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Design and Build a Real-Time Based 3 Kg LPG Distribution Information System Using the Laravel Framework at PT. Tasya Gasindo

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A B S T R A C T

PT. Tasya Gasindo, an LPG 3 kg distribution agent in Medan, Indonesia, faced significant operational inefficiencies due to the absence of a real-time stock and demand monitoring system. Trucks frequently returned to the depot with unsold cylinders, causing queuing delays and Pertamina fines for unmet daily Delivery Order targets. This study designed and implemented a web-based distribution information system using the Laravel frame-work (MVC architecture, MySQL) providing real-time stock and demand data across 69 distribution bases. The descriptive-qualitative and software engineering approach included observation, interviews, and documentation. Black Box Testing covered 16 scenarios (all passed) with direct user evaluation. Average monthly residual cylinders decreased from 744 units (2022–2024) to 220 units in March–April 2025 a 70.4% reduction. The Fulfill-ment Rate improved from 99.20% to 99.74%, reducing estimated monthly Pertamina fines from Rp22.32 million to Rp6.60 million.

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INTRODUCTION

Energy distribution efficiency is a critical challenge in developing countries where subsidized commodities such as Liquefied Petroleum Gas (LPG) serve millions of low-income households. In Indonesia, 3 kg LPG has been the main source of energy for households since the government's kerosene-to-LPG conversion program in 2007. The 3 kg LPG supply chain involves Pertamina's depots, authorized agents, distribution bases, and end consumers.

PT. Tasya Gasindo is an official 3 kg LPG distribution agent operating under PT. Pertamina, located on Jalan Karya No. 218, West Medan, Medan City. Managing 69 bases throughout Medan, the company is required to distribute six daily Delivery Orders (DO) equivalent to 560 cylinders each using five homogeneous trucks. Pertamina im-posed a fine of IDR 30,000 per cylinder that was not distributed until the end of the month, making distribution efficiency a very critical business factor

The core problem is the lack of real-time visibility of stock and demand. Existing business processes rely on manual coordination without integrated data between agents, bases, payment intermediaries, and consumers. Without real-time visibility, distribution decisions are reactive: trucks bring full loads to the base regardless of actual absorption capacity, and unsold cylinders are only known at the end of the day after queuing back at the filling depot (estimated 2–3 hours/day).

Previous research proves the value of digital interventions: Espinoza et al. (2024) show that IoT and Business Intelligence models reduce LPG distribution inefficiencies through real-time monitoring; Chowdhury et al. (2024) emphasize digital transformation through SCADA and IoT for operational efficiency; and Ngirimana (2024) found that an integrated logistics information system significantly reduces delivery delays. Howev-er, most research focuses on large companies with established digital infrastructure, leav-ing a gap for local-scale agent solutions.

The Laravel PHP framework, with its MVC architecture, Blade Template En-gine, Eloquent ORM, and Artisan CLI, is well-suited for building structured, easy-to-maintain web applications according to the limitations of technical resources [9]. Muthia et al. (2023) and Sinlae et al. (2024) also confirmed that Laravel improves the efficiency of information system development and maintenance. This research aims to: (1) design and implement a Laravel-based real-time distribution information system; (2) analyze demand and efficiency patterns using historical data 2022–2024; and (3) formulate da-ta-based distribution policy recommendations.

LITERATURE REVIEW

Advances in information technology have had a significant impact on improving operational efficiency across various sectors, including energy distribution such as LPG. The 3-kg LPG cylinder is a vital commodity intended for low-income communities, so its distribution must be precise, controlled, and transparent. Therefore, an information system capable of managing the distribution process effectively and in real time is required.

Previous research indicates that the manual management of LPG distribution such as using Microsoft Excel or logbook entries—leads to various issues, including data duplication, input errors, and delays in report generation. These conditions result in suboptimal monitoring by management and hinder timely decision-making. To address these issues, various studies have developed web-based information systems. These systems enable centralized data management, multi-user access, and real-time information presentation, thereby improving accuracy and work efficiency. In addition, web-based systems also facilitate the direct monitoring of LPG stock, transactions, and distribution through an interactive dashboard.

Several studies also emphasize that the implementation of a web-based LPG distribution information system can improve operational efficiency, speed up recording processes, and minimize human error. These systems are typically equipped with features for inventory management, customer data, distribution reports, and notifications, thereby assisting companies in monitoring and planning distribution. In the context of system development, the Laravel framework is widely used because it supports the Model-View-Controller (MVC) architecture, which simplifies code management and enhances application security and scalability. Using Laravel also enables more structured and efficient system development. Additionally, development methods such as the Waterfall model are often used to ensure that each stage of system development proceeds systematically, from requirements analysis to system testing.

Other research also indicates that web-based distribution information systems equipped with real-time monitoring features can provide information transparency and support faster and more accurate decision-making. This is particularly critical in LPG distribution, given the high public demand and the importance of maintaining supply stability. Based on this literature review, it can be concluded that the development of a web-based LPG distribution information system with real-time support and the Laravel framework is the appropriate solution to improve efficiency, accuracy, and transparency in the distribution process. Therefore, this study focuses on the design and development of a real-time 3 kg LPG distribution information system at PT. Tasya Gasindo as an effort to support the company's digitalization and business process optimization.

METHODOLOGY

Research Design

This applied research combines qualitative descriptive approaches and software engineering. The qualitative descriptive approach describes the existing distribution conditions and user needs, while the software engineering approach guides the design and development of the system.

Data Collection

The research was conducted at PT. Tasya Gasindo from July 2024 to April 2025 used: (1) direct observation of the distribution process; (2) semi-structured interviews with staff, truck drivers, and base operators; and (3) review of the documentation of the 2022–2024 monthly distribution report from 69 bases.

System Development

Development follows a Prototype Model integrated with the Laravel Frame-work, through six phases: (1) Needs Analysis identifies functional needs through field observation; (2) System Design creates UML (Use Case, Activity, ERD) diagrams, da-tabase schemas, and interface wireframes; (3) Build implementation with Laravel v10, PHP 8.x, MySQL, Bootstrap 5, and Eloquent ORM; (4) System integration connects all modules through Laravel routing and middleware; (5) Black Box Testing 16 scenarios plus direct user evaluation; and (6) Deployment of production configurations with .env security, Laravel Auth, and submission of complete documentation.

Efficiency Measurement

Three KPIs measure distribution efficiency: (1) Average Monthly Residual Cyl-inder; (2) Fulfillment Rate = (Total Realization / Total Normal Quota) × 100%; and (3) Estimated Pertamina Fines = Remaining Savings of × IDR 30,000 per unit. Each was measured before (historical 2022–2024) and after the implementation of the system (March–April 2025).

RESEARCH RESULT AND DISCUSSION

Distribution Conditions Before Implementation

Historical data from 2022 to 2024 reveal a persistent monthly residual tube, con-firming systemic inefficiencies. Table 1 summarizes the annual KPIs. The 2023 anomaly is noteworthy: the remaining cylinders almost doubled (536 → 957 units/month), driven by increasingly fierce competition from new agents and the absence of real-time stock visibility that prevents timely redistribution. Pertamina's estimated fine exposure will reach IDR 344.52 million in 2023, almost double the 2022 figure.

Table 1. Summary of PT. Tasya Gasindo 2022–2025

Period	Total Normal	Total Realization	Total Remaining	Average Remainder/Month	Fulfillment Rate
2022	999.052	979.540	6.430	536	98,05%
2023	1.005.860	994.374	11.486	957	98,86%
2024	980.320	973.264	7.056	588	99,28%
2025 (Mar–Apr)	165.860	165.100	760	220	99,54%

* After system deployment March–April 2025

System Design

The system is designed with role-based access for Admins (PT. Tasya Gasindo) and User (base operator). Figure 1 presents a Use Case Diagram that defines the entire system interaction. The Activity Diagram for the login flow (Figure 2) describes the au-thentication process with role-based redirects.

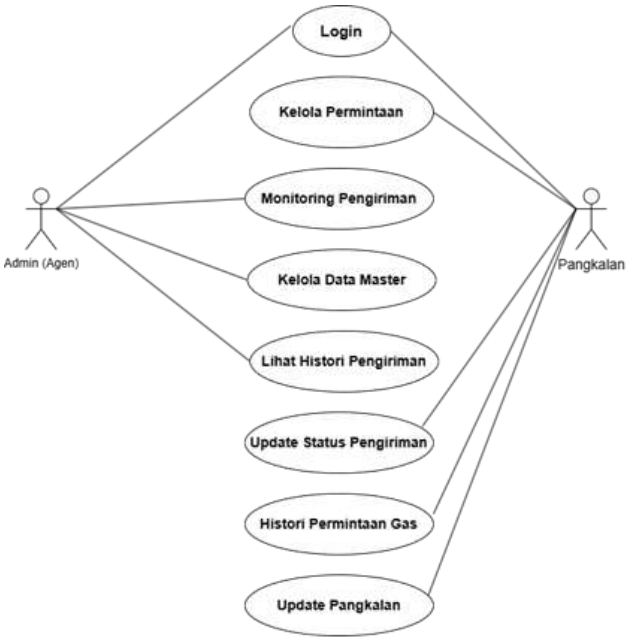

Figure 1. Use Case Diagram Distribution Information System

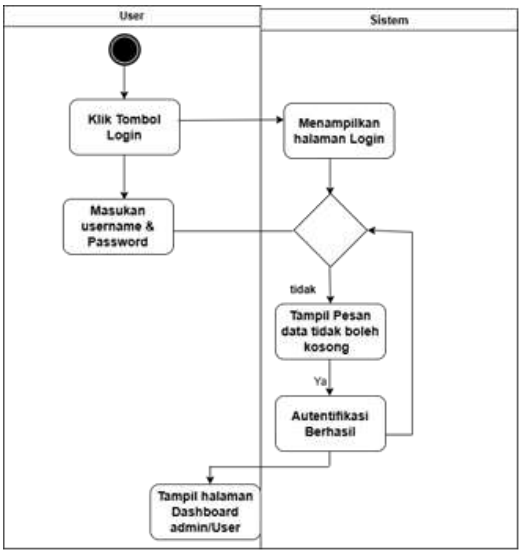

Figure 2. Activity Diagram Login Process

System Implementation

Six functional modules are implemented using Laravel v10, PHP 8.x, MySQL, and Bootstrap 5: Authentication (role-based), Real-Time Stock Monitoring (5-minute updates), Demand Management, Shipment Monitoring, Master Data, and Efficiency Reporting. Figure 3 shows the Login page as the system entry point.

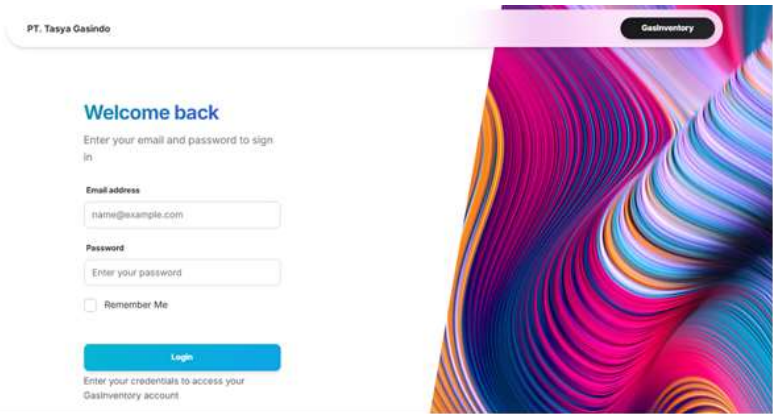

Figure 3. Distribution Information System Login Page of PT. Tasya Gasindo

After login, the base operator accesses the User Dashboard (Figure 4) which pro-vides navigation to stock updates, gas demands, shipment monitoring, and demand his-tory. The LPG Request Form (Figure 5) allows the base to place an order with a dropdown option to minimize input errors.

Figure 4. User Dashboard (Base View)

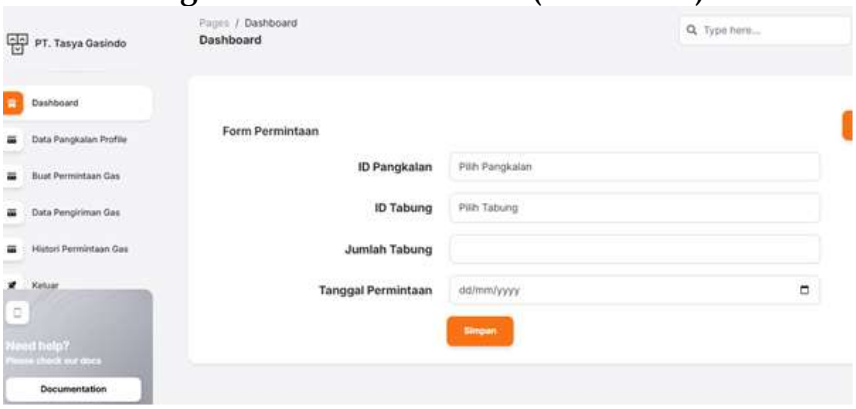

Figure 5. LPG Request Form

The Admin Dashboard (Figure 6) provides PT. Tasya Gasindo aggregates views of total users, approved requests, active deliveries, and active bases. The Master Data module (Figure 7) displays real-time tube stocks for all registered bases.

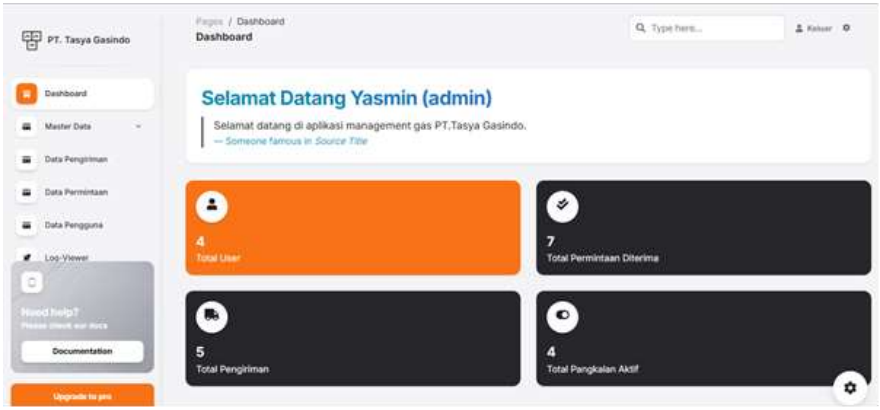

Figure 6. Admin Dashboard with Real-Time KPI Summary

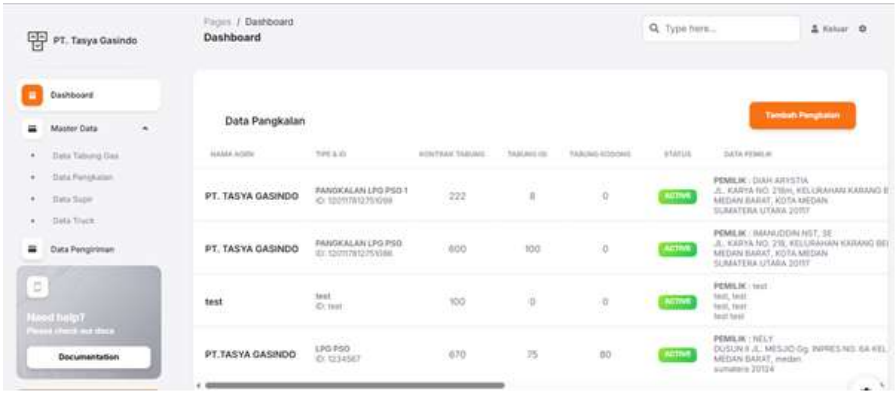

Figure 7. Base-Wide Real-Time Tube Stock Data Master

Black Box Testing Results

All 16 test scenarios get a status of Compliant. Table 2 presents a representative selec-tion. Key findings: role-based access control blocks unauthorized URL access (TC-12); input validation rejects invalid data before entering the database (TC-06); and the flow of state change runs sequentially according to design (TC-09 to TC-11).

Table 2. Black Box Testing Results (Selection of 10 Representative Scenarios)

Code	Scenario	Test Data	Expectations	Results	Status
TC-01	Valid admin login	Correct email & password	Log in to the admin dashboard	Successful	Conform
TC-03	Incorrect email login	Unregistered emails	Error message appears	Error appears	Conform
TC-05	Fill tube stock input	Valid numerical values	Real-time updated stock	Successful	Conform
TC-06	Negative value input	Value = -10	Validation rejects input	Rejected	Conform
TC-07	Make a complete request	All fields are valid	Saved requests	Successful	Conform

TC-09	Admin approves the request	Click the Approve button	Status berubah Approved	Successful	Conform
TC-11	Delivery status updates	Receive confirmation base	Status changed Done	Successful	Conform
TC-12	Admin access by base	Direct admin URL	Redirect/access denied	Rejected	Conform
TC-13	Generate efficiency reports	Click the report menu	KPI tables and charts displayed	Successful	Conform
TC-16	System logout	Click the login button	Return to the login page	Successful	Conform

Post-Implementation Efficiency Analysis

Table 3 presents a comprehensive comparison of efficiency before and after im-plementation**.**

Table 3. Distribution Efficiency: Before vs. After System Implementation

Indicator	**Before System (2022–2024)**	**After the System (Mar–Apr 2025)**
Average residual tubes/month	744 tabung	220 tabung (↓70,4%)
Fulfillment Rate	99,20%	99.74% (↑0.54 points)
Potential fines/month (Rp)	IDR 22,320,000	Rp 6.600.000 (↓Rp 15,72 juta)
Tube residue detection time	End of day / manual	Real-time (5 minutes)
Potential fines/year (Rp)	IDR 267,840,000	IDR 79,200,000 (save IDR 188,64 million)

The average monthly residual cylinder fell by 70.4% (744 → 220 units). These improvements come from two system capabilities: (1) real-time stock visibility that ena-bles proactive redistribution, and (2) formal demand flows that ensure bases communi-cate actual demand prior to distribution. The Fulfillment Rate increase of 0.54 percent-age points is equivalent to ~443 additional cylinders distributed every month, saving IDR 15.72 million/month (IDR 188.64 million/year) from Pertamina's exposure to fines.

These results go beyond the reported 30% increase in distribution efficiency Es-pinoza et al. (2024) using IoT and Business Intelligence, proving that targeted web-based systems can achieve substantial gains at local agent scale without complex IoT infrastructure. This difference is explained by the fact that the main inefficiencies in PT. Tasya Gasindo is an information gap that is directly and completely overcome by web information systems.

CONCLUSIONS AND RECOMMENDATIONS

Six data-driven recommendations were formulated: (1) Adaptation of seasonal demand reduce DO allocation by 10–20% to low-absorption bases during critical months (April, May, June, September); (2) Automatic warning of reorder threshold alert when stock is below 30% contract quota; (3) Data-driven scheduling optimizes weekly delivery using historical daily ingestion patterns; (4) Evaluation of non-compliant con-tracts marks the base with compliance below 70% for three consecutive months; (5) Demand forecasting for the implementation of Holt-Winters Exponential Smoothing using 2022–2024 data for 7–14 day predictions; (6) Depot queue monitoring integrates depot queue time data to minimize daily charging waiting time.

This research successfully designed and implemented a real-time web-based 3 kg LPG distribution information system for PT. Tasya Gasindo uses the Laravel frame-work. The system includes six integrated modules and is validated through Black Box Testing (16 scenarios, all of them passed) and live user evaluation. Quantitative results show a 70.4% decrease in the average monthly residual cylinder, an increase in the Ful-fillment Rate of 0.54 points, and a projected annual fine savings of IDR 188.64 million. This research contributes as a lightweight web-based approach that can be replicated for local-scale subsidized commodity distribution agents that do not have IoT infrastruc-ture. Follow-up research should implement a demand forecasting module (Holt-Winters), a WhatsApp notification API, and depot queue monitoring integration.

ADVANCED RESEARCH

Further research could also evaluate the system's performance on a larger scale by involving multiple bases and distribution areas, as well as comparing other system development methods—such as Agile—to enhance development flexibility.

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