Journal of Artificial Intelligence and Engineering Applications

Website: https://ioinformatic.org/

15th June 2025. Vol. 4. No. 3; e-ISSN: 2808-4519

Design and Creation of Application Estimation of Wood Packing Service Cost for Web-Based Goods Delivery With Prototype Model (Case Study: PT. Cahaya Lintang Lestari)

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Abstract

The development of information technology has driven the need for information systems that can improve efficiency and accuracy in business operations. PT Cahaya Lintang Lestari, a company engaged in logistics packaging services, still uses traditional methods such as manual recording and Excel in calculating estimated wooden packing costs. This method often causes errors and is less efficient. To overcome this, a web-based application was developed with a prototyping method, which aims to calculate estimated packing costs automatically. The system development process is carried out in stages in six stages, starting from gathering needs to the implementation stage. This application makes it easy for customers to obtain price estimates independently without having to contact the service provider, and facilitates integrated data management. Based on the implementation results, this system has been proven to improve calculation accuracy, speed up the service process, and provide price transparency to customers. Overall, the use of this system can improve the quality of service and the company's operational efficiency.

Keywords: *Web Applications, Cost Estimation, Logistics Packaging, Automation, Information Systems, Prototyping.*

1. Introduction

Manual systems are still widely used in small-to-medium logistics operations, including wooden packing service providers. PT. Cahaya Lintang Lestari relies on handwritten and spreadsheet-based processes for cost estimation, which introduces delays, human error, and inefficiencies. Customers must directly contact staff to inquire about pricing, which often leads to inconsistent responses. As a solution, this study proposes the development of a web-based application to automate packing cost estimation using the Prototype model. The approach emphasizes iterative development with continuous user involvement, ensuring the system is tailored to the company's needs. This paper presents the analysis, design, and implementation of the application.

2. Literature Review

The relevance of efficient, standardized, and transparent packing services has been widely discussed in recent studies. Sidjabat and Sunahardi [1] analyzed how wooden packaging affects goods safety and customer satisfaction. Their research emphasized that the use of proper packaging materials and techniques not only minimizes product damage during shipment but also contributes to a more positive customer experience. This finding aligns with the core goal of the current system, which ensures consistent and documented cost estimation for wooden packing, increasing customer trust.

In another study, Ernandy et al. [2] presented a cost estimation model for fire protection infrastructure in sugar factories, focusing on materials and construction. Although the context is different, their approach highlights the importance of accurately calculating material-based costs, which parallels the use of volume-based pricing in packing services. The methodology reinforces the need for systematic and data-driven estimation—an approach embedded in the web-based packing cost system developed in this research.

Rahmah [3] explored the influence of tariff accuracy and service quality on customer satisfaction within a well-known logistics company. Her study found that customers highly value clear pricing structures and timely service delivery. These insights validate the development

of an automated estimation feature that provides real-time, transparent pricing without the need for manual consultation, thereby improving customer convenience and confidence.

Nurzadqy et al. [4] proposed a procedural framework for handling dangerous goods in air cargo logistics. The emphasis was on compliance, documentation, and clear process stages to ensure safety and efficiency. While their research focuses on air freight, the underlying principle of structured, trackable logistics systems is highly relevant. The proposed web application incorporates similar principles by enabling digital order tracking, staff accountability, and secure data handling for wooden packing services.

Lastly, Kusaimah [5] discussed consumer rights in the context of freight delivery delays. She highlighted the importance of accurate information, service traceability, and the need for clear proof of service fulfillment. These concerns are addressed in the proposed system through features such as downloadable order histories, packing completion statuses, and transparent cost computation, all of which contribute to better customer protection and service accountability.

In today's digital landscape, manual inventory and transaction management systems pose significant challenges to business efficiency and accuracy. Agustio et al. [6] developed a web-based inventory and purchasing system using the Waterfall methodology, featuring real-time stock monitoring that reduces recording errors and operational inefficiencies. This approach proves particularly valuable for small to medium enterprises seeking digitization, offering flexible access for inventory management from any location with internet connectivity—essential for service-oriented businesses requiring real-time material tracking and logistics coordination.

Complementing the technical aspects, Puspitasari et al. [7] highlighted the importance of structured IT integration and digital literacy in technology adoption. Although focused on safe internet practices among students, their work emphasizes user-centric design considerations and community education for responsible technology usage, which are crucial when developing IT solutions for diverse user groups with varying digital proficiency levels.

Syafii and Haryono [8] demonstrated the effectiveness of agile development methods, specifically Extreme Programming (XP), in creating educational applications. The XP principles—iterative development, user feedback loops, and simplicity—are highly applicable to logistics and cost estimation platforms. Their positive user acceptance testing results support the methodology's effectiveness for software projects involving user interaction and modular content, making it suitable for prototype development in service-based systems.

Thoyyibah et al. [9] explored digital empowerment of small businesses through web-based tools like Google Business for promoting local products. Their research illustrates how accessible digital interfaces improve both internal operational efficiency and customer engagement opportunities. The successful digital adoption in rural micro-businesses demonstrates the potential benefits of user-friendly web-based applications for service operations, suggesting similar advantages for packing cost estimation systems.

Finally, Khusaeni and Haryono [10] analyzed a web-based Customer Relationship Management (CRM) system implementation at PT Madu Perkasa Jaya using the Waterfall model. Their study emphasized digital systems' critical role in managing customer satisfaction and loyalty through centralized data management and improved responsiveness. The 78.8% user satisfaction score reinforces the applicability of structured development approaches for service delivery and customer relationship management in web-based applications.

Collectively, these studies provide comprehensive support for developing a web-based wood packing cost estimation application, covering technical feasibility, user considerations, development methodologies, digital accessibility, and customer relationship management aspects.

3. Research Methods

This study employs the Knowledge Discovery in Databases (KDD) approach combined with the Prototype development methodology to create a comprehensive web-based cost estimation system. The research methodology is structured to ensure systematic development and thorough evaluation of the proposed solution.

3.1. Prototype Development Methodology

To achieve the research objectives, a qualitative descriptive approach was employed. The research methodology was composed of four core components: observation, interviews, literature review, and the Prototype development method. Each method contributed significantly to understanding existing workflows and crafting an effective solution.

1. Observation: The research began with field observations at PT. Cahaya Lintang Lestari to identify the current practices for packing cost estimation. During this process, the researchers directly noted the limitations and inefficiencies of manual calculations, reliance on Excel sheets, and communication bottlenecks between customers and the packing team. Observations also revealed that staff often estimated costs based on approximations without standardized parameters.

2. Interviews: Structured and semi-structured interviews were conducted with staff from multiple roles, including administrative personnel, packing staff, and the company owner. The goal was to gather insights regarding their daily operations, difficulties encountered, and expectations for a digital system. Interviews confirmed that manual methods frequently led to miscalculations, delays in order processing, and issues in record-keeping.

3. Literature Review: A thorough review of related research was performed, focusing on topics such as packing cost estimation, user-centered design, and software engineering using the Prototype model. The findings helped shape system requirements and validate the choice of technology.

4. Prototype Method: The Prototype model was selected due to its iterative nature, allowing for rapid development and frequent feedback integration. This model consists of six phases:

1) Requirement Gathering and Analysis
2) Quick Design
3) Build Prototype
4) User Evaluation
5) Refinement
6) Final Product Implementation

This research methodology ensured that the resulting application was grounded in real operational needs and refined through collaboration with actual users.

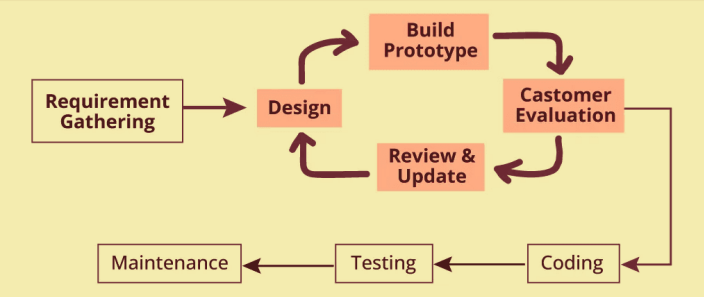

Fig. 1: Prototype

3.2. Data Collection Methods

Observation Direct observation of current cost estimation processes was conducted to understand workflow patterns, identify bottlenecks, and document existing procedures. This method provided insights into real-world operational challenges and user behavior patterns.
Interviews Structured interviews were conducted with various stakeholders including:
- Management personnel to understand business objectives and constraints
- Administrative staff to document current processes and system requirements
- Packing personnel to understand operational workflows and material requirements
- Customers to gather feedback on service expectations and pricing transparency needs

Document Analysis Existing documentation including cost calculation procedures, pricing structures, and operational guidelines were analyzed to ensure system alignment with established business practices.

4. Result and Discussion

The implementation of the web-based cost estimation application for wooden packing services has yielded significant improvements in operational efficiency and service quality at PT. Cahaya Lintang Lestari. This section presents the detailed analysis of system development, implementation results, and performance evaluation.

4.1. System Design

The design phase played a critical role in transforming user requirements into a structured application capable of solving the company's key problems. Multiple modeling techniques were employed, such as UML diagrams, database normalization, and system flow diagrams.

Use Case Diagram This diagram identifies interactions between the system and its users. Key actors include Customer, Admin, Staff Packing, and Owner. Customers can input item data and retrieve cost estimates; Admin manages data, transactions, and user roles; Staff Packing handles order updates; and the Owner reviews reports and analytics.

Fig. 2: Usecase

Activity Diagrams Two activity diagrams were created: one for the current manual system and one for the proposed digital system. The current system involves numerous steps like manual input, phone confirmations, and verbal order management. The proposed diagram simplifies this by introducing digital forms, automated estimations, and direct communication between system users.

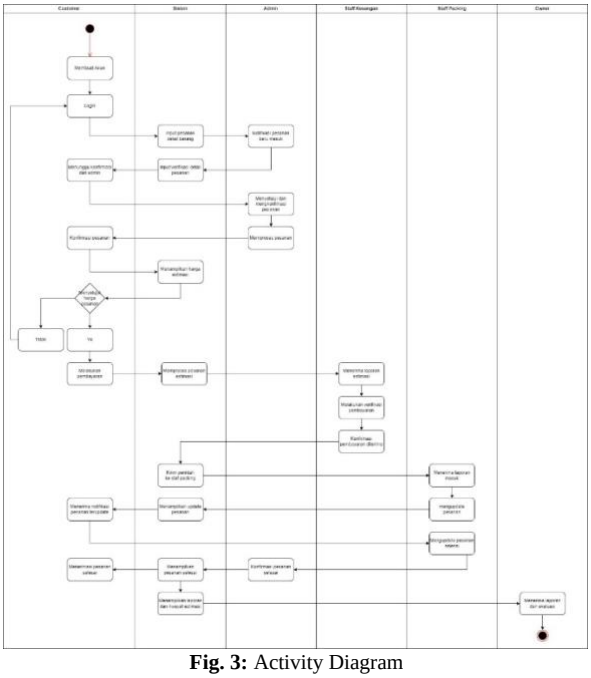

Fig. 3: Activity Diagram

Entity Relationship Diagram (ERD) The ERD outlines the logical structure of the database. Entities include:

1) **Customer**: Stores personal data and transaction history.
2) **Admin**: User responsible for managing materials, price rules, and user access.
3) **Order**: Links customers to specific service requests.
4) **Item**: Contains input data like dimensions and item type.
5) **Wood Type**: Material categories impacting pricing.
6) **Report**: Consolidated summaries of order data.

Relationships between these entities ensure normalization and optimized data access.

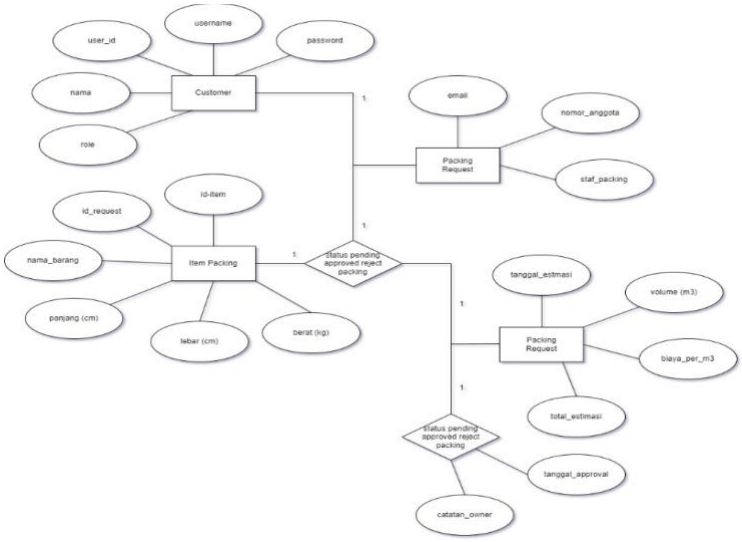

Fig. 4: ERD

Cost Calculation Algorithm The core cost estimation algorithm considers multiple factors including:

- Item dimensions (length, width, height)
- Item weight and fragility classification
- Wood type selection based on protection requirements
- Labor costs and material overhead
- Profit margin and service charges

The algorithm formula is implemented as:
Total Cost = (Volume × Wood Price per m^3) + (Weight × Weight Factor) + Labor Cost + Service Charge + (Total × Profit Margin)

Normalization: The database underwent normalization to 3NF:

1) **1NF**: Removed repeating groups.
2) **2NF**: Ensured all non-key attributes depended on the entire primary key.
3) **3NF**: Removed transitive dependencies.

This approach enhances performance, reduces redundancy, and improves update accuracy.

kode_pesanan	user_id	nama_barang	panjang	lebar	tinggi	berat	volume	jenis_kayu_id	harga_dimensi_id	nomor_whatsapp	estimasi_biaya	status	created_at	tipe
EST20250522160811356	1	Lemari	97.00	70.00	2800.00	12.00	14.00	2	2	8123233878	3510000.00	pending	22/05/2025	estimasi
EST20250523043321305	5	Lemari	90.00	60.00	2500.00	12.00	13.50	1	1	8143878789	3010000.00	pending	23/05/2025	order

Fig. 5: 1NF

kode_pesanan	user_id	created_at	jenis_kayu_id	harga_dimensi_id	nomor_whatsapp	estimasi_biaya	status	tipe
EST20250522160811356	1	22/05/2025	2	2	8123233878	3510000.00	pending	estimasi
EST20250523043321305	5	23/05/2025	1	1	8143878789	3010000.00	pending	order

Fig. 6: 2NF

kode_pesanan	nama_user	created_at	nama_barang	panjang	lebar	tinggi	volume	nama_kayu	harga_per_volume
EST20250522160811356	Dava	22/05/2025	Lemari	97.00	70.00	2800.00	14.00	crate	250714.29
EST20250523043321305	Farid	23/05/2025	Lemari	90.00	60.00	2500.00	13.50	crate	223703.70

Fig. 7: 3NF

Sequence Diagram This sequence diagram describes the chronological order of interactions among system components:

1) Customer logs in → enters item data → submits request
2) System calculates and shows estimated price
3) Admin reviews and assigns to staff
4) Staff updates order status
5) Owner accesses summary reports

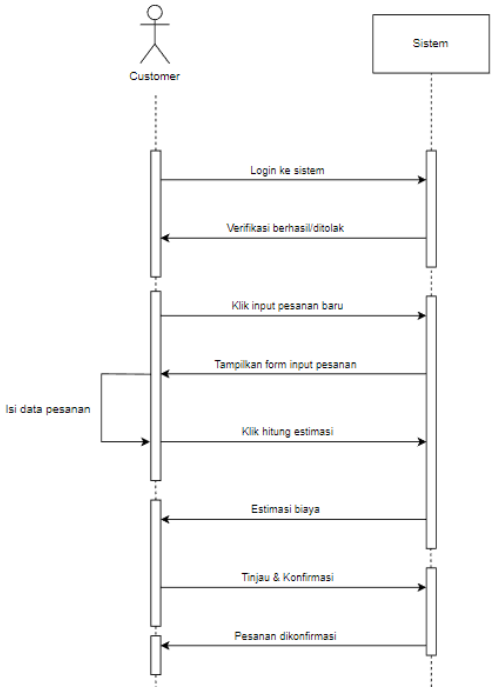

Fig. 8: Seqeunce Diagram

Flowchart The system flowchart shows the estimation process:

1) Input: Dimensions and wood type
2) Processing: Calculation using predefined formula
3) Output: Estimated cost and data storage

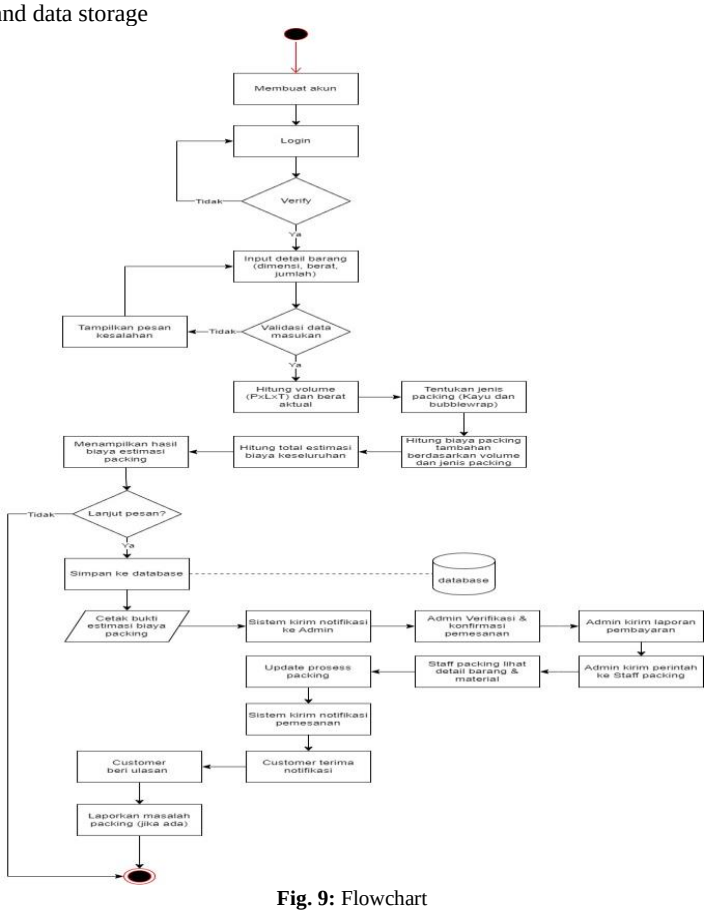

Fig. 9: Flowchart

4.2. User Interface

The system features a multi-role interface architecture built using modern web technologies. Each user type—Customer, Admin, Packing Staff, and Owner—is provided with tailored access to relevant functionalities to ensure operational clarity and usability.

1) **Login and Registration Page**: This interface allows users to sign in using a secure login mechanism. Passwords are encrypted using hashing algorithms, and session tokens prevent unauthorized access. New users can register by filling in basic credentials, and role-based redirection ensures only authorized menus are displayed post-login.
2) **Estimation Page (Customer View)**: The customer fills in item dimensions (length, width, height) via responsive form fields. A dropdown allows the selection of wood types (e.g., Pine, Meranti, Multiplex). The system dynamically calculates volume and estimated cost based on the chosen wood price per cubic centimeter. A "Preview Order" feature lets users review details before submission.
3) **Admin Dashboard**: Admins view all incoming orders, verify customer data, and assign packing tasks. A visual panel provides pricing control where admins can edit or update prices for different wood types. The dashboard also includes order status tracking and logs of completed transactions.
4) **Packing Staff Interface**: Staff members receive packing instructions based on verified orders. Interfaces allow status updates such as "In Progress," "Completed," or "Delayed." Staff can upload images of packed goods as verification and add notes for specific items. Completed tasks are logged for performance reviews.
5) **Owner Panel**: Displays summarized insights such as daily revenue, number of processed orders, top-used wood types, and average packing duration. The report section enables downloading of monthly financial data and tracking KPIs over time. Visualizations like pie charts and line graphs are included for strategic analysis.

The user interface was developed with Tailwind CSS to ensure clean design, responsiveness, and accessibility. Keyboard navigation and form validation are integrated to improve usability. The application is compatible with both desktop and mobile devices.

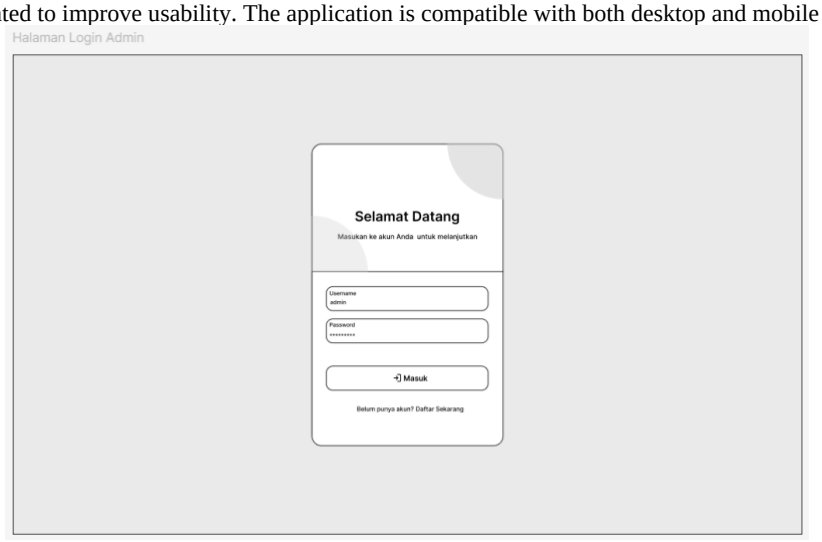

Fig. 10: Login

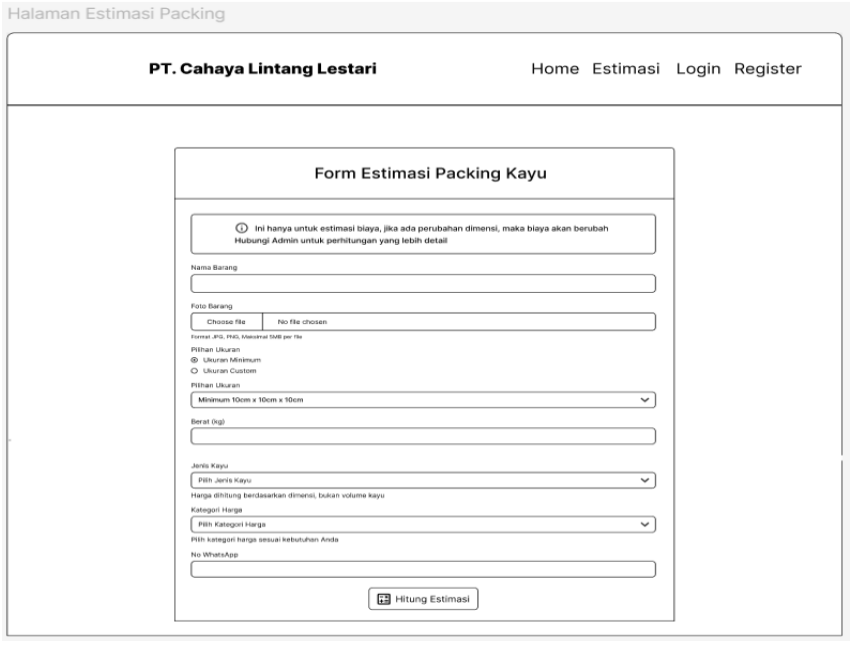

Fig. 11: Estimate Form

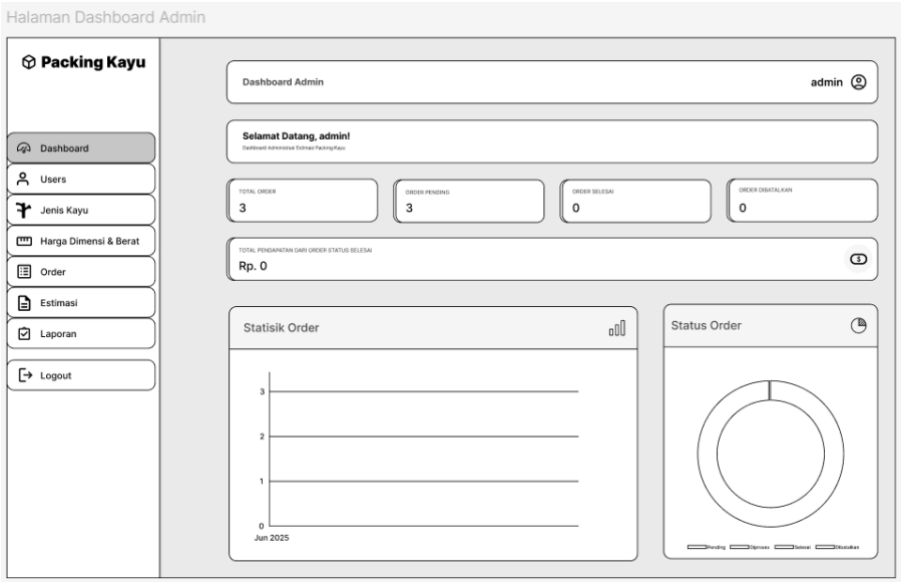

Fig. 12: Dashboard Admin

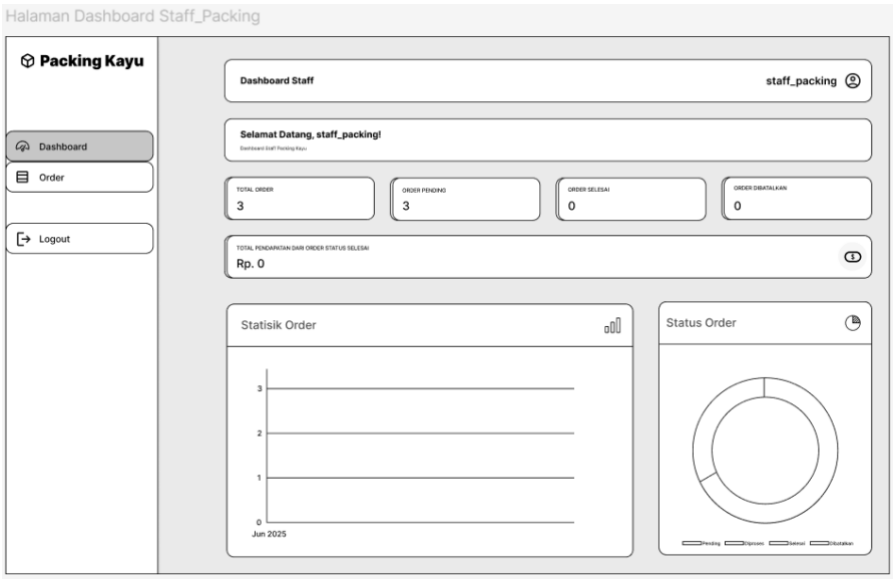

Fig. 13: Dashboard Staff

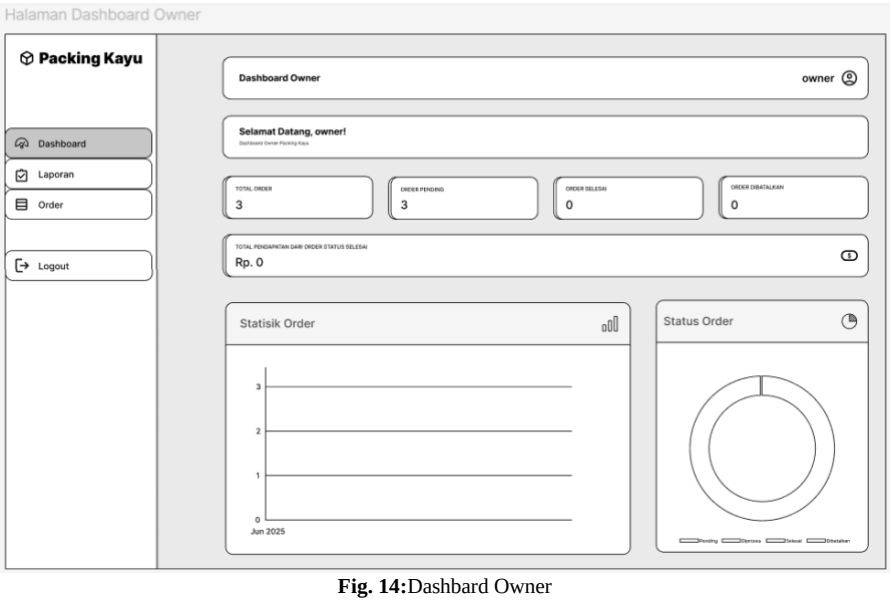

Fig. 14: Dashbard Owner

4.3. Implementation and Testing

The development of the application was carried out using core web technologies, specifically PHP for server-side scripting, and HTML, CSS, and JavaScript for the front-end interface. The architecture was built without using frameworks such as Laravel or React to keep the system lightweight, accessible, and easier to maintain by small development teams or SMEs.

Implementation Details:

1) **Frontend**: HTML5 was used to structure pages, CSS to manage layout and styling, and JavaScript for client-side interactivity such as input validation and dynamic field responses.
2) **Backend**: PHP handled server-side logic including form processing, user authentication, order management, and cost estimation.
3) **Database**: MySQL was used to store all application data including users, wood type pricing, orders, and transaction history. Tables were normalized to 3NF to ensure data integrity.
4) **Hosting Environment**: Initially deployed on a local development environment using XAMPP. The directory structure was organized into modules such as /pages, /functions, /assets, and /config for maintainability.

Functional Modules Developed:

1) **Estimation Module**: Uses PHP to process item dimensions submitted by the customer and calculate volume. Based on the selected wood type, the script multiplies volume by unit price to display an estimated packing cost.
2) **Login and Registration Module**: Facilitates secure access through session-based login. Passwords are hashed using built-in PHP functions. The system distinguishes user roles (admin, staff, customer) to redirect them to appropriate interfaces.
3) **Admin Control Panel**: Admins can manage master data (wood types and prices), review customer orders, assign packing responsibilities, and generate reports in HTML or CSV format.
4) **Packing Task Board**: Displays a list of orders assigned to staff with status update features like "in process," "completed," or "canceled." PHP-based file upload functionality allows staff to attach packing documentation images.
5) **Owner Dashboard**: Aggregates data into charts using a basic JavaScript charting library to visualize trends like monthly income, top-used materials, and average packing time.

Testing Methodology:

1) **Unit Testing**: Individual PHP functions were tested by feeding various sample inputs (including edge cases such as negative numbers and zero) to ensure accuracy in volume and cost calculations. For example, the formula (length × width × height / 1000000) × price_per_m3 was repeatedly validated.
2) **Integration Testing**: Focused on form submissions and database interactions. Forms for estimation and registration were tested to confirm that they correctly passed data to PHP scripts and stored entries in MySQL.
3) **System Testing**: A complete flow from user registration to final report generation was tested using various test accounts. Particular attention was given to validating input/output correctness, broken links, incorrect session redirection, and security vulnerabilities such as SQL injection.
4) **User Acceptance Testing (UAT)**: Conducted with four staff members from PT. Cahaya Lintang Lestari. They were asked to use the system independently and perform tasks like estimating costs, changing order statuses, and checking transaction history. Feedback was collected through a simple survey and informal discussion.

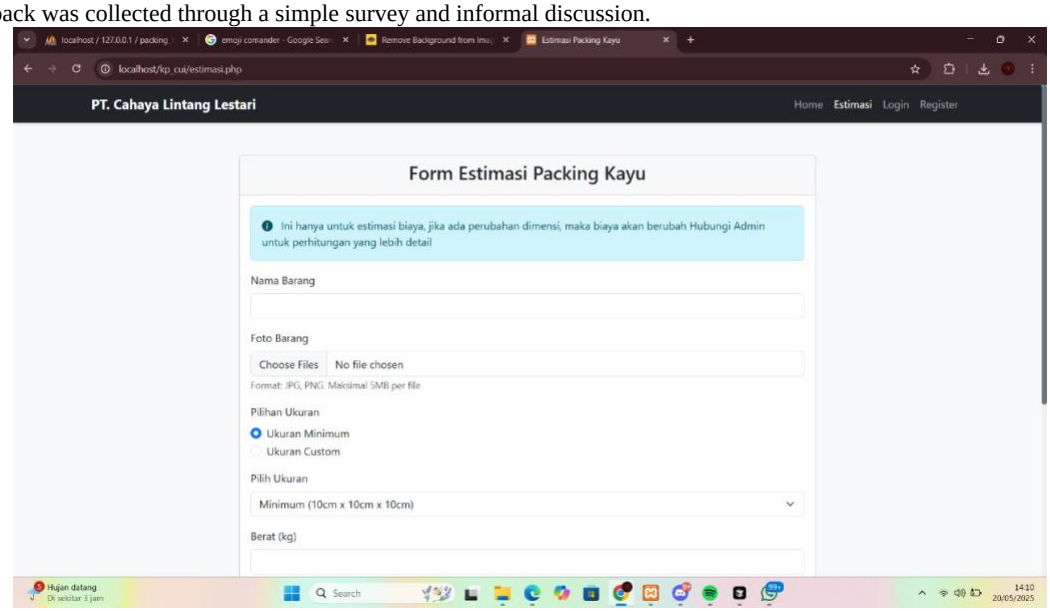

Fig. 15: Estimate Form Test

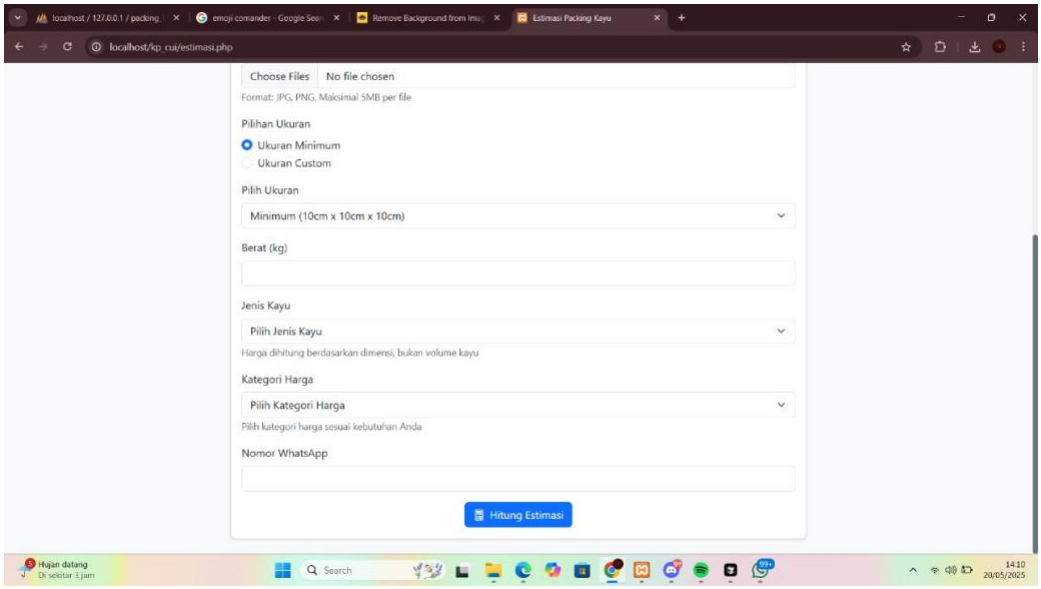

Fig. 16 : Estimate Form Test

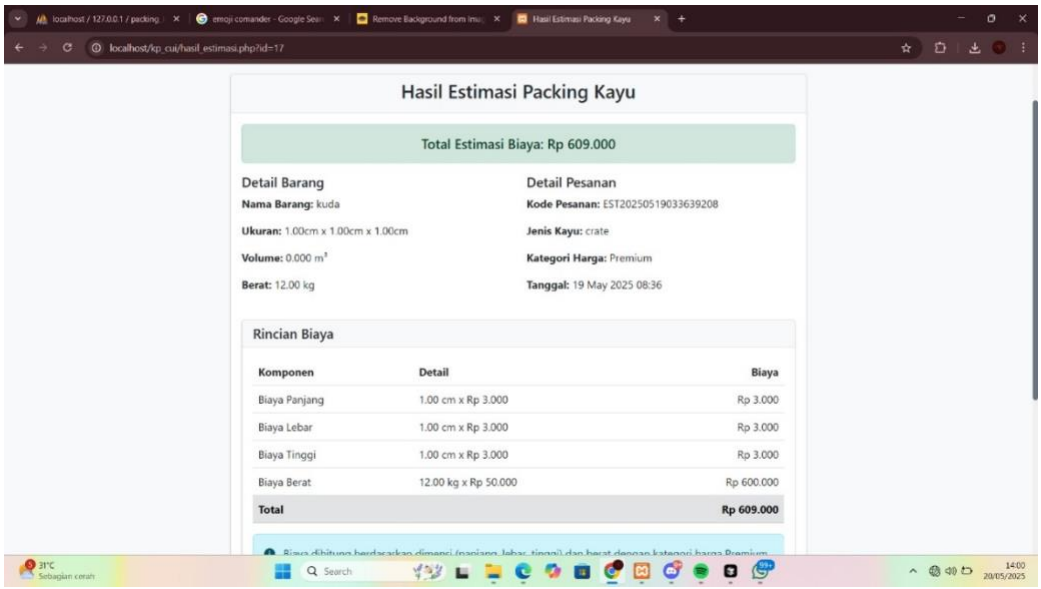

Fig. 17: Result Estimate

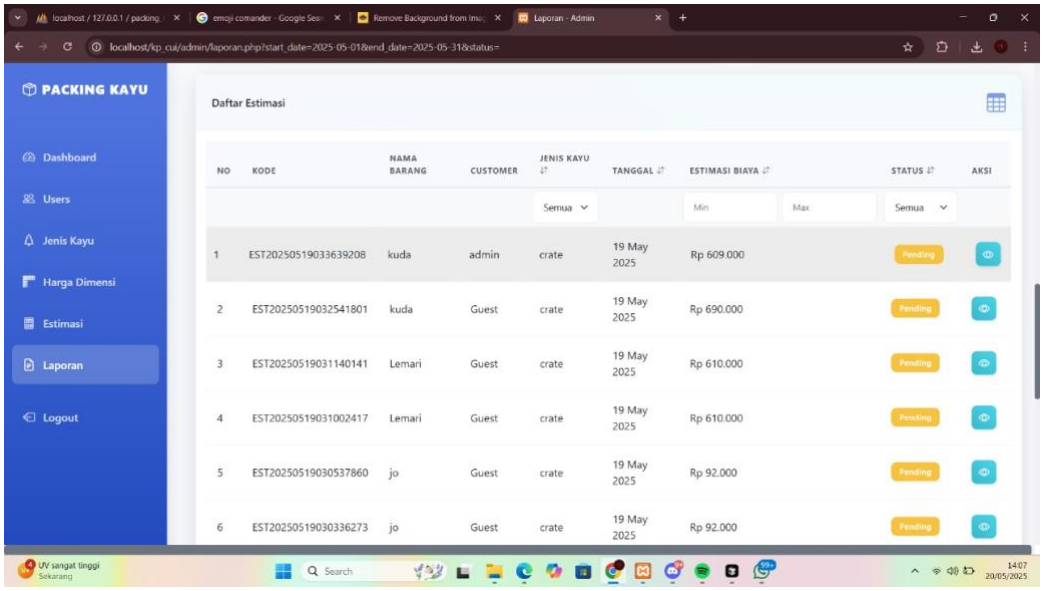

Fig. 18: Estimate List View

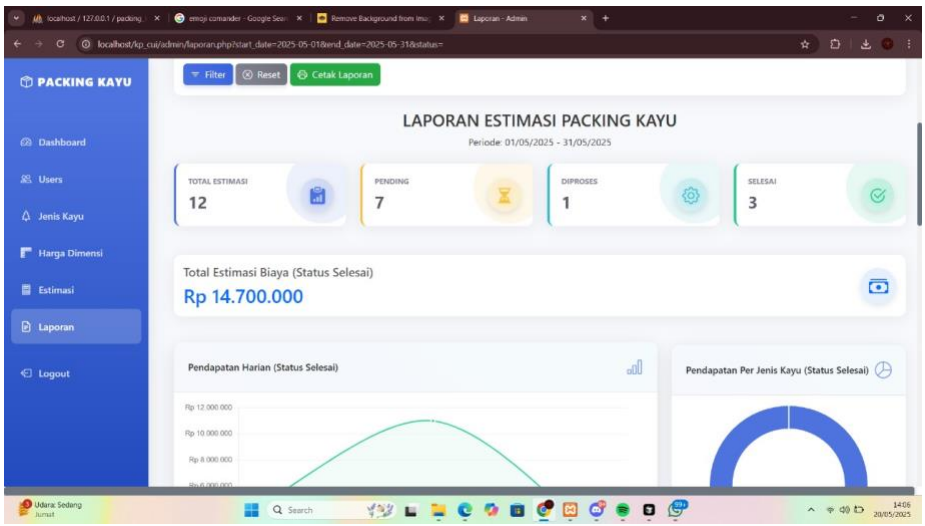

Fig. 19: Report Summary

4.4. Benefits and Limitations

Benefits: The implementation of the web-based packing cost estimation system at PT. Cahaya Lintang Lestari has brought several strategic advantages. Most notably, it has significantly improved operational efficiency. Tasks that previously required 10–15 minutes using manual calculations can now be executed in under a minute. This rapid processing capability allows staff to handle a higher volume of customer requests, directly impacting productivity. In terms of accuracy, the system minimizes human errors in volume and cost calculations by automating the entire estimation process. The algorithm ensures consistent output for identical inputs, removing the subjective variations that were previously common among different staff members.

Another major benefit is the increase in transparency and fairness. Since pricing is calculated by a fixed formula embedded in the system, customers receive uniform and predictable pricing. Additionally, the system stores all transactional data, enabling the company to track historical records for reporting, auditing, or customer service purposes. The role-based dashboard design further enhances usability and task alignment. Each user—customer, admin, packing staff, or owner—is presented with a customized interface containing only the features necessary for their function. This reduces confusion, shortens training time, and improves workflow organization across departments.

Lastly, the system enhances managerial oversight. Owners and supervisors can download real-time reports, monitor order fulfillment status, and evaluate team performance through metrics visualized in charts and tables. This empowers decision-making processes with accurate and accessible data.

Limitations:

Despite its many strengths, the system also has limitations that need to be addressed in future iterations. First and foremost, it relies on internet connectivity for access. In areas with unstable networks or during outages, users may experience interruptions in service, which could delay order processing. Another constraint is the current local hosting setup. Operating on a localhost server limits access to the internal network only, which restricts flexibility and scalability. To overcome this, future development should consider migrating to cloud hosting for better availability and multi-location access.

There is also a need for initial training, especially for employees who are unfamiliar with digital systems. While the interface is designed to be user-friendly, a learning curve still exists, and formal training sessions may be required during the adoption phase. Moreover, the system lacks integration with external services such as logistics tracking APIs or digital payment gateways. Including these features in future updates would improve the end-to-end automation of packing and delivery workflows.

Finally, the application is currently available only in the Indonesian language. To serve a broader customer base or expand internationally, it is recommended to add multilingual support.

5. Conclusion

The web-based cost estimation system developed using the Prototype model successfully addresses inefficiencies in the manual estimation process at PT. Cahaya Lintang Lestari. It enhances accuracy, reduces service time, and allows scalable operations. Iterative development enabled integration of real user feedback, making the system intuitive and aligned with business needs. Future enhancements may include mobile app integration, automated material inventory, and API-based shipping cost calculation modules. The methodology and system can be replicated across similar industries seeking to digitalize pricing and operations.

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