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Evaluation of Business Processes in Goods Delivery at a Digital Freight Forwarding Logistics Company

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Abstract
In a digital freight forwarding company, all operational activities—from RFQ creation to shipment delivery—are managed through the ELI Trade application. The RFQ (Request for Quotation) process is a critical determinant of business success, primarily influenced by timeliness and pricing accuracy. Company data from 2023 indicate that the KPI for RFQ pricing speed, measured from "Create RFQ" to "Approve Bid," stands at 92.1%, falling short of the 95% target by 2.9%. This gap highlights the need for process evaluation and improvement. This research aims to analyze and enhance the RFQ offer process using Process Mining (PM) techniques applied to event log data from the end-to-end shipping workflow captured by the ELI Trade platform. The event logs, containing shipment case identifiers, activities, and timestamps, were processed to discover the actual operational process model. Subsequent analysis identified process duration, variations, and deviations from the company's Standard Operating Procedures (SOP). A cause-and-effect analysis was then used to determine the root causes of inefficiencies. The results revealed delays in approval and bottlenecks in pricing validation activities that contributed to the KPI gap. Based on these insights, the study proposes process redesigns to streamline workflow execution, reduce lead time, and align operations with SOP targets. The implications of this research extend beyond the RFQ process, providing the company with a data-driven approach to monitor and continuously improve its logistics operations, ultimately enhancing operational effectiveness, decision-making, and overall service efficiency.
Keywords: Digitalisation, Event Log, Freight Forwarding, Business Process, Process Mining.

INTRODUCTION

Today, the rapid advancement of information technology offers great opportunities for many companies seeking to adopt the latest technology to support smooth business operations (Buhalis, Efthymiou, Uzunboylu, & Thrassou, 2024; Mutoffar, Bahar, & Mustafa, 2024). According to Singh et al. (2015), Information Technology (IT) is a technology that utilizes computers to collect, process, store, and manage data so that it can be transformed into useful information. The company has implemented information technology to replace the traditional paper-based system with a fully digital system. This step was taken to create more efficient business operations (Akinradewo, Aigbavboa, & Oke, 2025; Tuan, Hung, & Hang, 2021).

PT ELI is one of the freight forwarding logistics companies that serves the delivery of goods (end to end) between countries (export/import) (Anugraheni & Kurniawati, 2024; Mytsenko, Babets, Mytsenko, & Sokolovska, 2025). In April 2016, this company was just established and began expanding its business with B2B customer targets. At this stage, freight forwarding services were still conducted conventionally; for example, the price quotation process and the storage of important shipment documents were not yet organized within the system, and there was no information available for monitoring the delivery process. In accordance with the company's vision of simplifying the international cargo delivery process in Southeast Asia and its mission to build a standard operating system for international cargo delivery activities in Southeast Asia, the company carried out a digital business transformation in 2019 with the concept of integrating freight forwarding services through the platform *ELI Trade*. This platform supports digital service integration features so that customer communication during the price quotation process until the shipment is executed can be recorded through chat on the application (Fedeli et al., 2025; Igwe-

Nmaju, 2024). Important documents related to the delivery of goods are stored in the application database, and customers can monitor the delivery of goods in real time (Ismailov & Mammadzada, 2025; Sri Vigna Hema & Manickavasagan, 2024).

The operational process of shipping goods on the platform begins with the customer submitting details of the shipment request or RFQ, which contains data on the loading location, delivery location, volume of goods, weight of goods, delivery mode, and type of goods. Next, sales enter a selling price quote based on purchase price information from the pricing team (Jipps, 2024; Shams, Brown, & Hardcastle, 2025). When the offer is accepted by the customer, the process moves to shipment management. At this stage, the delivery of goods is arranged immediately according to the readiness of the goods (Naseer, Tariq, Alshahrani, Alruwais, & Al-Wesabi, 2025). Customers can monitor the status of goods delivery from the process of picking up goods, estimating delivery time, tracking the actual position of the goods, to the arrival of goods at the destination location (Jing et al., 2025; Mao, Ming, Rong, Tang, & Zheng, 2025).

Based on company data in 2023, the Key Performance Indicator (KPI) showed the achievement of the speed of the RFQ price bidding process at 92.1% of the target of 95%, with a gap of 2.9%, indicating the need for operational process evaluation. The main complaint stems from the long waiting time for customer price quote feedback due to the tiered workflow between the sales and pricing teams, even though this process is core to shipment success (Akpe, Ubanadu, Daraojimba, Agboola, & Ogbuefi, n.d.; Raval, 2025). In line with the company's vision to simplify operations through a digital platform, this study evaluates the effectiveness and efficiency of the RFQ offering workflow using the Process Mining (PM) method, which assesses the actual process based on system activity log data. PM is used because it can identify bottlenecks, process variations, and deviations from SOPs in detail and accurately, compared to simulation methods or flow analysis that tend to rely on assumptions (Ahmad et al., 2025; Alhussain & Obiedallah, 2024). This approach allows for easy-to-understand visualization of processes, detection of rework flows, and analysis of the effectiveness of operator task division (Sipila, 2019; Sunny, Sakil, & Al, 2024). The evaluation results are then used as a basis for process improvement through cause-and-effect analysis, aiming to increase service time efficiency and system performance. Overall, this research contributes to the implementation of Process Mining in the digital logistics industry and supports PT ELI in achieving KPI targets and improving operational performance (Dávila & Castañeda, 2024; Wikusna & Jie, 2024).

Previous research by Alnahas (2023) undertook a systematic review of process-mining applications in logistics for manufacturing firms, concluding that while process discovery and conformance checking are used, fewer studies progress to the enhancement phase—and those that do often lack deployment in non-manufacturing logistics service contexts. Meanwhile, Napieraj et al. (2025) applied process mining in a warehouse management context to uncover bottlenecks and noise in event logs, yet the domain remained internal logistics rather than customer-facing RFQ workflows in freight forwarding. These studies highlight valuable methods but reveal two key gaps relevant to our context: (a) insufficient application of process mining in service-oriented logistics (especially RFQ/offering workflows) and (b) limited linkage between event-log-based insights and targeted operational improvements (e.g., pricing timeliness) tied to KPI gaps. Our research addresses these gaps by applying process mining to the RFQ quotation process in the digital freight-forwarding platform *ELI Trade*, discovering actual process flows, deviations from SOPs, and performance bottlenecks directly associated with the KPI shortfall (92.1% vs. 95% target), then proceeding with cause-and-effect analysis and proposing process redesign for operational efficiency.

The purpose of this study is to evaluate and improve the RFQ workflow within a digital freight-forwarding company using process-mining techniques. The benefit is to provide the organization with data-driven insights to enhance timeliness, pricing process accuracy, and overall service delivery efficiency, thus contributing to more effective logistics operations and benchmarkable best practices.

METHOD

The research focused on historical data of the operational process in the freight forwarding business at PT ELI, a digital logistics company engaged in export-import with a vision of digitalization. It used data from January to December 2023, covering the entire process from delivery requests to delivery completion recorded in the app's internal system. The purpose was to map the actual process flow, identify potential improvements, and provide recommendations to enhance operational efficiency.

The research began with a field study that included interviews with operational managers, direct observations, and documentation to understand SOPs, KPIs, and company workflows. The data collected helped identify gaps between field practices and system records, supported by a literature review on digital logistics, business process improvement, and Process Mining (PM) methods.

Analysis was conducted using the PM method with the Apromore application to visualize process flows, evaluate time efficiency, and detect deviations from SOPs. This was followed by Root Cause Analysis (RCA) using fishbone diagrams to identify root causes based on human factors, methods, machines, materials, measurements, and the environment. Based on these findings, a process redesign proposal was developed using a heuristic approach to improve the efficiency and effectiveness of the goods delivery process.

The recommendations were validated by the operational manager of PT ELI for practical application. The research concluded with an assessment of its success in addressing the problem and suggestions for future research.

RESULTS AND DISCUSSION

Business Operational Process Log Event Data

The processing of event log extraction data in PT ELI's freight forwarding business process is carried out to determine the overall cycle of time needed for each process starting from the request for an incoming order for the shipment of goods to the delivery of the goods, as well as other supporting information according to the model found in the mining process. Data extraction is the stage of pulling event log data from the Internal application system. The data period taken was for one year in January-December 2023. This period is taken by taking into account the average length of delivery of goods for 6 months so that it is hoped that the data can represent the entire process.

Event log extraction data is obtained in the form of CSV, then the file is converted into excel form to facilitate data structuring. The data attributes are RFQ numbers, process activities, process operators, and process timestamps. Each of these attributes is interrelated with each other, where each case of shipping goods can be identified from the RFQ number. Each RFQ number has several series of activities that are carried out from the beginning to the end of the business process. Each activity retrieved has a time stamp data that indicates when the activity was processed. Each activity has one operator who works according to the position of responsibility of that staff.

After the data extraction process from the internal application is completed, then data structuring is carried out including RFQ numbers that do not have a starting point for the "CREATE RFQ" process will be deleted. This is because the RFQ has been made outside the predetermined research time span so that it cannot be included in the mining process so as not to affect the validity of the results. In addition, for RFQ numbers that have duplicate data, one of them is removed so as not to affect the validity of the results. Data that has gone through the structuring stage, meaning that the data is ready to be included in the process mining application program with a .csv format.

From the company's standard operating procedure (SOP), a series of process activities are obtained starting from CREATE RFQ PLACE BID EDIT BID ADD PROFIT SUBMIT BID ACCEPT BID APPROVE BID SCHEDULED_OTIF PICK UP ORIGIN_LOCAL_HANDLING DEPARTURE ARRIVAL COMPLETED_OTIF.

Process Mining Analysis

Evaluation is carried out using Process Mining (PM) to provide an assessment according to the actual process running in the system. Every process recorded in the event log can be extracted in the form of case ID data, activity, timestamps to be evaluated and process improvements made on PM. The Process Mining (PM) type is a type of excavation to provide suggestions for improvements to business process problems detected in the resulting process model (Cahyaningtyas et al., 2018). According to Aalst (2016), PM can help to identify, analyze, and improve processes by digging into knowledge from event logs in information systems. In this study, the PM method was chosen to evaluate the business processes that have been running in the operations of shipping goods. The PM approach will be used to find out whether the operational business processes in the system are in accordance with the company's SOPs, whether there is a rework flow that has an impact on the delivery service process. The results of the PM visualization can also be used as a basis for identifying possible obstacles in the system and the appropriate division of operator tasks in the system to improve the operational process. The findings of the identification process are used as a basis for improvement at the process analysis stage.

Business Process Flow

Modeling of operational business process flows through process mining (PM) is visualized by paths, activities, and filters contained in the Apromore application. The visualization results of the timestamp extraction data can represent the actual conditions of business processes that may not be visible in observations in the field. There is some data information from process flow modeling which is carried out as follows:

a) Main Activities : CREATE RFQ, PLACE BID, EDIT BID, ADD PROFIT, SUBMIT BID, ACCEPT BID, APPROVE BID, SCHEDULED_OTIF, PICK UP, ORIGIN_LOCAL_HANDLING, DEPARTURE, ARRIVAL, COMPLETED_OTIF
b) Number of cases : 5467 cases
c) Number of Variants : 100 varian data
d) Number of Activities : 27 activities
e) Operator : 4 operator (customer, sales, pricing, operation)
f) Log timeframe : 02 Jan 2023 – 20 Dec 2023
g) Median duration : 1.02 months
h) Average duration : 1.19 months
i) Max Duration : 9.98 months

From the results of process mining (PM), the Apromore application uses the Apromore application by displaying a model made with 100% nodes and 50% arcs for the entire model of the company's freight forwarding business process flow so that various activities and paths can be identified in the actual process. The following are the results of visualizing the business process flow using process mining with the Apromore application.

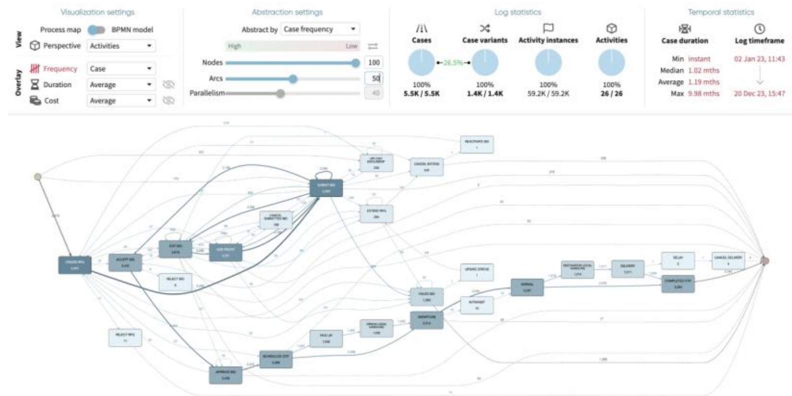

Figure 1. Process Flow Visualization by Case Frequency

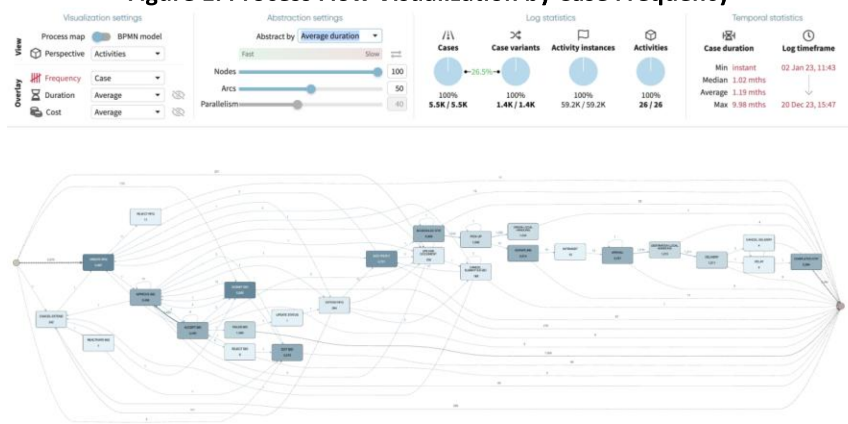

Figure 2. Process Flow Visualization by Average Duration

Process Discovery and Evaluation

This study focuses on the RFQ quotation process for every request for shipment of goods by customers through the customer apps platform. The quotation stage is an important stage in the freight forwarding logistics industry because it plays a role in the success of sales to get shipments. Other considerations are related to the readiness of goods to be delivered, the approval of the delivery of goods between shippers and consignees who have a delivery time limit, adjustments to the delivery arrangements of the shipping liner or airline. So to ensure that the RFQ quotation process is effective, it is necessary to evaluate the process cycle time of each variant and analyze the time needed for each process transfer. To get the results of the evaluation of the process that has been running, the author will compare the time directly follow diagram of each variant of the case including "Completed Shipment Process" and "Failed Shipment Process". The following is the number of cases in each variant of "Shipment Process Completed" and "Shipment Process Failed" visualized by Process Mining (PM).

Table 1. Number of Cases of Each Shipment Variant Resolved and Failed

Shipment	Number of Cases	Percentage
Shipment Completed	3276	70%
Shipment Gagal	1370	30%

Of the total number of shipments, there were 3276 cases of completed shipment processes, representing 70% of the total cases analyzed. This shows that the delivery process has been successfully implemented, from the creation of RFQs to the delivery of the final goods. On the other hand, there was a failed shipment process, which was as many as 1370 cases, which accounted for 30% of the total cases analyzed. These cases indicate that the delivery process is experiencing obstacles or complications that hinder a successful completion. Failure in the shipment process can be caused by internal or external factors. Internal factors include human error related to failures in the operating system process and user failure to use the system, technology errors related to IT failures in processing data so that the system goes down. Meanwhile, external factors include customer behavior in terms of customer behavior in choosing services, including the speed and accuracy of services, cargo readiness related to the readiness of the goods to be delivered. In the 2023 evaluation report, shipment failures at the RFQ stage were most due to cargo readiness factors (30% of cases), customer behavior (25% of cases), human error (17% of cases), technology errors (15% of cases), and other factors (13% of cases).

As a dynamic company, continuous evaluation and change are carried out to ensure the optimization of business operations so that it can support the company's business continuity. Previous research (Oktaviani et al, 2023) proved that process innovation has a positive and significant effect on the company's operational performance (coefficient of 0.247 and p value of 0.049). This indicates that the adoption of process innovations in digital systems can increase the efficiency and productivity of the company. Market orientation also has a positive and significant effect on the company's operational performance (coefficient of 0.282 and p value of 0.042). This indicates that the market orientation that implements service integration provides the company's effectiveness because every activity through the digital system can be faster and more flexible. Digital systems can reduce the number of documents and email communications. However, on the other hand, there are research conclusions that explain that product innovation has a negative effect on the company's operational performance (coefficient -0.0275 and p value 0.043). This indicates that the company's product innovation is too quickly developed in the market with massive introduction with a duration of one year, but the development of product innovation is not followed by the expertise of the company's employees so that the transition to a digital system does not go well as well as product errors that do not meet customer expectations. Therefore, it is necessary to conduct an in-depth evaluation of each process activity recorded in the system with the aim of finding gaps that occur so that process innovations can be carried out appropriately.

Evaluation of the Completed Shipment Process at the RFQ Bidding Stage

The shipment process is completed starting with the "Create RFQ" activity and ending with the "Completed_OTIF" activity. Of the total cases that came in from January to December 2023, there were 3276 resolved shipment cases with a percentage of 70% of the total cases. From the results of the Map Process of each shipment case resolved, an overview of the order of RFQ bidding process activities is obtained, including Create RFQ ⍰ Place BID ⍰ Edit BID ⍰ Add Profit ⍰ Submit BID ⍰ Accept BID ⍰ Approve BID. The median price quote cycle time from "Create RFQ" to "Approve BID" is 1.35 days. However, there are cases that have a shortest cycle duration of 1.6 minutes. This happens in RFQ repeat orders. There is a feature on the platform to display the purchase price history in RFQs that have the same shipment details so that it can shorten the time. In other cases, there is the longest cycle time, which is 3.02 months. In this case, there is a pending action that can be caused by human error. The following is the Process Map of the completed shipment.

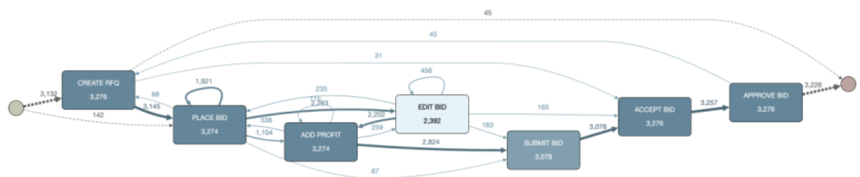

Figure 2. Map of Shipment Variant Process Completed RFQ Bidding Stage

Table 2. Performance Time Cycle Shipment Process Variants Completed RFQ Bidding Stage

Process	Min Duration	Max Duration	Average Duration	Median Duration
Create RFQ → Place BID → Edit BID → Add Profit → Submit BID → Accept BID → Approve BID	1.6 minutes	3.02 months	4.61 days	1.35 days

From the graph below the diagram illustrates the histogram of the time distribution needed for a certain process. The statistical metrics include a minimum time of 1.6 minutes, a median time of 1.35 days, an average time of 4.61 days, a maximum time of 3.02 months, and a total cumulative time of 41.31 years. The X-axis represents the length of time required for the process, ranging from 0 weeks to 13 weeks, while the Y-axis represents the frequency or number of events for each time-duration interval. The highest bar on the left (0 weeks) indicates that most processes are completed in a very short period of time, perhaps in less than a week. As the duration of time increases, the frequency decreases, indicating that fewer and fewer processes take longer. The median time of 1.35 days is much lower than the average time of 4.61 days, indicating that although most processes are completed quickly, there are some anomalies that take longer, which pulls the average upwards. The maximum time recorded for the process was 3.02 months, indicating significant variability in the time required. The total cumulative time of 41.31 years underscores the volume of data processed.

Furthermore, a cycle time evaluation is carried out in each activity process to find out the bottlenecks of the ongoing business operational process. To find out the details of the cycle time that occurred in each activity. In accordance with the key performance indicators (KPIs) that have been set, the purchase price input process for Place BID activities has a time limit of 1x24 hours. From the results of the evaluation, the median cycle time of the Create RFQ Place BID activity cycle was 1.5 days. This shows that the process has not been maximized in accordance with the KPI targets. At this stage, it is an important process for the RFQ bidding stage by the Pricing Team to be able to provide the best purchase price choice. From the overall cycle time ratio of each process, the Add Profit Submit BID activity has the longest median cycle time of 2.08 days. At this stage, it is an important process for the RFQ bidding stage by the Sales Team to enter the selling price by adding the margin profit percentage of the purchase price that has been entered. The ease of the digital system on the ELI Trade platform should be able to provide time efficiency to speed up this process. From the findings of the evaluation results, it will be further analyzed at the problem analysis stage.

Table 3. Comparison of Time Between Completed Shipment Processes

Process	Min Duration	Max Duration	Average Duration	Median Duration
Create RFQ → Place BID	1.83 min	3.02 months	4.73 days	1.5 days
Place BID → Edit BID	4.6 minutes	3.02 months	5.52 days	1.9 days
Edit BID → Add Profit	4.6 minutes	3.02 months	5.58 days	1.9 days
Add Profit → Submit BID	1.83 min	1.27 months	4.49 days	2.08 days
Submit BID → Accept BID	1.83 min	3.02 months	4.51 days	1.28 days
Accept BID → Approve BID	1.6 minutes	3.02 months	4.6 days	1.35 days

Evaluation of Failed Shipment Process at RFQ Bidding Stage

The failed shipment process starts with the "Create RFQ" activity and ends with the "Failed BID" activity. Of the total cases that came in from January to December 2023, there were 1370 cases of failed shipments with a percentage of 30% of the total cases. From the results of the Process Map variant of each case of failed shipment, there is a variable evaluation of the final stage of the process (Failed BID) from each case. It can be seen from Table 4 that the highest cases of shipment failure occurred after the

"Place BID" process, namely 130 cases (9.49%) in the Create RFQ → Place BID → Place BID → Failed BID case variant and 127 cases (9.27%) in the Create RFQ → Place BID → Failed BID case variant. At this stage, the purchase price has been entered by the Pricing Team but does not have a continuation process from the Sales Team. From the evaluation results, it was obtained that the case variants in Table 4 had a median cycle time of up to 1.12 months in the case variant of Create RFQ → Place BID → Place BID → Failed BID and 3.33 weeks in the case variant of Create RFQ → Place BID → Failed BID. The very short shipment failure process at the Create RFQ stage can be caused by incorrect shipment and cargo information data from the customer side, incomplete shipment information data so that the offer price cannot be given, there is the same shipment with a different RFQ, the request cannot be served. The following is an overview of the Process Map of a failed shipment.

Table 4. Variants of Failed Shipment Process RFQ Bidding Stage

Process	Case	Frequency
Create RFQ → Place BID → Place BID → Failed BID	130	9,49%
Create RFQ → Place BID → Failed BID	127	9,27%
Create RFQ → Place BID → Place BID → Edit BID → Add Profit → Place BID → Failed BID	88	6,42%
Create RFQ → Place BID → Place BID → Add Profit → Place BID → Failed BID	59	4,31%
Create RFQ → Place BID → Edit BID → Add Profit → Place BID → Failed BID	54	3,94%
Create RFQ → Failed BID	54	3,94%

Table 5. Performance Time Cycle Shipment Process Variant Failed RFQ Bid Stage

Process	Min Duration	Max Duration	Average Duration	Median Duration
Create RFQ → Place BID → Place BID → Failed BID	2.89 hours	9.98 months	1.45 months	1.12 months
Create RFQ → Place BID → Failed BID	37.5 minutes	9.73 months	1.33 months	3.33 weeks
Create RFQ → Place BID → Place BID → Edit BID → Add Profit → Place BID → Failed BID	1 day	6.86 months	1.9 months	1.38 months
Create RFQ → Place BID → Place BID → Add Profit → Place BID → Failed BID	1.31 days	3 months	3.88 weeks	3.41 weeks
Create RFQ → Place BID → Edit BID → Add Profit → Place BID → Failed BID	7.41 hours	7.23 months	1.89 months	1.44 months
Create RFQ → Failed BID	8.31 hours	7.16 months	1.73 weeks	3.46 days

From the graph below the diagram illustrates the histogram of the time distribution needed for a certain process. The statistical metrics include a minimum time of 15 seconds, a median time of 1.06 months, an average time of 1.58 months, a maximum time of 9.98 months, and a cumulative total time of 180.74 years. The X-axis represents the length of time required for the process, ranging from 0 weeks to about 43 weeks, while the Y-axis represents the frequency or number of events for each time duration interval. The highest bar is at around 4 weeks, indicating that most of the process is completed within that time span. As the duration of time increases, the frequency decreases, indicating that fewer and fewer processes take longer. The median time (1.06 months) was lower than the average time (1.58 months), suggesting that while most processes are completed relatively quickly, there are some anomalies that take longer, which pulls the average upwards. The maximum time recorded for this process was 9.98 months, indicating significant variability in the time required. The cumulative total time of 180.74 years underscores the volume of data processed.

To find the shipment pattern of failure in each RFQ bid process activity, the direct path process evaluation of each activity to the Failed BID was carried out. It can be seen in Table 5 that the median failure cycle time is the fastest in the Accept BID Failed BID activity, which is 15.5 minutes. There is only one case of the Accept BID Failed BID process variant. Meanwhile, the median time of the failed process cycle is the longest in the Add Profit Failed BID activity, which is 1.51 months. Some of the reasons that cause shipments to fail at this stage include cargo that is still not ready to be delivered, the offer price is not included in the customer's allocation, there is no follow-up from the sales team, or there is no space on the nearest ship schedule. From the overall shipment case, it can be seen in Table 4-9 that most direct path processes fail for more than one month. These activities include Place BID Failed BID for 1.08 months, Edit BID Failed BID for 1.01 months, Add profit Failed BID for 1.51 months. This shows that the lack of monitoring from the sales side causes RFQ to be in a pending status for a long time. Below is the direct path cycle time of each process activity.

Table 6. Comparison of Time Between Failed Shipment Processes

Process	Min Duration	Max Duration	Average Duration	Median Duration
Create RFQ → Failed BID	8.31 hours	8.88 months	2.88 weeks	3.83 days
Place BID → Failed BID	37.5 minutes	9.98 months	1.59 months	1.08 months
Edit BID → Failed BID	1.46 hours	9.73 months	1.7 months	1.01 months
Add Profit → Failed BID	4.69 hours	9.1 months	2.23 months	1.51 months
Accept BID → Failed BID	15.5 minutes	15.5 minutes	15.5 minutes	15.5 minutes

Evaluation of Process Conformity to SOPs

To ensure efficiency and reliability in freight forwarding services, it is important for companies to evaluate the suitability of business processes that run against the Standard Operating Procedures (SOPs) that have been set. The evaluation aims to ensure that all operational aspects are running in accordance with the established standards, as well as to identify areas that need improvement. In this case, an evaluation is carried out to identify the variants of the process that are running to see the suitability of the process to the SOP.

From the total findings of data variants from the results of process mining, 100 cases were identified. However, the data shown below is the variant of cases that have the most cases often appearing, the complete process order is starting with CREATE RFQ and ending with FAILED, REJECT RFQ, or COMPLETED_OTIF. For cases that do not have a complete sequence of processes, they are not included in the variance analysis.

From this data, it is known that there are several variants of process flows recorded in internal applications categorized as follows. There were 2260 cases (48.64%) of the process completed according to the standard, 1016 cases (21.87%) of the process that was not in accordance with the standard and 1370 cases (29.49%) of the process failed. A solved standard process is a solved case that has a complete process sequence ranging from "CREATE RFQ" to "COMPLETED_OTIF" in accordance with the Standard Operating Procedure (SOP). A non-standard process is a resolved case where there is a complete process ranging from "CREATE RFQ" to "COMPLETED_OTIF", but has a reverse process sequence or is not in accordance with the Standard Operating Procedure (SOP). A failed process is an unresolved case ending with a "FAILED BID". From the evaluation, it was found that the ideal process that is running is still in the category of not optimal. There are still 50% of processes that are not ideal and fail in the running business operational processes. This is in line with previous research (Oktaviani et al, 2023) which stated that the digital system of this freight forwarding service platform still has many gaps due to the system being still early and still needs to be made many improvements. The following is a summary of the total cases for each recorded process variant.

Table 7. Summary of Process Flow Variant Results

Process Type	Total Cases	Percentage
Standard Process Completed	2260	48,64%
Non-Standard Process Resolved	1016	21,87%
Process Failure	1370	29,49%

Problem Analysis based on Cause/Effect

The final goal of this study is to produce improvement proposals, especially in the RFQ bidding process recorded in the internal app. Suggestions for improvement based on facts in the field obtained from knowledge transfer with stakeholders (operational managers), findings from the mining process, and in-depth analysis of the causes of the problem.

At this stage, root analysis is carried out to understand, solve, and find out a problem that occurs. Root cause analysis (RCA) identifies the origins of problems through specific process stages to find the main cause of the problem (Gozali et al, 2020). RCA identification uses a fishbone diagram consisting of Machine, Man, Method, Milleu, Material, and Measurement.

This study analyzes the problems that cause the failure of the RFQ bidding process. As discussed in the previous sub-chapter, there was a failure in the RFQ bidding process of 29.5% with the achievement of KPIs of 92.1% of the target of 95% during the period January to December 2023. There is a gap of 2.9% to meet the KPI target that has been determined. Therefore, it is necessary to unravel the root of the potential problem to solve this problem so that it can be an evaluation for the operational implementation of the RFQ bidding process in the future. The following is an explanation of the problems that occur in the RFQ bidding process.

Table 8. Problem Factors for RFQ Bidding Process

Problem Groups	Problem Code	Information
Measurement	MA01	Changes in the amount of buying cost
Method	MB01	There is no fixed list of buying *costs*
	MB02	*Sourcing* prices *on the spot*
Man	MC01	User enters the wrong price
	MC02	Operator coordination of each process
	MC03	Lack of insight into app features
Mileu	MD01	Frequently switch vendors to meet demand
Machine	ME01	There is a *bug* in the system (*internal app*)
	ME01	App features not running

From the results of the analysis that has been carried out, there are five types of problem groups that cause RFQ bids to fail as follows.

a. Measurement
The root of the problem of measurement is the change in the amount of the purchase cost from the sourcing results to the vendor. In this case, the role of the pricing team is needed to ensure that there are no price changes when it has been entered into the app's internal system

b. Method
The root of the problem with the method is that there is no exact list of buying costs for each service provided because it uses external vendors and there is no dedicated vendor for each service provided. In addition, purchasing price sourcing is still done by request so that there is a waiting time to get purchase price feedback from vendors

c. Man

The root of the problem is the user's mistake in entering the buying cost and coordination between the operator pics of each process that often occurs in the system, causing a longer process leadtime. As well as lack of knowledge and insight into the use of application features

d. Thousand
   The root of the problem of milieu is that there are no dedicated vendors so that it often changes vendors to meet customer demands. This certainly hinders the operation of the RFQ bidding process because the acquisition and negotiation process of vendors that start from scratch takes more time.
e. Machine
   The root of the problem of the machine is that there is a bug in the system that causes the system to run longer. And there are application features that are less supportive, slowing down the operational process in the system.

Proposed Process Improvement Redesign

In this sub-chapter, proposals for process redesign based on root problem analysis and heuristic analysis are described. Heuristic analysis can be applied in the redesign of business operational evaluation process improvements to improve the efficiency and effectiveness of the process. The specific purpose of the heuristic analysis in this study is to reduce the process time. The steps taken in heuristic analysis include examining the overall and specific operational processes in the area studied, noting any problems or inefficiencies found, as well as the broken heuristics. Findings obtained from field facts will be categorized based on their severity and impact on the efficiency and effectiveness of operational processes. The result of this process is improvements in the specific areas that have the most impact on the business operational processes by referring to reducing the process time.

Based on the problems described in the previous sub-chapter, problem groupings are carried out to combine problems identified with the same characteristics. The following is a summary of the results of the grouping of problems.

Table 9. Problem Grouping List

Code	Category 6M	Category PG	Problem Factors
PG1	Man	Repetitive process	User enters the wrong price
PG2	Measurement	Price changes	Changes in the size of the purchase price
	Method		No fixed list of purchase price
	Method		*Sourcing* prices *on the spot*
	Mileu		Frequently switch vendors to meet demand
PG3	Man	Lack of integration and information	Operator coordination of each process
	Man		Lack of insight into app features
PG4	Machine	System errors	There is a *bug* in the system
	Machine		App features don't run smoothly

After the description of the problem based on the category is known, a heuristic analysis is carried out focusing on the dimensions of time, cost, quality, and flexibility as follows.

Repetitive Process

In PG1, the performance indicator (PI) focuses on time and quality (service). There is a repetition of the process due to an error from the user when entering the bid price. These errors can be caused by several things, namely incomplete bid prices, inappropriate prices, or changes in shipment cargo details. From the results of the Process Mining evaluation, it was found that there were the most frequent repetitive activities (rework) in the Edit BID process as many as 25 cases. This shows that there is a repetition in terms of pricing in entering the purchase price in the system. The next highest case of repeated activity is the Add Profit activity with 19 cases. This shows that there is a repetition of the process from the sales side in entering the selling price of the offer. The impact of the repetition of these activities will affect the cycle time of the RFQ bidding process to the customer. When the purchase price has not been fixed, then the next process (Place BID) cannot be carried out. The heuristic proposal for this problem is the restructuring of the business operational process flow, i.e. by making changes to the flow of process activities and related operators.

As a consideration in solving problems with business process flow restructuring solutions, the characteristics of the proposed solution are described. Restructuring the process flow has a positive effect on the aspects of time and quality. However, it has a neutral effect on quality and flexibility. With changes in the process flow and operators in each activity, it can reduce the idle time of switching process activities, cut the process flow chain shorter, and accelerate the process of escalation to become more centralized. To relay this proposed change solution, it is necessary to transfer understanding and improve capabilities to each individual operator of related activities.

Table 10. Characteristics of Proposed Process Flow Restructuring

Heuristics	Time	Cost	Quality	Flexibility
Process flow restructuring	+	n	+	n

Price Changes

In PG2, the performance indicator (PI) focuses on time, cost, and quality (service). There are price changes resulting from the absence of a fixed price list for each service. Most of the prices obtained for the bidding process are prices given on the spot from each vendor. Added to this is the absence of a definite partner for each service, so it is often necessary to change vendors to meet the demand at a non-binding price. This can be seen from the results of the evaluation of Edit BID activities with the highest number of rework activities as many as 25 cases. As well as from the median activity cycle time of Create RFQ → Place BID for 1.5 days, Place BID → Edit BID for 1.9 days, and Edit BID → Add Profit for 1.9 days. Based on the key performance indicators (KPIs) of the pricing team that have been set, namely the maximum duration of the purchase price input on the system of a maximum of 1x24 hours since the RFQ was made, business operations have still not reached the KPI target set. These findings can be an indication of the failure to achieve operational KPIs in 2023 with a gap of 2.9%. The proposed heuristics for this problem are trusted party and database price component & calculation. The practice of trusted parties involves external parties to be controlled by the company in an effort to support the smooth operation of business. With a trusted party, the company has a trusted relationship with partners so that it can avoid uncertain price changes, untested and uncertain services, and no obligation to the ongoing cooperation. In the field of services, trusted parties or vendors provide important value for the company's image because it is an extension of serving customers. Trusted parties have a positive influence on time, cost, and quality (services). However, it has a negative effect on flexibility. The following are the characteristics of a trusted party.

Table 11. Characteristics of Trusted Party Proposals

Heuristics	Time	Cost	Quality	Flexibility
Trusted Party	+	+	+	-

However, in the application in the field, the needs of the demand for shipping goods are very varied such as loading and delivery locations, goods delivered, road conditions traveled so that there are very many and varied supply of services needed. The existence of a trusted party can help for the needs of regular delivery of goods, but on the other hand there are shortcomings in the price options offered. Often the sales team gets feedback from customers regarding negotiating a much cheaper price, which encourages the pricing team to always provide alternative vendor options.

Another heuristic proposal is the database price component and calculation. This database will serve as a centralized system that stores all the price components as well as their calculations in detail. With this database, companies can easily track price changes caused by various factors such as price fluctuations against fleet availability conditions. So that companies can also analyze price trends and can respond to market changes more quickly and efficiently, and can increase profitability and competitiveness in the market. The implementation of this database will also reduce the risk of human error in pricing calculations and ensure that all department operators have access to consistent and up-to-date pricing information. This proposal has an influence on several dimensions including a positive effect on time and cost, a negative effect on flexibility, and a neutral effect on quality. The following are the characteristics of the proposed price component and calculation database.

Table 12. Characteristics of Database Price Component and Calculation

Heuristics	Time	Cost	Quality	Flexibility
Database price component & calculation	+	+	n	-

The demand for freight forwarding in freight forwarding companies varies widely. These databases must be designed with high flexibility to handle a wide range of complex and changing demand situations. This can add to the level of difficulty in the development and maintenance of the system. In addition, there is a shortage of pricing position labor to manage the database because it already has a high workload for every incoming quote request.

Lack of Integration and Information

In PG3, the performance indicator (PI) focuses on time, quality (service), and flexibility. The lack of integration and information on platform applications is often due to ineffective coordination between operators in each process. This misalignment creates bottlenecks in the flow of information, which in turn hinders operational efficiency. Operators at different stages of the process may not have access to the necessary information in a timely manner, leading to errors and delays in decision-making. Just like the activity of entering the purchase price by the pricing team, but the activity of entering the selling price by the sales team. In this case, there is idle time in the process of transitioning activities. Moreover, the app's limited feature insights exacerbate this situation. When users do not fully understand or do not take advantage of the existing features, the potential for process optimization through the application becomes hampered. This platform also still has gaps in the development of features that can support operations because some features actually hinder the effectiveness of work in the system such as the mirroring system between the purchase and selling cost components which will hinder the team in efforts to accelerate the process, monitoring shipments that have not been connected automatically so that they are not up to date in real time and increasing the workload of the operational team. Overall, the lack of coordination between operators and the lack of understanding of application features negatively impact the effectiveness and efficiency of business operational processes, demonstrating the need for a more integrated approach and better user training to optimize the use of platform applications. A heuristic proposal to address this problem is the restructuring of operational process workflows. Improvement efforts include process flows and operator pics that hold each position. The following are the characteristics of the proposed restructuring of the operational process workflow.

Table 13. Characteristics of Process Flow Restructuring

Heuristics	Time	Cost	Quality	Flexibility
Restructuring of operational process flows	+	-	+	n

System Errors

In PG4, the performance indicator (PI) focuses on time, quality (service), and flexibility. In business operations, system errors caused by bugs and non-running application features are serious problems. Bugs in the system can cause a variety of disruptions, from data errors to breakdowns in automated workflows. For example, bugs can cause the data input by the user to be incorrect or lost, which can ultimately affect the business decisions taken based on that data. In addition, the app's features that don't run as they should hinder the team in carrying out their tasks. When features that were supposed to make work easier don't work, teams have to look for alternative solutions that often take longer and are less efficient. As a result, operational processes are hampered, productivity decreases, and operational costs increase. Therefore, heuristic analysis emphasizes the importance of regular testing and maintenance of the system to detect and fix bugs, as well as ensure that all application features function properly, so that business operational processes can run smoothly and efficiently. The following are the characteristics of the periodic system testing and maintenance proposal.

Table 14. Characteristics of Periodic System Testing and Maintenance

Heuristics	Time	Cost	Quality	Flexibility
Periodic testing and maintenance	+	+	+	n

Heuristic proposals for periodic testing and maintenance in business operational systems provide significant benefits in terms of time, cost, and quality, as potential problems can be detected early, reducing major disruptions and repair costs later on. Although it requires an initial investment, this step actually saves long-term expenses and improves the reliability and quality of the system. Based on the results of the heuristic analysis, redesign and restructuring of operational process flows is also important to improve business efficiency and effectiveness through workflow remapping, elimination of bottlenecks, and better system integration so that the flow of information between departments is smoother. These changes help speed up response times, improve data accuracy, and reduce costs due to operational errors. In the context of the RFQ bidding process, efficiency benchmarks are focused on the time of the process cycle, where improvements are made by shifting the role of Add Profit to Submit Profit from sales to the pricing section to speed up bid submissions, control profit margins, and allow sales to focus more on business development, so that overall operational performance becomes more efficient, effective, and adaptive.

CONCLUSION

The research identified two main stages in PT ELI's shipping process: the RFQ bidding stage and the manage shipment stage. Process Mining analysis revealed that 70% of shipments were successfully completed, while 30% failed, with significant time differences between successful (4.61 days) and failing processes (about 1.45 months) in the RFQ stage. Additionally, 21.87% of cases deviated from standard procedures. Root causes of inefficiencies included measurement issues, lack of a price database, operator errors, frequent vendor changes, and system limitations. To address these, the study proposed redesigning the operational flow by shifting profit submission responsibility from the sales to the pricing team, aiming to speed up the process and enhance productivity and service quality. Future research could explore the impact of this redesign on long-term performance and investigate additional automation opportunities within the system.

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