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Design of a web-based information system for domestic sea transportation services for limited liability company goods

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Abstract: This research aims to design and implement a web-based information system for domestic sea transportation services of goods owned by a Limited Liability Company. Currently, the Limited Liability Company faces challenges in administrating goods due to the time-consuming recording process and using Excel applications that are prone to manual errors, accompanied by inaccuracies due to the absence of an integrated database system. The information system developed uses the waterfall approach for system design and the Unified Modeling Language (UML) for modelling, resulting in a requirements analysis, UML-based system design, and eight database tables that support system functionality. The use of PHP programming and MySQL database in the system implementation resulted in a web application that allows PT NSE to manage administration in a timely and accurately, with reports stored in the database. To enhance the executive dashboard of the domestic sea transportation service information system for goods, revamping the display for more visual and informative data presentation is essential. Additionally, integrating an Excel export feature will facilitate further data processing by relevant parties. Adequate resources must be allocated to maintain and manage the system effectively, ensuring seamless and sustainable operation. By implementing this information system, the Limited Liability Company is expected to boost administrative efficiency and accuracy, thereby solidifying its position in Indonesia's logistics service industry.

Keywords: Decent work and economic grouwth; Logistics; Information system; Waterfall model; Database integration

1. Introduction

Currently, the development of information technology in the government and private sectors is snowballing, including in the world of transportation (Iyer, 2021; D. Lee & Lee, 2020). Efficiency and accuracy in delivering goods are a priority, considering that people want everything practical and straightforward (Javaid et al., 2022). Goods delivery services aim to provide effective and efficient services, both individually and in organizations. Many people choose delivery services because of the long distance and speed of delivery (Zhou et al., 2020). Shipping companies often work with business partners such as cargo services and cargo ships, such as Limited Liability Companies engaged in cargo services.

The Limited Liability Company has specialized in overseas sea freight services, domestic sea freight for particular goods, fuel trading, and motorized freight for unique goods since 2008 (J. Lee et al., 2023). As one of the leading independent cargo companies in Batam port and throughout Indonesia, the Limited Liability Company carries the motto "Fast Delivery & Fast Information" to help customers choose goods and delivery services.

However, observations and interviews with admins show that there are obstacles in the system of receiving and shipping goods. The Limited Liability Company faces the problem of not having a database system for domestic sea freight services (Xiao et al., 2024). Reports are stored using Microsoft Excel, which requires much copy-pasting and is not integrated, causing unsynchronization between monthly reports. In addition, the company does not have a permanent admin skilled in report processing.

In order to solve this problem, the development of an information system for domestic sea transportation services for goods using the waterfall software development model was carried out (Kusuma, Adi, Afrina, et al., 2023; Kusuma, Adi, Jimenez, et al., 2023; Prasetya et al., 2023). This model involves sequential stages: Analysis, design, coding, testing, and support. With this model, features that meet user needs can be identified more clearly and systematically.

The creation of this web-based information system aims to enable the Limited Liability Company to manage shipping data with enhanced efficiency and precision. This system will allow data storage in an integrated database, reduce manual errors, and increase the speed and accuracy of report generation (Eswaran & Bahubalendruni, 2022; Parsamehr et al., 2023). Additionally, integrating the new and existing systems will ease the monthly reporting process and ensure the data is continuously synchronized. Overall, the development of this information system will not only solve existing problems but will also increase the competitiveness of the Limited Liability Company in the freight forwarding industry, ensuring that they can continue to provide fast and reliable services to their customers. This research and development is essential in supporting the company's goal of becoming a leading cargo service provider with cutting-edge information technology.

2. Methods

This research uses a design with the Unified Modeling Language (UML) and a waterfall model development method (Abdelnabi et al., 2021; Gosala et al., 2021). UML is an image-based language that visualizes, specifies, builds, and documents object-based software development systems (Khan et al., 2019). UML, although not a programming language, allows direct mapping from models to object-oriented programming languages such as Java (Wang et al., 2021). UML is essential for system analysts as it helps manage system complexity, detect errors during implementation, and explain system workings to stakeholders (Jang et al., 2024).

UML diagrams include different types, each with a specific function for modelling systems. Use Case Diagrams to describe how actors interact with the system, providing a clear picture of roles and tasks (Vachharajani & Pareek, 2019). Activity Diagrams visualize conditions or circumstances that affect the course of processes or functions in the system, thus helping in understanding the workflow (Jaffari et al., 2020). Sequence Diagrams show interactions between objects in a time sequence, providing insight into communication dynamics within the system (Nadeem et al., 2022). Class Diagrams organize attributes, operations, methods, and relationships between objects with similar features, helping to define the structure and behaviour of objects in the system in detail (Chen et al., 2022). By leveraging this diagram, the system's complexity can be navigated more effectively and efficiently, ensuring a comprehensive representation of all its components and intricacies.

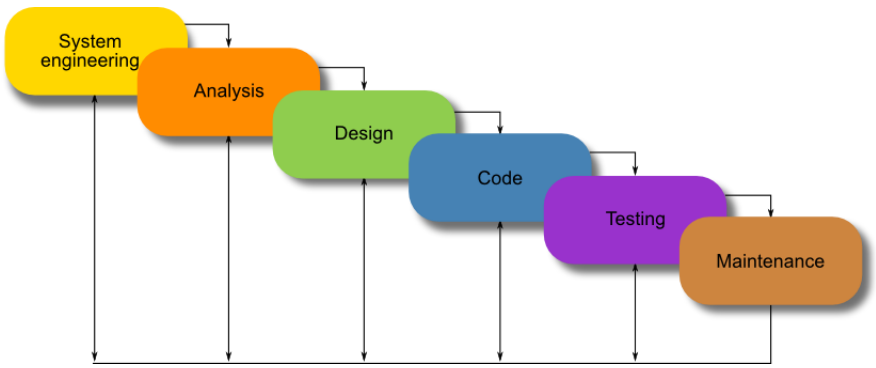
The waterfall stage includes several sequential steps to ensure efficient and effective system development (Kusuma, Adi, Jimenez, et al., 2023). The initial phase, Analysis, involves comprehensively examining the system, identifying existing issues, and specifying functional and non-functional requirements through UML. This phase includes the meticulous collection and processing of relevant data. Moving forward to the System Design stage, a detailed blueprint for a web-based sea

transportation service information system is created using UML, ensuring every program development aspect is meticulously outlined (Torre et al., 2023).

The Program Code Writing stage involves implementing the design into the software using the PHP programming language and the MySQL Framework database (Alamsyah et al., 2024). After that, the Program Testing stage is carried out using the black box testing method and user evaluation to ensure that the results are in accordance with expectations and needs.

The software, database, interface, installation, and maintenance are thoroughly implemented at the Program Implementation stage. Finally, at the Conclusion stage, the system's success is evaluated based on the initial development objectives. This waterfall approach ensures that the system built is effective and efficient and fully meets users' needs. The following is a visualization of the waterfall diagram used as a research method presented in Figure 1.

Figure 1.
Waterfall models



3. Results and discussion

3.1 System design

This research produces a web-based information system for domestic sea transportation services for Limited Liability Companies. System development follows the waterfall model, which includes requirements analysis, system design, program code writing, testing, and implementation. Unified Modeling Language (UML) allows a more transparent and organized system structure. The Developed UML diagrams are presented in Figures 2, 3, 4, and 5.

Figure 2.
Usecase Diagram

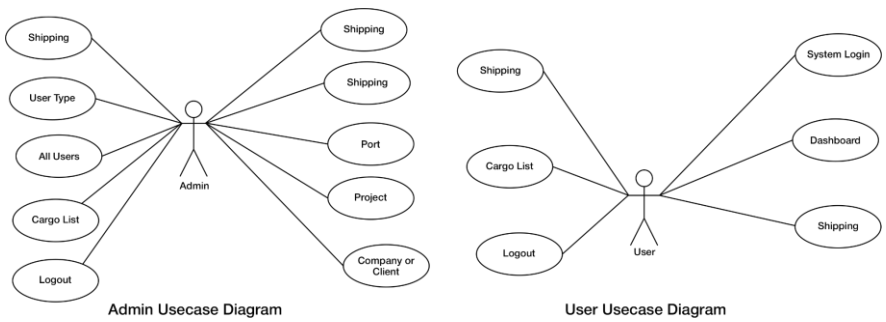


Figure 2 presents this Usecase Diagram identifying the main actors, namely the admin and the system's users, and their interactions with the system. This diagram helps determine the functional requirements of the system. In the Use Case Diagram for the web-based sea transportation service information system, admins and officers play pivotal roles in managing various system functionalities. Admins possess comprehensive authority to oversee and regulate the system, including handling port data, project management, and user-type configurations. This diagram further illustrates that officers

can access and manage critical elements such as the login page, dashboard, company information, and shipping and cargo lists. This structured division of responsibilities ensures that the operational process flows smoothly and efficiently, enhancing overall system performance.

Figure 3.
Activity diagram

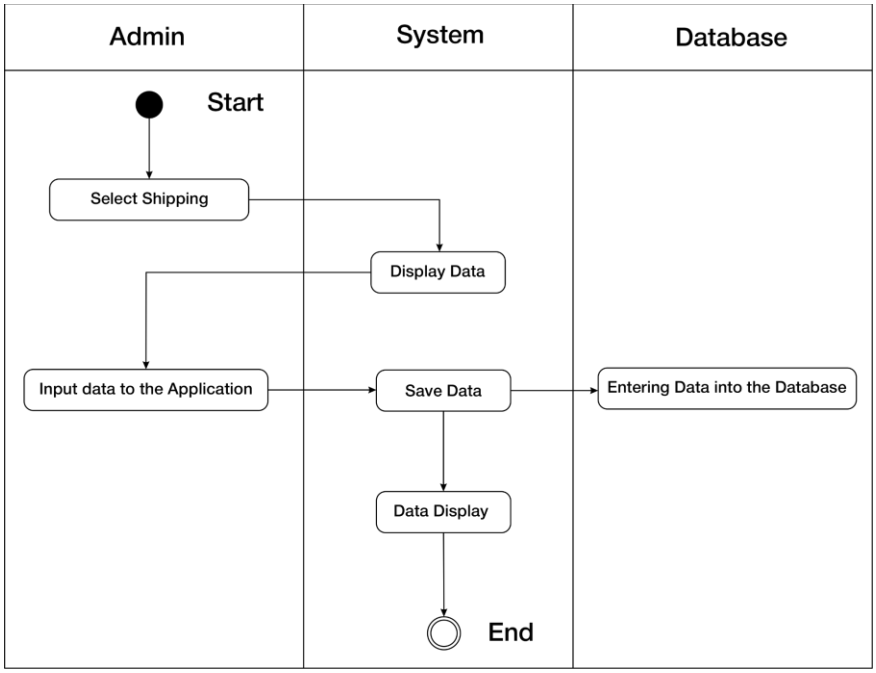


Figure 3 illustrates the Activity Diagram that models the system's workflow, including receiving and shipping goods. This diagram describes the conditions or circumstances that determine the process or function in the system. The Activity Diagram depicting the shipping menu shows that admins and officers can manage shipping data. Admins can add, change, and delete shipping data, ensuring that shipping information is always up-to-date and accurate. This diagram highlights admins' flexibility and control in manipulating shipping data to support efficient operations.

Figure 4.
Sequence diagram

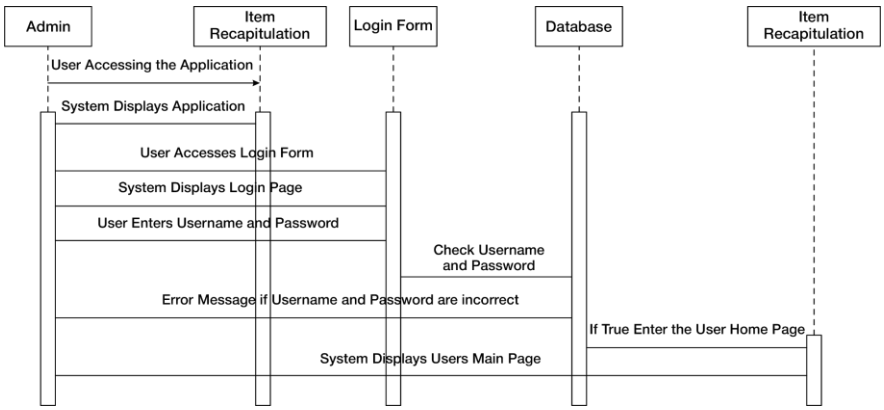


Figure 4 shows a visualization diagram that shows the interactions between objects in a time sequence, providing insight into the dynamics of communication within the system. This diagram helps us understand how data flows through the system during operational processes. In addition, Figure 4 shows a flowchart with multiple steps and decision points, which illustrates the user interaction process with the login and database verification system. This flowchart starts with "User Accesses Application" and ends with "If Correct, Enter User Home Page," signalling a successful login. This chart includes steps like accessing the login form, entering a username and password, system validation, and error

handling. This image is relevant for understanding the user authentication process in software applications.

Figure 5. Entity-relationship diagram

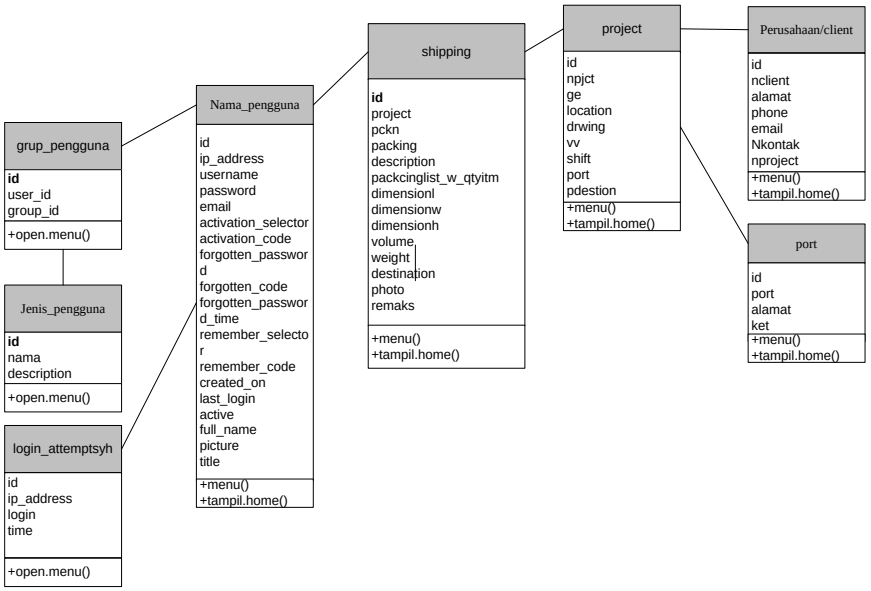


Figure 5 is an Entity-Relationship Diagram (ERD) used in database design. This diagram shows the relationship between various entities in the database system. There are several rectangular boxes connected with lines. Each box represents an entity and has specific attributes in it, such as "id," "name," "address," and others. Some of the entities seen in this diagram include "user group," "user," "shipping," "project," and "client company." The lines connecting these boxes likely represent relationships or foreign keys between these tables in the database. This figure is fascinating because it provides insight into how data might be organized for a system involving user groups, users, shipping details, projects, and client companies. This diagram is relevant for understanding the planning phase of database design or for someone studying database structure.

Table 2. Sea Transportation service application description

No	Table name	Description
1	Klien	To store client data
2	Groups	To store group data
3	Login_attempts	To save login record data
4	Port	To save Port location data
5	Project	To store delivery project data
6	Shipping	To save delivery project list data
7	User	To store user data
8	User_groups	To store the system user ID and group data

In the Entity-Relationship Diagram of the shipping application shown in Figure 5, this system consists of eight interrelated tables to support the design of the information system for domestic sea transportation services for Limited Liability Company goods. Further details are shown in Table 1, which covers various operational aspects, from shipping data management to customer information processing, all designed to ensure data integrity and efficiency in a comprehensive system.

Figure 6.
Design the admin
dashboard page

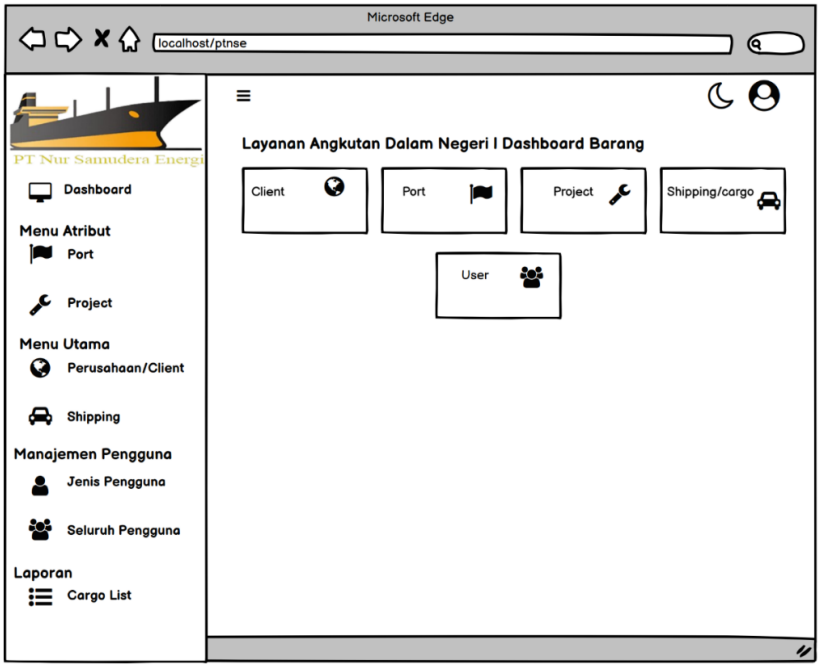


Figure 6. displays a prototype user interface page for a domestic sea freight service information system for goods, accessible via a web browser. The page is titled "Domestic Transport Services | Goods Dashboard," indicating that this is the main dashboard of the system. The sidebar on the left contains navigation menus covering various categories: Dashboard to return to the main page, Attribute Menu (Port and Project) to manage related data, Main Menu (Company/Client and Shipping) to manage company and shipping data, User Management (User Type and All Users) to manage users, and Report (Cargo List) to view the cargo list. The centre of the page displays quick access buttons to the system's primary functions, including Client, Port, Project, Shipping/Cargo, and User. In the upper right corner are icons for the user profile and night view mode. The URL address "localhost/pt" indicates that this is a localized version of the website being tested or developed. This interface provides quick and easy access to various aspects of managing domestic sea freight services.

Figure 6.
Design the admin
dashboard page

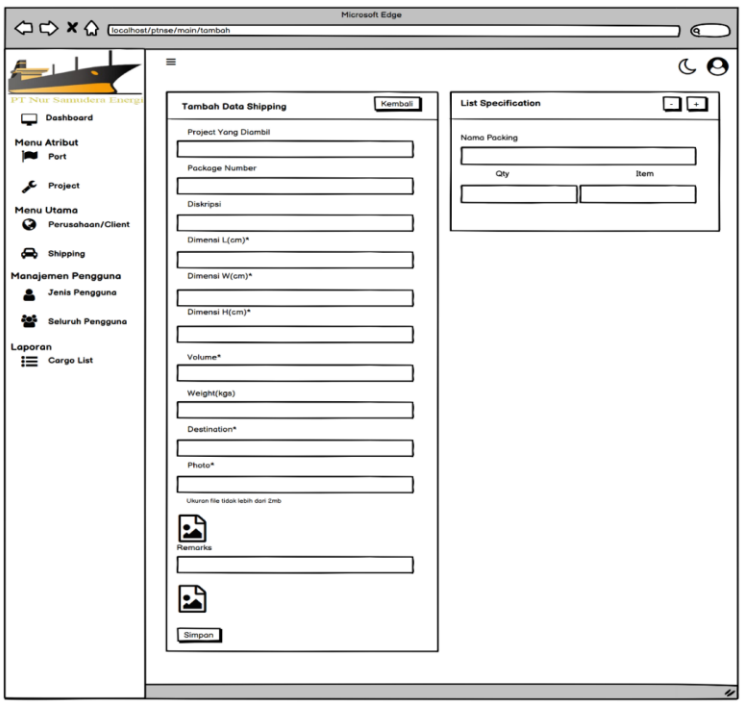


Figure 7 is a mockup of the user interface of an information system for domestic sea transportation services for goods, precisely the page "Add Shipping Data." This page is accessed through a web browser with the URL "localhost/pt/main/add," indicating that this is the local version being tested or developed. This view consists of two main sections. The left section contains the same navigation sidebar as the previous page, including the dashboard, Attribute Menu (Port and Project), Main Menu (Company/Client and Shipping), User Management (User Type and All Users), and Reports (Cargo List). In the centre to the right is a form to add shipping data. Overall, this interface is designed to make it easier for admins and officers to enter and manage shipment data in a detailed and efficient manner.

3.2 Writing program code

This stage involves developing a system or application by integrating software and hardware technologies based on previous Analysis and design results to create an operational system. The process of writing program code (coding) is a transformation of conceptualization and design into a functional and integrated system. This system is implemented using the PHP programming language and MySQL database for code management, as well as Notepad++ as a development platform for running applications.

3.3 Testing

The testing process integrated into each coding phase includes black box techniques. This testing, a crucial part of system development, focuses on validating the program code (coding) to ensure compliance with the predefined functional specifications. We utilize black box testing to evaluate whether the developed system fulfils all defined functional requirements. This approach is also highly effective for verifying the performance of various features within the web-based domestic sea transportation of service information system designed for a Limited Liability Company.

Table 2. Officer page testing

Testing activity	Expected realization	Results
Click the login page	The admin login view appears	Success
Main page	The main page appears	Success
Click on the dashboard menu	The dashboard view appears	Success
Click on the company	Company data display appears	Success
Click company-add	Company-add view appears	Success
Click Company-modify	Company-change view appears	Success
Click company-delete	Company-delete view appears	Success
Click company-search	Company-search view appears	Success
Click shipping	Appears to display shipping data	Success
Click shipping-add	Appears to display shipping data	Success
Klik shipping-ubah	Appears to display shipping-changes	Success
Click shipping-delete	Appears to display shipping-delete	Success
Click shipping-search	Appears to show shipping-search	Success
Click cargo list	The report menu appears	Success

The results from testing using the sample test cases have shown that the software works effectively. However, keep in mind that this test does not cover all aspects, as it only focuses on one test area. Nevertheless, the results of this test are expected to provide a representative picture of other functions

in the application of the domestic sea transportation of service information system for goods belonging to the Limited Liability Company.

Table 3. Admin page testing

Testing activity	Expected realization	Results
Click the login page	The admin login view appears	Success
Main page	Main page appears	Success
Click on the dashboard menu	The dashboard view appears	Success
Click the port menu	Port data display appears	Success
Click the add-port menu	The port-add view appears	Success
Click the change-port menu	Change-port view appears	Success
Click the port-delete menu	A port-delete view appears	Success
Click the search-port menu	The port-search view appears	Success
Click the project menu	Project data display appears	Success
Click the project-add menu	Project-add view appears	Success
Click the project menu-modify	Project-modify view appears	Success
Click the project menu-delete	Project-delete view appears	Success
Click the project-search menu	The project-search view appears	Success
Click on the company	Company data display appears	Success
Click company-add	Company-add view appears	Success
Click Company-modify	Company-change view appears	Success
Click company-delete	Company-delete view appears	Success
Click company-search	Company-search view appears	Success
Click shipping	Appears to display shipping data	Success
Click shipping-add	Appears to display shipping-add	Success
Click shipping-changes	Appears to display shipping-changes	Success
Click shipping-delete	Appears to display shipping-delete	Success
Click shipping-search	Appears to show shipping-search	Success
Click user type	User type display appears	Success
Click all users	All users appear	Success

3.4 Program implementation

The application of the admin dashboard page provides a unified view that displays information about the number of company clients, port data, ongoing projects, shipment/cargo details, and system user data.

Figure 8. Admin dashboard page implementation

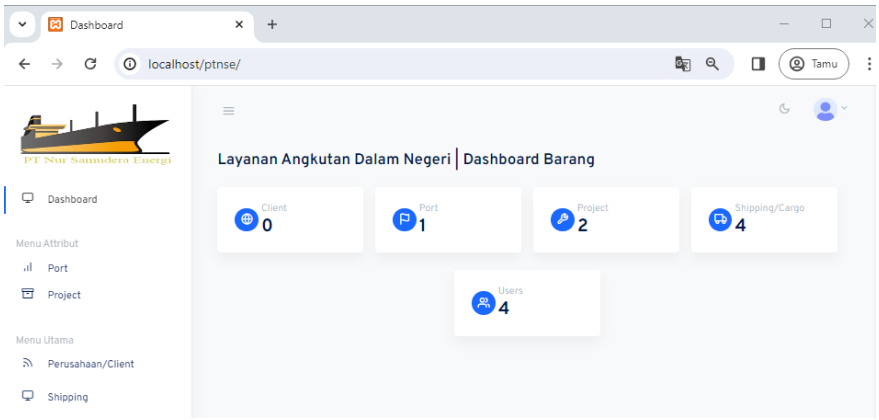
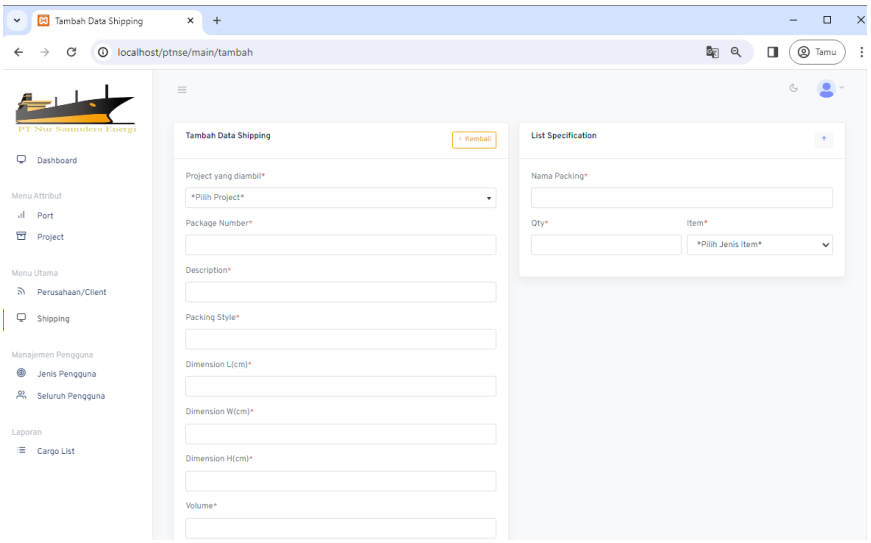


Figure 9. Implementation of admin page add shipping data



The application of the admin page to add shipping data above displays shipping fields starting from the project taken, package name, description, packing style, dimension, dimension weight, volume, list specification, qty, item and the save button on the system.

4. Conclusion

This research successfully designed and implemented a web-based information system for domestic sea transportation services for Limited Liability Companies. The system solves existing problems and improves operational efficiency and customer satisfaction. With cutting-edge information technology, the Limited Liability Company can maintain its competitiveness in the freight forwarding industry. This research demonstrates the importance of a structured approach, such as the waterfall model, in developing complex systems that serve to meet users' specific needs. Implementing this system is essential in supporting the Limited Liability Company's goal to become a leading cargo service provider, offering prompt delivery and precise information to their customers. This system can be further developed in the future by adding new features based on user feedback and technological developments.

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Declarations

Author contribution

Afrina: Conceptualization, methodology, Validation, data curation and writing - original draft. Army Trilidia Devega: Investigation, resources, writing - review & editing. Diki Pratama Putra: Writing - original draft, software, formal analysis, investigation and data curation.

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Conflict of interest

No conflicts of interest in this research

Ethical clearance

This research followed the provisions of the Declaration of Helsinki in the conduct of research involving human subjects. Prior to the research, the management and staff of PT NSE agreed to be informants in this research. They were also willing to have their data used as the basis for the website and material for this published article.

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