has 34 operating doors, called Gate 1-34 allowing trucks to unload and load products. The warehouse has many processes happening at once and with such large number of clients and company branches spread across Indonesia, the pharmaceutical company must make sure that their logistic transport performance is at its best capabilities from start to finish.

Transport logistics within the pharmaceutical company encompasses the movement of goods in both inbound and outbound directions (Muehlbauer et al., 2022). Inbound logistics involves the receiving of products from clients, requiring efficient coordination and optimization of transportation routes (Breschi et al., 2020). On the outbound side, the focus shifts to distributing stored products to each one of the company's branches. In both cases, ensuring swift movement is crucial in transport logistics. Transport logistics concentrates in efficiently transporting goods to where they are needed while also ensuring a timely delivery (Fleur et al., 2023).

As a distribution company, the pharmaceutical company needs to make sure the loading, and unloading process takes the least time needed as a part of the service provided. With many deliveries and limited number of personnels, the long waiting and processing time can make the performance report get a low KPI score. Because of the number of gates operating at once, warehouse personnels will have a hard time monitoring which gate is available for process, which gate is occupied, and which truck should be processed first. To ease the management of truck queue and which gate will handle incoming trucks, a monitoring dashboard is needed to visualize the trucks, gates, and ongoing loading/unloading activity (Manoj et al., 2024). With a dashboard installed, warehouse personnel can easily monitor every loading/unloading related activity in a single screen, resulting in an easier gate assignment for trucks and less time wasted on waiting for queues (Soni et al., 2024).

An important problem faced by the company is the monthly performance report that needs to be sent to principals at the beginning of every month before the 5th. The problem currently, is the data reported are recorded in separate places. Compiling and checking the data validity takes a long time, often resulting in lateness of the inbound-outbound monthly report submission (Hoffenson et al., 2023). There have been several occasions where supervisors could not send the monthly report before the 5th, several principals then contacted the related division and demanding the monthly report being sent as soon as possible because they also need the data for their own analysis. Lateness in sending the monthly report could result in the company seeming unprofessional or even worse, reducing the trust the clients have in the pharmaceutical company. Currently, the supervisors work around this case by working on the monthly report separately per principal and prioritizing the report of several stricter principals. This workaround is not optimal as it does not solve the problem that cause lateness in monthly report making. A better solution to solve the problem is to create a tool that can streamline the monthly report creation process (Torbali & Alpan, 2023). An information system that integrates data from all relevant sources, which can automate the data compilation and validation processes, and ensures timely and accurate monthly report generation is preferred (Marbella et al., 2024). The automation tool can help the supervisors reducing the time and effort needed for report generation while improving data accuracy, this improvement will make sure that there will be no more lateness in monthly report creation.

2. Methods

In the research methodology, the System Development Life Cycle (SDLC) framework is adopted as the guiding methodology for the study. SDLC provides a structured approach to software development, encompassing various phases from initial planning to deployment and maintenance (Sun et al., 2023). The methodology

involves several key steps, including plan, analysis, design, development, testing, deployment, and maintenance (Tissen et al., 2024). Figure 1 shows the research methodology.

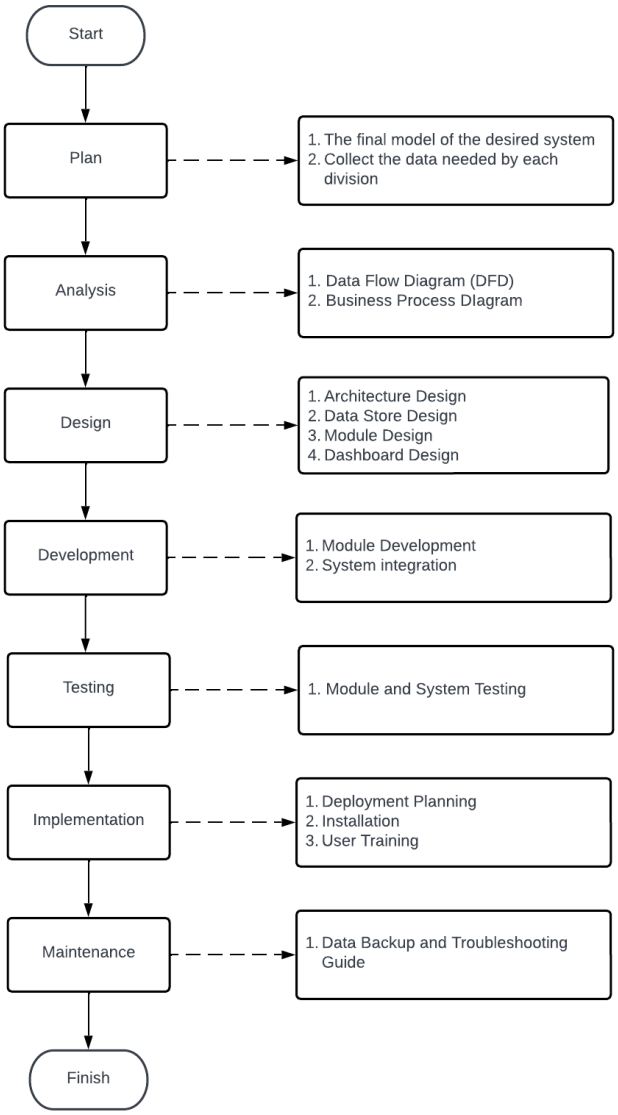

Figure 1. Research Methodology

In the planning phase, it is important to get an understanding of the current condition and challenges through data collection (Wei et al., 2023). Data collection is conducted through interviews with stakeholders from security, admin, supervisor, and most importantly the transport manager. Other than interviews, there is also the collection of previous documents. These methods provide a comprehensive understanding of the current processes and challenges. Then, collecting previous business process flows and identifying the defects in the current system are also critical components of this phase. This detailed data collection lays the groundwork for understanding the issues that need to be addressed.

Moving into the analysis phase, the collected data is carefully examined to identify key areas for improvement. This analysis gives an idea on how to enhance the system, with a focus on solving the identified problems and optimizing the overall process (Padoa-Schioppa, 2022). This phase starts with visualizing the current business process to gain a clear understanding of how operations are currently being conducted. The identified problems, inefficiencies, and defects within the existing process are then highlighted. Using the problem identification as a foundation, the analysis phase then focuses on defining a solution to address these issues (Aramouni et al., 2023). This includes doing root cause analysis to find the root of the problems and then proposing changes or enhancements to the process, such as adjusting workflows, implementing automation, or implementing new tools to optimize processes. The goal of this phase is to use the gathered data to develop a well-informed, practical solution that will improve efficiency, reduce errors, and enhance overall business performance.

The former phase informs the design phase, where blueprints and specifications are created to outline the system's architecture and functionality (Berghman et al., 2023). Once the design is finalized, the development phase begins, wherein the system is built according to the specifications outlined in the design phase. This involves coding, module development, and integration of components. Subsequently, the integrated system undergoes rigorous testing to ensure its functionality, reliability, and performance in the subsequent testing phase.

Upon successful testing, the system is implemented in the production environment, marking the transition from development to operations. This phase involves deployment planning and user training to ensure a smooth transition and adoption of the system by end-users. Finally, the maintenance phase involves problem anticipation and maintenance activities to address any issues, bugs, or updates that arise post-deployment. By adopting the SDLC framework in the research methodology, the study ensures a structured and systematic approach to the development and evaluation of the system built.

3. Result and Discussion

3.1 Plan

During the planning phase of the System Development Life Cycle (SDLC), the main focus is conducting data collection then defining the objectives, methods, and requirements necessary to successfully solve encountered problems. This involves clearly outlining the goals of the project, as well as determining the specific data and the sources needed for the objectives.

Inbound and outbound logistics processes are critical to ensuring that operations run smoothly. The inbound process, which involves the receiving, handling, and storage of raw materials or products, is the first step in inventory management within the warehouse. Any delays or inefficiencies in inbound logistics can disrupt delivery schedules, increase costs, and ultimately lead to the failure to meet customer demands. This process is vital for ensuring that the right materials are available at the right time, allowing for seamless product distribution and minimizing delay time.

On the other hand, the outbound process is equally important as it focuses on the distribution and delivery of finished goods to customers. This process directly impacts customer satisfaction, as it ensures that products are delivered on time, in good condition, and at a reasonable cost. An optimized outbound process not only enhances customer experience but also strengthens the company’s reputation and market competitiveness. Together, the efficiency of both inbound and outbound processes is essential for reducing operational costs, improving service quality, and maintaining a strong, reliable supply chain. This is precisely why optimizing both processes is crucial as failing to do so can lead to customer dissatisfaction and lowering customer’s trust for the company.

Business Process Diagram is pivotal in understanding the structure and workflow of a business operation. This graphical depiction not only aids in clarifying intricate processes but also serves as a foundational tool for process analysis, optimization, and improvement. It acts as a visual representation of the sequential steps, tasks, and interactions that constitute a particular process within an organization which in this case shows the entire process from truck driver entering the plant until the monthly report making.

Inbound and Outbound have the same flow process, their difference is only in the product being unloaded from the truck or loaded in the truck. The beginning of a process is started when a driver enters the plant, the driver will need to register in security post first and report their identity and activity either inbound or outbound. Security will note the truck’s entry time and its information in a logbook. At the same time, the driver should scan a QR code, which will redirect them to a Google form. In that form, they also have to input their information and activity, the data submitted can be viewed in a google sheet. The driver may then drive to the waiting bay where they will queue for their turn. When the driver’s turn comes up, they will move their truck to the designated gate. Their gate position is determined by the type of load they carry. If the load type is cold chain, the truck will park at gate 1-4, if the load type is regular, the truck will park at gate 5-31. If the load type is returned goods, the truck will park at gate 32-34.

In the loading/unloading dock, the driver should scan a QR code which redirects them to a different google form to note the starting process time. For the unloading process, products from within the truck will be moved inside the plant and arranged in rows or several rows. After the unloading process is done, the driver will hand over the delivery note document to admin and driver may continue to the next step. For the loading process, products already checked, packed, wrapped and ready to be shipped will be loaded in the truck. After loading process is done, the admin will hand over a delivery note document which contains product name, product code, quantity, and destination to the driver, the driver may continue to the next step. The driver will then scan another QR code to fill in a google form which notes the finishing of the process.

Past this point, the admin's activity is done. The next step that the driver has to do is to drive back to the security post and report that their activity inside the plant is done. Security will then check the truck and load condition, and writes down their exit time. At the same time, the driver will scan a QR code for the last time, which will redirect them to a different Google form and note the exit time of the truck. Lastly, the driver and the truck are allowed to leave the plant, which marks the end of the process flow.

Optimizing inbound and outbound processes is essential for maintaining efficient logistics operations, which directly impacts customer satisfaction and overall business performance. When these processes are streamlined, data becomes more organized and accessible, enabling faster and more accurate tracking of product movements. This optimization lays the groundwork for better data input and storage. Meanwhile, the output of these data is the inbound-outbound monthly report. As the last step of the logistic transport documentation system, automating the monthly report creation process is also crucial. By automating this reporting, the time and effort required are significantly reduced, allowing for quicker insights and better decision-making, ultimately enhancing the company's ability to respond to customer needs and market demands.

The improvement plan is to automate the inbound-outbound monthly report creation process, which involves setting up a system to generate monthly report with the click of a button automatically. This means making it easier to compile and organize the needed information from different sources. The report has a simple tabular layout with a title at the top row and a table describing the reported data made of multiple columns. The aim is to create a reliable system that can handle this task consistently and accurately every month.

3.2 Analysis

In the analysis phase, it is important to develop a comprehensive dataflow diagram to depict the flow of data within the system. This diagram will illustrate how information is input, processed, outputted, and stored throughout the various stages of the process. By visually mapping out the dataflow, the key interactions between system components can be understood. Also, the data flow from each entity to each process all the way to data store can be easily visualized with the help of dataflow diagram. This diagram will serve as a valuable tool for gaining insights into the system's operation and informing subsequent design and development decisions.

The project aims to optimize the inbound and outbound data documentation process by improving the current business process flow. This involves shifting from a manual Google Form-based data input method which heavily reliant on truck drivers and prone to inaccuracies due to inconsistent data entry and network issues to a centralized data storage system. The proposed solution includes creating a unified data input system with individual interfaces for various stakeholders, connected to a single, centralized database. This system will feature robust data validation to ensure completeness and consistency, and will automate the monthly report creation process, significantly reducing time and effort. By transitioning the data input responsibility to internal stakeholders and implementing a blocking system to enforce data completeness, the new approach addresses existing data inconsistencies and inefficiencies, ultimately streamlining the workflow and improving report accuracy. Figure 2 and 3 shows the context level diagram and Data Flow Diagram of the proposed system. Both figures visualize the relation between the entities, system, and data flow.

3.3 Design

An Entity Relationship Diagram (ERD) is a type of flowchart that illustrates how "entities" such as people, objects, or concepts relate to each other within a system (Dintén et al., 2022). ERD is most often used to design or debug relational databases in various fields. The following Entity Relationship Diagram (ERD) depicts interactions among four essential entities: D1 Activity Record data store, Truck Activity Dashboard, D2 SAP, and Inbound-Outbound Monthly Report.

This Entity-Relationship Diagram (ERD) represents the data flow between Activity Record which acts as the data source, Truck Activity Dashboard, which reports real-time truck activity by retrieving data from Activity Record data store, the Inbound-Outbound Monthly Report that retrieve the data from both Activity Record data store and exported SAP data, and the data taken from SAP system in the company which also serves as data source.

Activity Record data store serves as the central repository for all truck activity data. The Inbound-Outbound Monthly Report compiles and summarizes this data for monthly reporting. SAP contributes additional product detail and order data via an exported text file. The Truck Activity Dashboard displays real-time truck activities by accessing the Activity Record data store. This system ensures efficient and accurate management of logistics and inventory activities. Figure 4 shows the entity relationship diagram of delivery entry ticket system.

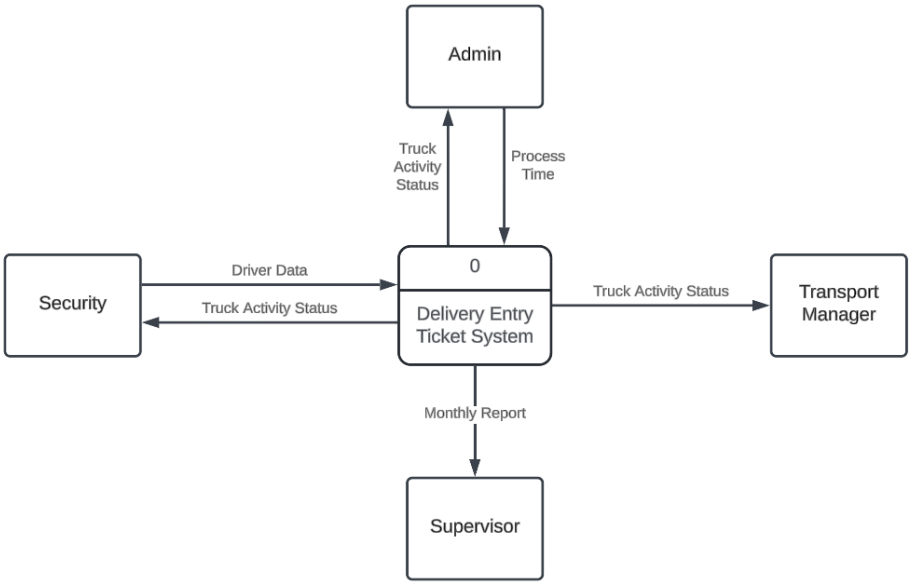

Figure 2. Context Level Diagram of the Delivery Entry Ticket System

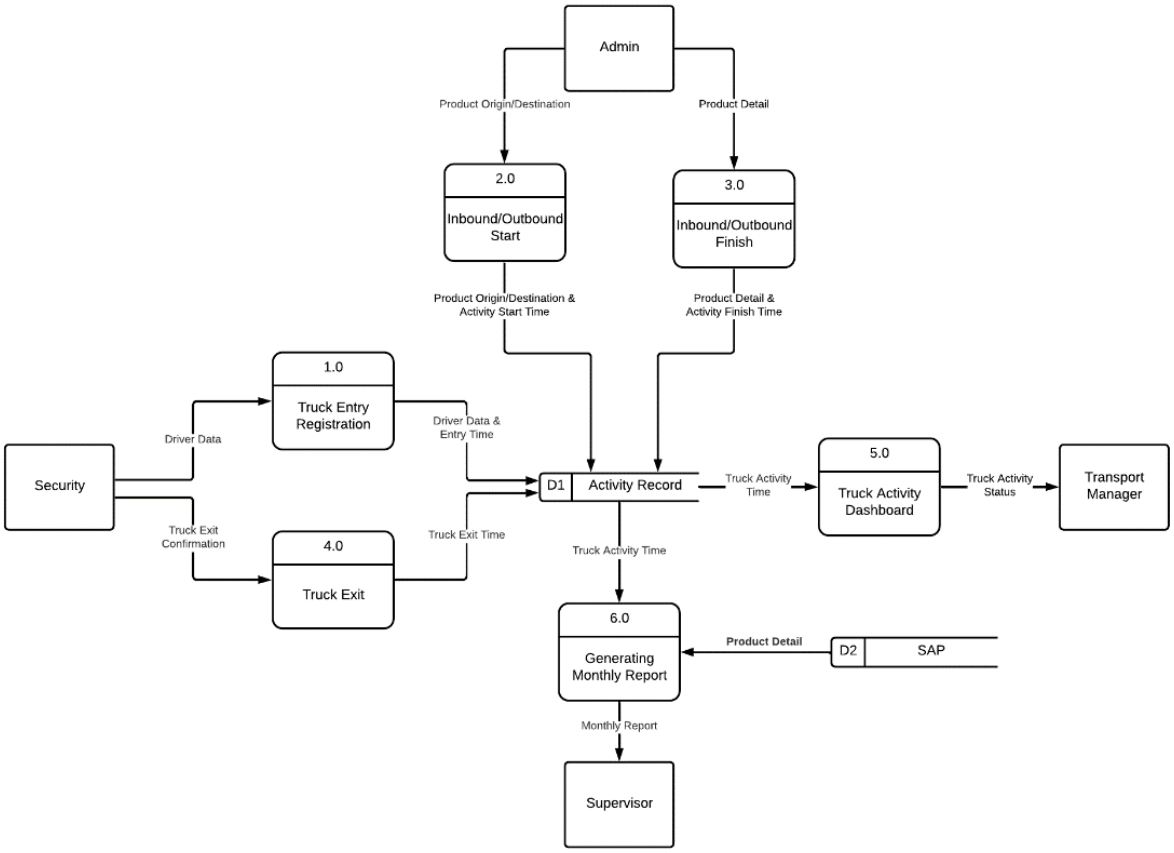

Figure 3. Data Flow Diagram of the Delivery Entry Ticket System

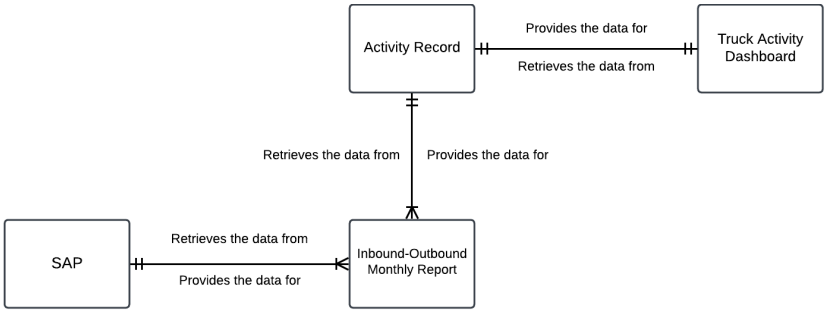

Figure 4. Entity Relationship Diagram of Delivery Entry Ticket System

The design phase is a pivotal step where concepts and requirements gathered during the analysis phase are transformed into a detailed visualized plan. The design phase serves as the bridge between requirements and actual system implementation. It is during this phase that the system's blueprint takes shape, ensuring alignment with the initial goals and user expectations. Design encompasses various critical activities, including architectural decisions, user interface or module design, and dashboard design. Ultimately, the design phase lays the groundwork for successful development, testing, and deployment, guiding the developer towards a clear, accurate plan of action. Figures 5 and 6 show the design of the userform and dashboard, respectively.

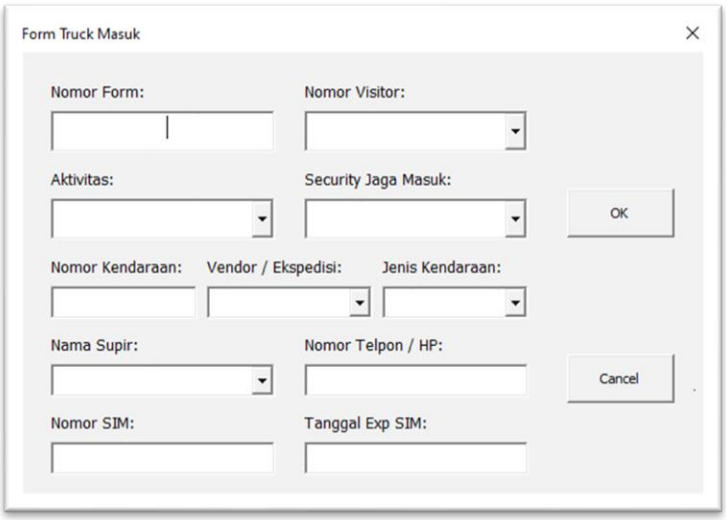

Figure 5. Userform Design

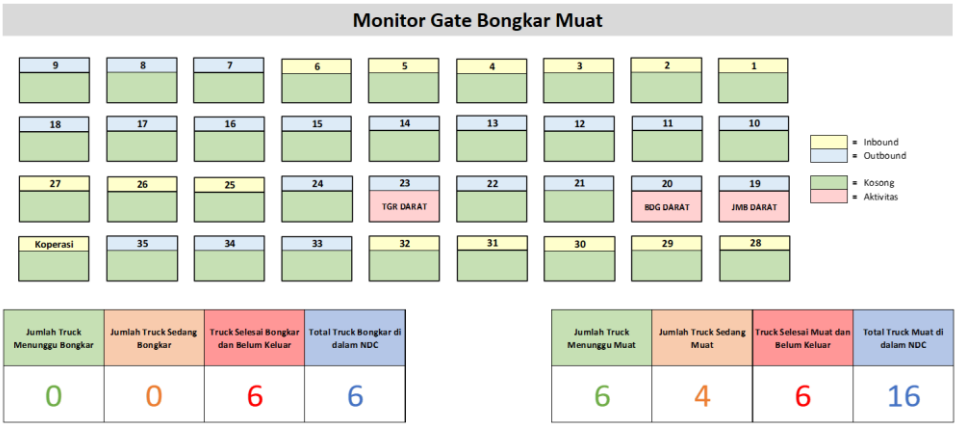

Figure 6. Dashboard Design

3.4 Development

Module development is a focused part of the overall development phase where individual units or components of the software are developed. The Delivery Entry Ticket System will have 5 modules, each serving different purpose and designated to different stakeholders. The modules are Security Input, designated to the security, Admin Inbound designated to the inbound admin. Admin Outbound designated to the outbound admin, Monthly Report Generator designated to the supervisor, and Truck Activity Dashboard designated to the transport manager. All the modules are coded with Macro VBA, each of the modules has several features such as data validation, autofill, dropdown, data conversion, and data recording code.

In the system integration code, however, Power Query in Excel is used to connect the data store with the user interface application, ensuring seamless interaction between components. This approach allows all user interfaces to access the same data source at once. As a result, every time data is refreshed, all users can see the most current information, maintaining consistency across the system. All the modules will use the same concept of system integration, which is to use power query to connect all the data across different modules and data stores, with a slight adjustment on the data being retrieved. Using a centralized data store with the modules retrieving a copied version means changes made within the user interface application do not directly change the data store because the main data is stored in a separate file. For example, when a user accidentally deletes or changes some data in the query table in the user interface application, the changes are not relayed to the actual data store. The user can simply refresh the query, and the system will update the query table with the most current data. This method preserves the data integrity and prevents unauthorized modifications to the central data store.

3.5 Testing

The testing phase is the next step in the SDLC method. This step is crucial to ensure each module of the system works as intended, and the entire system operates smoothly. This phase involves various types of testing, including module testing to check individual components, integration testing to ensure combined individual parts work well together, and other testing to check whether the features work as intended. Through these thorough tests, any issues or bugs that are found could be fixed early, ensuring the system is reliable and ready when it is time for deployment step.

The objective of the testing phase in this project is to verify the features available in each module, checking whether each module can work properly and can adequately function when they are integrated as a whole system. The testing phase also checks the features that are present in each module, including data validation, indicator light, autofill, dropdown, and data refresh. At the end, the testing phase will check whether the system can provide a complete set of data while at the same time generating complete monthly reports. The following sections detail the various test cases and scenarios used for each component of the module and the overall system. Table 1. shows the multiple tests that are conducted on the system.

Table 1. Test Cases for Delivery Entry Ticket System

No	Test	Expected Result	Obtained Result
1	Valid data entry	The fields in the form are filled in without trouble, autofill and dropdowns work correctly, and in some forms the indicator light beside “Nomor Form” lights up green.	Pass
2	Invalid data entry	A warning message box pops up explaining the problem encountered. In some form, the indicator light beside “Nomor Form” turns red.	Pass
3	Data submission	All the data entered into the form are successfully converted and stored in the Activity Record data store.	Pass
4	Truck exiting before finishing an ongoing activity in the warehouse	A message box will appear explaining that the data submission cannot be continued before the previous activity has not been finished.	Pass
5	Data refresh in truck activity dashboard	The table containing data from Activity Record data store updates to the latest version while the dashboard updates the gate activity and truck count accordingly.	Pass

No	Test	Expected Result	Obtained Result
6	Generating inbound-outbound monthly report	Monthly reports containing complete data are generated for each principal.	Pass

3.6 Deployment

The first step in deployment involves listing the admin usernames and their corresponding computers. This list is reported to the IT department to grant access to the shared folder where the Activity Record data store is saved. Then ensuring that all stakeholders have the same version of Microsoft Office is also critical to prevent compatibility issues. The stakeholders include the personnels inputting the data in each process, from security, admins, supervisors, and transport managers. The admin list consists of 2 admins in CCP (1 working and 1 stand-by), 3 in the AC room, 4 in the ambient room, and 2 in the RG room (with 1 stand-by). By completing these preparations, the next deployment step could be smooth and efficient.

The next step, which is the installation process, is crucial for ensuring that every confirmed computer is equipped with the necessary user interface designed for each stakeholder. During this step, the Excel application designated for each stakeholder is installed on all the computers listed in the preparation phase. This includes the computers used by the security, 2 admins in CCP, 3 in the AC room, 4 in the ambient room, 2 in the RG room, the supervisor computers, and the one owned by the transport manager. The security computer will have a security module to input truck entry and exit data, admins will have admin inbound and outbound module to input truck inbound and outbound data, supervisors will have a monthly report generator to compile monthly reports at the end of every month, and the transport manager will have truck activity dashboard to monitor each truck's activity in the warehouse. The security initially already has a computed installed in their post; this eases the deployment process as the only hardware needed to be installed is the thermal printer. A thermal printer is installed on the security computer, allowing incoming trucks to have the entry ticket when entering the warehouse plant. The truck activity dashboard will also be installed in a television screen in the warehouse to allow warehouse personnel to view the ongoing truck and gate activity. The installation process ensures that all stakeholders have the required tools to access and interact with the system.

The last step in the deployment phase is user training. The user training step is important to make sure that all stakeholders are well-informed on how to use the implemented system. This training is designed to help users understand the purpose of the system, how it works, and how to operate it effectively based on their role. User training is done by arranging a meeting inviting every stakeholder in the warehouse facility, including security, admin, supervisor, and transport manager. The agenda of the meeting is to talk about the primary purpose of the system, which is to streamline and complete the documentation logistics activities. Explaining the system can aid in recording, monitoring, and reporting inbound and outbound transactions efficiently. It is then followed by a general explanation of how the system works. As a system, the truck entry/exit and inbound/outbound form will serve as data input, while the dashboard and monthly report will serve as data output. Data store is done automatically in the background by the system after data submission. Figure 7 shows the documentation of the deployment step, which is a user training meeting.

Figure 7. User Training Meeting

3.7 Maintenance

The maintenance phase will ensure that the system continues to operate without trouble after deployment. Regular maintenance activities include debugging, performance optimization, and adding new features based on user feedback. This phase is essential for prolonging the system's lifespan and maintaining user satisfaction. Several important notes in the maintenance phase are:

- **Backup Copy:** A backup copy of each module and the data store is created and saved in the local storage of each stakeholder's computer. Another backup is also saved in the sharefolder that every listed stakeholder can access. This serves as a backup in case the main system is inaccessible, having trouble, or not working as intended. Users can just copy the backup file and use it as the main interface.
- **Data Store Backup:** Instructions are made on how to back up the data regularly, the time interval for each backup, and the backup location to prevent data loss and also to prevent performance issue due to large memory space. It includes saving copies of the data on personal computer storage or cloud storage.
- **Troubleshooting Common Issues:** Users are trained on how to troubleshoot common issues, such as data entry errors or problems running the code. A note is also written containing the commonly occurring problems and how to deal with it.
- **Complex or Hardware Problems:** For complex problems or problems regarding the hardware, users are advised to contact the IT department or a designated support team.

3.8 Comparison of Before and After Improvement in Warehouse Operations and Reporting Processes

This section highlights the improvements of the newly implemented system. It compares the data input, data output, and efficiency between the old method and the new one. The comparison aims to provide a summary of the improvements made and at the same time showing benefits of the new system. Table 2 shows the comparison of before and after system implementation.

Table 2. Comparison Table of Before and After System Implementation

No	Comparison Aspects	Before Implementation	After Implementation
1	Data input method	Google form, inputted by truck driver	Microsoft Excel form, inputted by warehouse personnel (Security and Admin)
2	Data Completeness	Not complete, many activities are missing because the driver does not fill in the form.	Complete all the activity data are filled in completely by the warehouse personnel
3	Monitoring truck activity	Direct observation	Monitoring through a truck activity dashboard, the dashboard has a summary of the number of trucks in each activity and can monitor which gate has an ongoing activity remotely.
4	Monthly Report	Manual compiling (copy and paste) and manual document review to find any missing inbound/outbound activity data. The completion of all monthly reports requires more than 5 working days.	Automatically compiled and grouped using Macro with already complete data. Requires approximately 12 minutes (with more or less time depending on computational power and memory)

4. Conclusion

By utilizing the System Development Life Cycle (SDLC), the project has successfully created an information system that streamlines the process of compiling inbound-outbound monthly reports. This system consolidates data into a centralized storage, reduces manual data entry, and integrates robust validation methods to ensure data accuracy and completeness, thereby significantly improving report generation efficiency.

Additionally, the near real-time truck activity monitoring system has been established, allowing for practical and remote management of truck queues and processes within the National Distribution Center. This enhancement facilitates better oversight and optimization of loading and unloading operations.

Together, these improvements address the problems encountered by the company which are incomplete data, data inconsistency and inefficient monitoring, resulting in a more streamlined, accurate, and manageable workflow.

References

1. Aramouni, N. A. K., Steiner-Browne, M., & Mouras, R. (2023). Application of process analytical technology (PAT) in real-time monitoring of pharmaceutical cleaning process: Unveiling the cleaning mechanisms governing the cleaning-in-place (CIP). *Process Safety and Environmental Protection*, 177(June), 212–222. https://doi.org/10.1016/j.psep.2023.07.010
2. Berghman, L., Kergosien, Y., & Billaut, J. C. (2023). A review on integrated scheduling and outbound vehicle routing problems. *European Journal of Operational Research*, 311(1), 1–23. https://doi.org/10.1016/j.ejor.2022.12.036
3. Breschi, V., Formentin, S., Todeschini, D., Cologni, A. L., & Savaresi, S. M. (2020). Data-driven on-line load monitoring in garbage trucks. *IFAC-PapersOnline*, 53(2), 14300–14305. https://doi.org/10.1016/j.ifacol.2020.12.1370
4. Casola, V., De Benedictis, A., Mazzocca, C., & Orbinato, V. (2024). Secure software development and testing: A model-based methodology. *Computers and Security*, 137, 103639. https://doi.org/10.1016/j.cose.2023.103639
5. Dintén, R., García, S., & Zorrilla, M. (2022). Fleet management systems in Logistics 4.0 era: a real time distributed and scalable architectural proposal. *Procedia Computer Science*, 217(2022), 806–815. https://doi.org/10.1016/j.procs.2022.12.277
6. Fleur, D. S., van den Bos, W., & Bredeweg, B. (2023). Social comparison in learning analytics dashboard supporting motivation and academic achievement. *Computers and Education Open*, 4(February), 100130. https://doi.org/10.1016/j.caeo.2023.100130
7. Gershon, P., Seaman, S., Mehler, B., Reimer, B., & Coughlin, J. (2021). Driver behavior and the use of automation in real-world driving. *Accident Analysis and Prevention*, 158, 106217. https://doi.org/10.1016/j.aap.2021.106217
8. Hoffenson, S., Philippe, C., Chen, Z., Barrientos, C., Yu, Z., Chell, B., & Blackburn, M. (2023). Graphical features of interactive dashboards have little influence on engineering students performing a design task. *International Journal of Human Computer Studies*, 180(November 2022), 103121. https://doi.org/10.1016/j.ijhcs.2023.103121
9. Manoj, R., Ranganayaki, M. C., & Varthan, V. (2024). Customer Satisfaction on Inbound and Outbound Logistics of VL Appliances India Pvt Ltd. *Rabindra Bharati University Journal of Economics*, 28(32), 49-54. https://www.researchgate.net/publication/381774733
10. Marbella, H. N., Akbar, I. A., & Setiawan, B. (2024). Design and development of a web-based patient management information system. *Procedia Computer Science*, 234, 1799–1806. https://doi.org/10.1016/j.procs.2024.03.188
11. Muehlbauer, K., Wuennenberg, M., Meissner, S., & Fottner, J. (2022). Data driven logistics-oriented value stream mapping 4.0: A guideline for practitioners. *IFAC-PapersOnline*, 55(16), 364–369. https://doi.org/10.1016/j.ifacol.2022.09.051
12. Padoa-Schioppa, C. (2022). Logistic analysis of choice data: A primer. *Neuron*, 110(10), 1615–1630. https://doi.org/10.1016/j.neuron.2022.03.002
13. Parhi, S., Joshi, K., Gunasekaran, A., & Sethuraman, K. (2022). Reflecting on an empirical study of the digitalization initiatives for sustainability on logistics: The concept of sustainable logistics 4.0. *Cleaner Logistics and Supply Chain*, 4(January), 100058. https://doi.org/10.1016/j.clscn.2022.100058
14. Sampaio, Á. M., Lima, A., Silva, C., Carneiro, V. H., Fernandes, F., Fernandes, A., & Pontes, A. J. (2023). Design and development of an Automatic Optical Inspection (AOI) system support based on digital manufacturing. *Procedia CIRP*, 119, 15–20. https://doi.org/10.1016/j.procir.2023.03.080
15. Soni, P., de Runz, C., Bouali, F., & Venturini, G. (2024). A survey on automatic dashboard recommendation systems. *Visual Informatics*, 8(1), 67–79. https://doi.org/10.1016/j.visinf.2024.01.002

16. Sun, X., Durkin, A., & Guo, M. (2023). Life cycle optimisation tool development for process systems and centralised supply chain design. *RSC Sustainability*, 1(9), 2224–2240. https://doi.org/10.1039/d3su00251a

17. Tissen, D., Wiederkehr, I., Koldewey, C., & Dumitrescu, R. (2024). Data from start to finish: A System Life Cycle Data Map. *Procedia CIRP*, 122, 413–418. https://doi.org/10.1016/j.procir.2024.01.060

18. Torbali, B., & Alpan, G. (2023). A multi-agent-based real-time truck scheduling model for cross-docking problems with single inbound and outbound doors. *Supply Chain Analytics*, 3(February), 100028. https://doi.org/10.1016/j.sca.2023.100028

19. Wei, B., Çetinkaya, S., & Cline, D. B. H. (2023). Inbound replenishment and outbound dispatch decisions under hybrid shipment consolidation policies: An analytical model and comparison. *Transportation Research Part E: Logistics and Transportation Review*, 175(December 2022), 103135. https://doi.org/10.1016/j.tre.2023.103135

20. Zhou, Z. (2023). Discussion on the integrated design and innovation of enterprise information systems based on supply chain. *Procedia Computer Science*, 228, 952–956. https://doi.org/10.1016/j.procs.2023.11.125