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ROOT CAUSE ANALYSIS AND PROPOSED IMPROVEMENT OF OUTBOUND LOGISTICS PERFORMANCE IN PERTAMINA PATRA NIAGA

Awindya Candrasmurti [1)], Gatot Yudoko [2)]
School of Business and Management, Institut Teknologi Bandung, Bandung, Indonesia [1,2)]

Correponding Author:
awindya_candrasmurti@sbm-itb.ac.id [1)], *gatot@sbm-itb.ac.id* [2)]

Abstrak

PT Pertamina Patra Niaga merupakan perusahaan nasional terkemuka di Indonesia yang bergerak di bidang distribusi bahan bakar industri. Meskipun keberadaan SPBU tersebar luas di seluruh Indonesia, stabilitas pasokan bensin di Indonesia menghadapi tantangan, terutama yang berasal dari isu-isu yang terus-menerus terkait dengan kekurangan bahan bakar. Tantangan-tantangan ini dipengaruhi oleh beberapa faktor seperti fluktuasi harga minyak dunia, kendala transportasi, dan inefisiensi dalam proses distribusi. Penelitian ini berlokasi di Terminal Terpadu Surabaya, dengan fokus pada isu-isu yang berkaitan dengan tidak tercapainya target MS2 karena keterlambatan waktu pengiriman yang terkait dengan kinerja logistik eksternal. Penelitian ini secara khusus bertujuan untuk mengidentifikasi faktor-faktor yang mempengaruhi nilai MS2 Compliance di Terminal Terpadu Surabaya dan mengusulkan inisiatif untuk meningkatkan kinerja logistik keluar. Kerangka kerja konseptual yang digunakan dalam penelitian ini menggambarkan desain rantai pasokan, dengan penekanan khusus pada logistik keluar yang bertujuan untuk secara efisien mengirimkan produk akhir ke pengecer. Strategi ini selaras dengan pencapaian rantai pasokan yang responsif dengan meningkatkan kinerja logistik keluar, dengan truk tangki sebagai alat transportasi utama. Root Cause Analysis dilakukan dengan menggunakan Ishikawa Fishbone. Hasilnya menunjukkan empat faktor utama yang berkontribusi: metode, lingkungan, manusia, dan mesin. Untuk faktor metode, analisis menggunakan metode heuristik, khususnya pendekatan "cluster pertama, rute kedua", sebagai komponen untuk memecahkan masalah perutean kendaraan. Temuan dari analisis ini mengungkapkan bahwa kapasitas truk tangki sesuai dengan permintaan pelanggan; namun, ada kebutuhan untuk meningkatkan penjadwalan rute dan pengiriman dengan menggunakan alat heuristik untuk mengoptimalkan pemanfaatan truk tangki.

Kata Kunci: root cause analysis; outbound logistics

Abstract

PT Pertamina Patra Niaga represents a prominent Indonesian national enterprise specializing in the distribution of industrial fuels. Despite the widespread presence of gas stations nationwide, the stability of gasoline supply in Indonesia encounters challenges, primarily stemming from persistent issues related to fuel shortages. These challenges are influenced by factors such as transportation constraints and inefficiencies in distribution processes. This study is focusing on issues related to the non-attainment of the MS2 Compliance target due to delays in delivery times associated with outbound logistics performance. The research especially seeking to identify factors

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influencing the MS2 Compliance value at Integrated Terminal Surabaya and proposing initiatives for enhancing outbound logistic performance. The conceptual framework employed in this research delineates the supply chain design, with a specific emphasis on outbound logistics aimed at efficiently delivering final products to retailers. This strategy aligns with achieving a responsive supply chain by improving outbound logistic performance, with tank trucks serving as the primary equipment for transportation. The Root Cause Analysis was conducted using Ishikawa fishbone. The results reveal four main contributing factors: method, environment, human, and equipment considerations. For method factors, the analysis employs a heuristic method, specifically "cluster first, route second" approach, as a component of solving the vehicle routing problem. The findings of this analysis reveal that the tank truck capacity aligns with customer demand; however, there is a need for improved routing and delivery scheduling using heuristic tools to optimize tank truck utilization

Keywords: root cause analysis; outbound logistics

PENDAHULUAN

PT Pertamina Patra Niaga is an Indonesian national firm that primarily distributes industrial fuels at competitive costs in accordance with Indonesian government specifications and international standards. PT Pertamina Patra Niaga has expanded fast since its inception in 1997, owing to its business strategies that focus on the downstream oil and gas sector, fuel and petrochemical trading and services, transportation and fleet management, terminal storage management, and bunkering. Strive to consistently supply energy demands to businesses at competitive prices, from oil and gas trading to logistics and storage (Pertamina, 2023). Despite the number of gas stations around the country, gasoline supply in Indonesia remains unstable, owing mostly to the ongoing issue of fuel shortages. These shortages have been a recurrent issue, owing to variables such as global oil price volatility, transportation constraints, and distribution inefficiencies.

MS2 Compliance serves as an indicator of customer satisfaction and reflects Pertamina's commitment to timely deliveries, constituting a vital Key Performance Indicator (KPI) for Pertamina Patra Niaga. MS2 is delineated as Stock Management for Gas Stations (SPBU), a system wherein demands or order requests and fuel stock reports are transmitted through Short Message Service (SMS) and a dedicated application. Within the KPI framework, the quarterly target for MS2 Compliance is under the designated target. However, a notable business challenge has arisen concerning MS2 Compliance, specifically centered on delays in delivery times aligned with the designated delivery shifts. Consequently, the MS2 Compliance outcome for Quarter 4, 2022 falls short of meeting the established target within the KPI framework.

To cater to the requirements of the Indonesian market, it is imperative for a company to transition its supply chain design towards one that is responsive to customer demand. According to the discoveries made by (Roh et al., 2014), adopting a supply chain design aligned with customer demand responsiveness aids the company in achieving objectives such as mitigating risks by minimizing bottlenecks and disruptions in the supply chain. Furthermore, it enhances flexibility in addressing dynamic

customer demands and boosts agility in delivering the appropriate product at the precise time and location.

There are 2 types of supply chain to determine the designs of the company's supply chain. The types will be shown in table below:

Table 1. Supply Chain Efficiency and Responsiveness

	Supply Chain Efficiency	**Supply Chain Responsiveness**
Objectives	Lowest cost supply and demand	Quickly respond to supply and demand
Pricing strategy	Motivated by low final price	Not motivated by its final price
Lead time strategy	Reduce expenses, but not at the expense of others	Higher costs, shorter lead time
Supplier strategy	Based on quality and cost	Based on its quality, responsiveness, and reliability

The objective of implementing a responsive supply chain is to elevate the MS2 compliance value by adhering to elevated service standards and minimizing lead times for customers. However, it is crucial to acknowledge that every strategic decision aimed at enhancing responsiveness incurs additional costs, potentially diminishing overall effectiveness (Chopra & Meindl, 2007). Establishing strategic alignment entails assigning roles that ensure an optimal level of responsiveness across various stages of the supply chain. Achieving the necessary responsiveness requires recognizing that each stage of the supply chain is associated with varying degrees of efficiency and responsiveness.

METODE PENELITIAN

The study specifically aims to identify the determinants impacting the MS2 Compliance value at Integrated Terminal Surabaya and recommends strategies for improving outbound logistic performance. The conceptual framework utilized in this research outlines the supply chain design, placing particular emphasis on optimizing outbound logistics for the efficient delivery of end products to retailers. This approach is in line with the goal of establishing a responsive supply chain, achieved through enhancements in outbound logistic performance, where tank trucks play a central role in transportation.

Data collection was collected through primary data and secondary data. Primary data refer to information gathered specifically for a particular research issue. Techniques such as experimentation, observation, structured and unstructured interviews may be employed to collect primary data (Hox & Boeije, 2005). The primary data is collected through observation and open-ended interview, initially presenting a

set of questions and subsequently introducing additional inquiries that emerged organically during the course of the conversation. Meanwhile, according to (Martins et al., 2018), secondary data is information acquired from a source other than the author. This data has been previously collected and was not originally intended for the specific purpose or target under consideration. The secondary data was collected through journals, news sources, and company's data. Apart from data gathering, the author aims to enhance the research by incorporating pertinent theories. This involves conducting a comprehensive examination of e-books, articles, journals, and online resources that offer theoretical frameworks aligned with the research objectives.

The analysis incorporated the use of the Ishikawa Fishbone Diagram for scrutinizing the data. These methodologies were applied to discern both manageable and uncontrollable elements, facilitating a comprehensive investigation. The Ishikawa Fishbone Diagram served as a visual tool, illustrating the connections between outcomes and their underlying causes and offering a structured breakdown of identified issues.

1. Ishikawa Fishbone

The Ishikawa Fishbone Diagram is a visual tool that depicts the connection between the result of an effect and its root cause, also known as the cause-and-effect method (Morris et al., 2019). It encourages active involvement from all relevant parties, enabling them to contribute suggestions regarding potential causes of the issue (Slameto, 2016). The primary factors represented in the cause-and-effect diagram include people, method, environment, and machines (Saori et al., 2021).

2. Vehicle Routing Problem

In addressing the existing challenges, the selection was made to employ the Vehicle Routing Problem (VRP) as a means to enhance outbound logistics performance. The concept of VRP was initially introduced by Dantzig and Ramser in 1959. The fundamental concern revolves around efficiently distributing goods to a specified set of customers with known demands, utilizing a uniform fleet of vehicles originating from a central depot, and aiming to fulfill all requests at the most economical cost, as outlined by (Rezgui et al., 2019). The adopted strategy involves a two-stage process, initially clustering through the Sweep Algorithm, followed by solving the route problem using the Nearest Neighborhood method for each cluster.

3. Sweep Algorithm

To tackle the prevailing business challenge, a proposed approach involves initially clustering the vehicles before determining the routing. The chosen heuristic method for the Vehicle Routing Problem (VRP) is the Sweep Algorithm. This algorithm entails the identification, computation, and analysis of vehicle locations to guarantee optimal

customer service within the available capacity, all while adhering to the predefined delivery time. The Sweep algorithm employs polar coordinate angles to ascertain the positions of individual pick-up points, determining routes based on these locations and considering capacity constraints (Chen et al., 2015). When applying the Sweep algorithm to address the Vehicle Routing Problem, the steps outlined by (Suthikarnnarunai N., 2008) involve identifying necessary information, including loading time, tanker number, SPBU Address (customer location), SPBU City (Surabaya city), product type, volume capacity for each customer, actual shift (Rit), scheduled shift (Rit MS2), X and Y coordinates of each gas station, and angular positions calculated using Google Maps. The angular position is computed as ATAN((y1-y))/((x1-x)) (Chopra & Meindl, 2007), with results sorted from highest to lowest. The subsequent steps involve grouping angular angles based on their demand during each shift and tank truck capacity, assigning each customer covered by the sweep to the current cluster, and initiating a new cluster from the previous one's endpoint. These steps are instrumental in analyzing the available data, with the ultimate outcome of the sweep algorithm being the determination of how customer clusters (fuel stations) influence hour reduction and fleet optimization.

4. Nearest Neighbour

The second strategic approach involves the utilization of the nearest neighbour algorithm. This algorithm assumes a pivotal role in scrutinizing and optimizing the most efficient route, thereby contributing to an overall improvement in operational efficiency. The nearest neighbour heuristic operates by connecting nodes closest to the current node, repeating this process with the newly connected node until all available nodes are visited. This method strikes a commendable balance between delivering favorable outcomes and minimizing computation time (Euchi & Sadok, 2021). In the context of the Vehicle Routing Problem (VRP), the effective nearest neighbour algorithm addresses problems through the following steps:

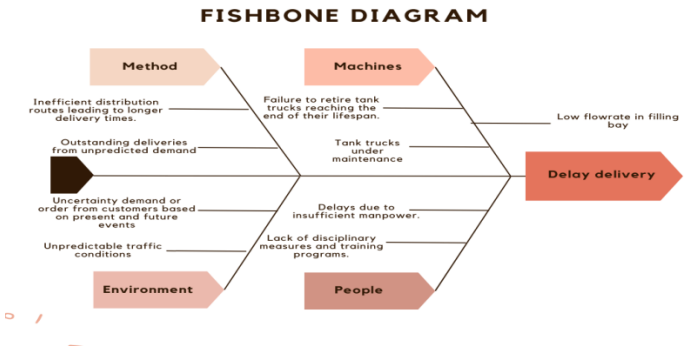
a. Select a point to represent the city or starting point.
b. Choose the next destination point or city to visit, considering only the city with the shortest distance to the preceding city.
c. Designate the last visited point as the starting point and identify the shortest point from the last visited point.
d. This sequence forms a travel route, with vehicle capacity serving as a constraint in delivery.
e. Upon visiting all cities or connecting all points, return to the starting point (city of origin) (Harahap & Sawaluddin, 2023) & (Koswara et al., 2017)

HASIL DAN PEMBAHASAN

A. Hasil

The following is a thorough analysis of a business issue using root cause analysis and the Ishikawa fishbone diagram:

Figure 1. Ishikawa Fishbone



The examination and interviews conducted at the Fuel Terminal unveiled four contributing factors to the business issue concerning MS2 compliance: method, environment, machines, and people. These factors exhibit various effects on the identified problem, with this research placing particular emphasis on method and environment. In terms of method, the author has made efforts to tackle the root cause by employing a heuristic method in the vehicle routing problem. The machines-related root cause is closely linked with the method causes, aiming to optimize tank truck utilization and mitigate the impact of machines-related issues. The people factor is not extensively explored, as it falls beyond the study's scope. Addressing the environmental factor involves a settlement approach, which includes incorporating allowances in alignment with company policy.

For the proposed solution of method factors, the author used VRP with sweep algorithm and nearest neighbour method. The summary of the result from week 1 can be seen from the table below. The analysis was conducted from week 1 until week 4, where the sample was taken randomly from Quarter 4 of 2022 which in October, November, and December where the KPI is below the target. The full detail of 1 week calculation of sweep algorithm and nearest neighbour is shown below:

Table 2. Summary of Sweep Algorithm and Nearest Neighbour Calculation

Date	Shift	Total Location	Total Delivery	Tank Trucks Maximization	Total Tank Trucks	Average Travel Time
Monday, November 14th 2022	1	85	23	9	14	3.45
	2	109	29	7	22	4.06
	3	92	24	6	18	3.83
After Maximization			**76**		**54**	
Tuesday, November 1st 2022	1	80	25	10	15	3.32
	2	103	29	3	26	4.07
	3	58	15	0	15	4.23
After Maximization			**69**		**56**	
Wednesday, October 5th 2022	1	88	24	8	16	3.22
	2	109	30	5	25	4
	3	97	26	9	17	3.74
After Maximization			**80**		**58**	
Thursday, December 1st 2022	1	68	19	5	14	3.25
	2	103	26	2	24	4.38
	3	68	19	3	16	3.95
After Maximization			**64**		**54**	
Friday, October 14th 2022	1	112	30	8	22	3.5
	2	64	18	6	12	3.68
	3	71	20	2	18	5.14
After Maximization			**68**		**52**	
Saturday, November 5th 2022	1	82	22	7	15	3.4
	2	90	26	4	22	3.8
	3	68	17	1	16	4.3
After Maximization			**65**		**53**	
Sunday, December 18th 2022	1	67	18	5	13	3.35
	2	74	21	4	17	4.1
	3	58	16	2	14	4.04
After Maximization			**55**		**44**	

B. Pembahasan

Environmental factors are external elements beyond our influence. Customer demand variability introduces an unpredictable aspect to the fuel distribution process, with demand levels fluctuating due to various events. Negotiating unforeseen traffic conditions, especially in urban areas, further complicates fuel distribution logistics. The interplay of these uncontrollable factors underscores the significance of planning and flexibility within the distribution system. This is essential for facilitating effective and timely responses to the challenges posed by continually changing demand patterns and unpredictable traffic conditions.

Addressing the environmental factor requires the consideration of additional time in the calculation of average delivery time due to city traffic. Each shift, with its distinct delivery time, is impacted by traffic conditions affecting fuel delivery. Allocating resources toward advanced technology for real-time traffic monitoring allows for timely updates on road conditions, facilitating adjustments to delivery schedules in response to significant traffic conditions. Including allotted time in the calculation ensures that the overall delivery time encompasses specified allowances for unpredictable traffic conditions. This allowance time incorporates unloading time (in hours), setup time (in hours), the percentage of traffic probability, and filling time, aligning with company policies.

Regarding the issue related to people, the primary factor identified is the shortage of tank truck drivers and instances of indiscipline among them. The insufficient number of tank truck drivers is attributed to a shortage, leading to many drivers being absent. The indiscipline among tank truck drivers stems from external pressures, forcing drivers to exceed their designated working hours. This results in demotivation, numerous leave requests, and, in some cases, a lack of incentives and rewards. It is crucial to acknowledge that the manpower-related issue is not explored in greater detail as it falls outside the study's designated focus.

The central problem identified in the method-related cause pertains to challenges in scheduling and the suboptimal selection of routes and delivery hours. Scheduling

difficulties primarily arise from the sub-cause of adapting schedules during unpredictable peak demand periods. On the other hand, the inefficient selection of routes and delivery hours is attributed to the lack of a dedicated tool for route calculation analysis. Accordingly, this study seeks to tackle the routing issue by employing a heuristic method within the framework of the vehicle routing problem.

The resolution to address the factor method involves the adoption of a novel approach to optimize the utilization of tank trucks in gasoline delivery. The "cluster first, route second" strategy offers an alternative for determining the most efficient route, aiming to reduce distance and shipping costs. Despite the availability of 77 tank trucks for 32 KL, 104 for 24 KL, and 23 for 16 KL, delays should theoretically be avoided since it was employed for delivery purposes, can be optimized to a maximum of 52 daily. However, potential inefficiencies in scheduling may lead to routing delays. Through the application of the sweep algorithm and nearest neighbour examination of significant angular angles, there is potential to minimize the need for tank trucks or enhance their utilization through improved routing and route selection. This approach presents a concise and supportive framework for establishing a more efficient and reliable logistic network configuration, leveraging the sweep algorithm method. Ultimately, the objective is to mitigate delays in delivery.

In the realm of issues related to machines, the principal factor identified is the inadequate capacity of tank trucks. This insufficiency is primarily linked to a sub-cause involving some tank trucks undergoing maintenance, while another segment exceeds the specified lifespan of over 10 years as per Pertamina policies. The challenge associated with machines is closely connected to the tools used to address issues related to methods, aiming to optimize tank truck utilization and alleviate the impact of the root cause originating from equipment-related factors.

SIMPULAN

PT Pertamina Patra Niaga, a Commercial & Trading Sub-Holding of PT Pertamina (Persero), is a prominent Indonesian national company specializing in the distribution of industrial fuels, offering competitive rates compliant with both Indonesian government specifications and international standards. The company is committed to consistently meeting the energy demands of businesses at competitive prices, engaging in activities ranging from oil and gas trading to logistics and storage. Despite the widespread presence of gas stations across the country, the stability of gasoline supply in Indonesia encounters challenges, primarily rooted in persistent issues of fuel shortages. This recurring problem is influenced by factors such as transportation constraints and distribution inefficiencies.

The failure to meet the Key Performance Indicator (KPI) target in Quarter 4, 2022, was attributed to delays experienced by gas stations, a crucial clientele. The data also underscores challenges faced by Integrated Terminal Surabaya in outbound logistic

performance, particularly in recurrent delays in delivering products to consumers. Consequently, this study focuses on enhancing outbound logistic performance to improve the responsiveness of the fuel delivery process in the Surabaya region, ultimately aiming for an elevated MS2 Compliance value through a more responsive delivery process. The findings of this analysis reveal that the tank truck capacity aligns with customer demand; however, there is a need for improved routing and delivery scheduling using heuristic tools to optimize tank truck utilization. Consequently, the study includes calculations of total travel time to enhance routing and delivery scheduling, aiming to maximize tank truck utilization through the application of heuristic methods. Within the domain of machinery-related issues, the principal factor recognized is the insufficient capacity of tank trucks.

In future research initiatives, various enhancements can be explored. For example, a comprehensive analysis could be undertaken that encompasses all customers, extending beyond those in Surabaya to include other regions covered by Integrated Terminal Surabaya. This comprehensive approach seeks to improve overall business processes at Integrated Terminal Surabaya.

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