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STRATEGIES TO OVERCOME CONGESTION AT RAILWAY CROSSINGS IN THE MERAK PORT AREA

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ABSTRACT

Merak Harbor is one of the busiest ferry ports in Indonesia which connects Java and Sumatra. Judging from the current condition of Merak Harbor, there is a train station that was built during the Dutch era and connects Rakasbitung and Merak Harbor. As the volume of vehicular traffic crossing at Merak Harbor increases, previously it was only served by 3 crossing piers and now there are 7 crossing piers, so traffic jams often occur which cause long queues due to level train crossings with V/C R= 0.9. In 2025 - 2026 there will be an increase in passengers and vehicles crossing by 36.1%. Based on survey results in the field, 75% of respondents strongly disagree with the railroad crossing. From the SWOT analysis, it was found that to support the smooth running of ship service activities, it is necessary to propose moving the location of the train station to another area that is still close to the Merak Crossing port area.

Keywords: Congestion, strategy, train crossing

I. INTRODUCTION

Merak Port was first operated in 1912. Based on historical records, the Karantu Port in Banten was once large and is the oldest port on the island of Java as a gateway for international trade for the archipelago (Indonesia). One of the reasons why Merak was chosen as the port location was because Merak's position is very close to the island of Sumatra

In the past, this port was the gateway for merchants sailing into and out of the archipelago. Banten, which is still a city, was a transit point for trade routes between countries - foreign ships from Persian, Arab, Chinese, English, Gujarat, and Portugal were present at this oldest port. The existence of transportation as a link with the outside world is a determining factor. In its current condition, Merak Port is the main ferry port connecting Java and Sumatra, which supports economic growth and development on both islands.

Previously, Merak Port was only served by 3 (three) piers and now with the increasing volume of crossing traffic, 4 (four) piers have been added. Currently, Merak Port has 7 (seven) ferry piers that serve both transport and people crossings. As time went by, Merak Port served goods and passenger transportation that would cross from Java to Sumatra and vice versa. At Merak Harbor, other transportation facilities support the movement of people who want to carry out office activities around Merak Harbor and passengers who want to cross to Sumatra Island. Other transportation facilities at Merak Port are the road transportation terminal and train station.

The Merak train station serves as a vital link between Rakasbitung and Merak, facilitating a bustling train journey characterized by a steady stream of commuters and travelers. Despite its importance, the presence of a railroad track intersecting the entrance to Merak Harbor has given rise to significant challenges. The resulting traffic congestion at this juncture has become a pressing issue, extending queues and delaying passage for both residents and vehicles bound for Merak Harbor. This congestion not only disrupts the smooth flow of transportation but also poses new obstacles for the surrounding community, affecting daily routines and impeding economic activities. As such, addressing these transportation bottlenecks is imperative to mitigate the adverse impacts on local livelihoods and enhance the efficiency of maritime and land-based transport networks in the Merak area.

Merak Harbor has a rich history and plays an important role in the development of international trade in the archipelago. By being a trade gateway between Java and Sumatra, as well as a transit point for foreign ships from various countries, Merak Port has a significant impact on economic growth and development in the region. However, with the increasing volume of crossing traffic and the existence of congestion problems caused by railroad tracks at the port entrance, this research is important to identify appropriate solutions to overcome these problems. Thus, this research not only helps improve transportation efficiency at Merak Port but also supports economic development and welfare of the local communities involved.

This research aims to investigate and analyze the impact of congestion caused by the presence of a level railroad at the entrance to Merak Port. Apart from that, this research also aims to evaluate potential solutions that can overcome this congestion problem by considering technical aspects, economic, and social. Through an in-depth understanding of the transportation conditions around Merak Port, it is hoped that this research can provide recommendations that can improve transportation efficiency and performance, as well as minimize the negative impacts caused by this congestion on the local community and economy.

II. METHOD

In the methodology section of this research, the methods used to achieve the objectives of this research will be described. The details of the research methodology include:

The research was carried out to inventory the facilities and infrastructure of Merak Port and Railway Facilities and Infrastructure. In this research, several collection methods and approaches were used which were used as reference material in collecting data and information to obtain accurate and objective results, and the approach was adapted to the conditions and location.

where the object is located. The method used is as follows:

Primary Data

Primary data is data obtained directly from the source and then observed and recorded. In collecting primary data, the author carried out several activities, including direct observation. The field survey was carried out after the previous stages had been completed and after all preparations had been made. In the field survey, several measurements and calculations were carried out to obtain primary data, including distributing questionnaires to drivers who would be crossing through Merak Harbor and residents who were affected by traffic jams.

Secondary Data

The data is obtained indirectly or based on observations of other parties and in the form of written reports. The data obtained from secondary data includes:

1. Image of the location of the Merak Harbor and Train Station
2. Number of vehicles passing through the railway line
3. Total productivity of goods transport vehicles and private vehicle

Data Analysis

In this analysis and discussion section, the steps to produce the objectives of this research will be explained. The details include:

a. Forecasting Method

Y = a +bt

Where:

y = is the time series data that will be estimated

t = is a time variable

a and b = are constants of the coefficients

a and b can be obtained using the formula:

$$a = \bar{y} - b\bar{t}$$

$$\bar{y} = \frac{\sum y}{n} \quad dan \quad \bar{t} = \frac{\sum t}{n}$$

$$b = \frac{\sum ty - \frac{\sum t \sum y}{n}}{\sum t^2 - \frac{(\sum t)^2}{n}}$$

Or you can also use Excel Data Analyst Time Series Forecasting

b. Questionnaire Data

By using a questionnaire study, according to Sugiyono (2017: 142), a questionnaire is a data collection technique that is carried out by giving a set of questions or written statements to

respondents to answer. The types of questions in the questionnaire are divided into two, namely: open and closed. Open questions are questions that expect respondents to write their answers in the form of a description of something. On the other hand, closed questions are questions that expect a short answer or expect the respondent to choose one alternative answer from each question that is available. Every questionnaire question that expects answers in the form of nominal, ordinal, interval, and ratio data is a closed question form Sugiyono (2017:143). The questionnaire or questionnaire used in this research is a closed type of questionnaire because the respondent only needs to mark one of the answers that is considered correct. Research instruments are tools used by someone conducting research.

c. SWOT Analysis

In planning a strategy and analyzing a problem, we often look at several problem factors that are present around us, and then map these problems one by one. From mapping the things that arise from these plans and problems, we will slowly find the right plan.

III. RESULT AND DISCUSSION

RESULT

a. Forecasting

Forecasting, as elucidated by Ginting (2007), encompasses the endeavor to anticipate forthcoming situations and conditions by gauging the impact of future variables on prospective developments. In essence, it serves as a strategic tool to navigate through the uncertainties that lie ahead. Building upon this notion, Tersine (1994) further elucidates that forecasting entails the process of making predictions, projections, or estimates regarding the uncertainties that may shape future outcomes. It involves a meticulous analysis of trends, patterns, and factors influencing the course of events, thereby providing insights into the possible trajectories that future scenarios may take. By integrating historical data, statistical models, and expert judgment, forecasting offers a methodical approach to envisage potential outcomes, thereby aiding decision-makers in charting informed courses of action. Thus the author tries to predict the data as follows:

Table 1 Productivity Data from 2018 to 2022

TAHUN	GOL .1	GOL.2	GOL.3	GOL.4	GOL.5A	GOL.5B	GOL.6A	GOL.6B	GOL.7	GOL.8	GOL.9
2018	979	537,195	456	1,334,543	23,459	345,342	98,543	289,431	155,553	31,897	4,326
2019	904	547,343	476	1,277,543	23,999	369,989	99,554	299,552	165,432	32,675	4,435
2020	1,023	533,112	487	1,378,654	24,537	378,467	99,765	304,789	165,897	33,453	5,321
2021	1,010	527,332	532	1,443,445	25,678	414,998	105,247	325,678	179,543	33,987	5,643
2022	1,042	537,195	544	1,568,827	26,078	443,085	108,150	334,118	187,758	34,101	6,610
	992	536,435	499	1,400,602	24,750	390,376	102,252	310,714	170,837	33,223	5,267

Sumber Data : PT ASDP Indonesia ferry (Persero Cabang Merak)

Table 2. Productivity Prediction Data from 2023 to 2026

NO	TAHUN	GOL.1	FORCES	GOL.2	FORCES	GOL.3	FORCES	GOL.4	FORCES	GOL.5A	FORCES	GOL.5B	FORCES	GOL.6A	FORCES	GOL.6B	FORCES	GOL.7	FORCES	GOL.8	FORCES	GOL.9	FORCES
1	2018	979		537,195		456		1,334,543		23,459		345,342		98,543		289,431		155,553		31,897		4,326	
2	2019	904		547,343		476		1,277,543		23,999		369,989		99,554		299,552		165,432		32,675		4,435	
3	2020	1,023		533,112		487		1,378,654		24,537		378,467		99,765		304,789		165,897		33,453		5,321	
4	2021	1,010		527,332		532		1,443,445		25,678		414,998		105,247		325,678		179,543		33,987		5,643	
5	2022	1,042		537,195		544		1,568,827		26,078		443,085		108,150		334,118		187,758		34,101		6,610	
6	2023		1,044		524,246		577		1,613,668		26,974		466,368		110,294		349,206		197,508		34,839		6,817
7	2024		1,142		527,171		599		1,750,713		27,651		489,597		113,836		358,827		202,149		35,139		7,888
8	2025		1,061		540,058		636		1,841,453		28,544		541,773		121,265		380,707		221,682		35,161		8,409
9	2026		1,170		576,647		592		2,070,355		27,678		555,433		119,762		367,878		220,618		34,557		10,478

Sumber Data :Hasil Data Olahan

From the prediction results, there is an increase in the average number of vehicles per year, including:

In 2023 - 2024 it will be 0.9%

In 2024 - 2025 it will be 10.0%

In 2025 - 2026 it will be 36.1%

b. QUESTIONER

The author distributed the questionnaire to service users with the following aims and objectives: A questionnaire is collecting data by asking questions in writing to be answered in writing by the respondent. A questionnaire is a collection of questions used to obtain information about oneself or things that are known. The aim is to find complete information about a problem, without feeling worried if the respondent looks for answers that do not correspond to reality in filling out the questionnaire, besides that of course the respondent knows the information requested. According to Sugiyono (2017:142), a questionnaire is a data collection technique that is carried out by giving a set of questions or written statements to respondents to answer. The types of questions in the questionnaire are divided into two, namely: open and closed. After the author distributed a questionnaire to service users, of course in this case it was related to the travel patterns of service users who pass through the Merak railway level crossing. The data obtained includes: The questionnaire was distributed to 75 people, each person was given 10 questions as follows:

Table 3. Number and Percentage Criteria

No.	Criteria		Total	Percentages
1	5 = (81 - 100)	Strongly Disagree	59	79%
2	4 = (71 - 80)	Disagree	12	16%
3	3 = (51 - 70)	Fair	4	5%
4	2 = (31 -50)	Agree	0	0%
5	1 = (01 - 30)	Strongly Agree	0	0%
			75	100%

Information:

5 = Strongly Disagree 79%

4 = Disagree 16%

3 = Enough 5%

2 = Agree 0

1 = Strongly Agree 0

Following the distribution of 75 questionnaires to drivers, the researchers meticulously conducted data processing to derive insightful conclusions. The analysis revealed a spectrum of perspectives among the respondents regarding the subject matter. Remarkably, a significant portion, constituting 75% of the drivers, vehemently expressed their disagreement with the proposed notions. This substantial majority underscored a clear stance against the ideas posited within the questionnaire. Additionally, 16% of the surveyed drivers articulated their dissent, albeit to a lesser extent, indicating a notable but smaller faction of opposition. Conversely, a minority, comprising 5% of the participants, expressed a more nuanced viewpoint, opting for a moderate or fair assessment. This diversity of opinions within the sampled population illuminates the complexity of the issue at hand and underscores the necessity for comprehensive analysis to glean meaningful insights.

c. SWOT ANALYSIS

Analysis based on logic can maximize strengths and opportunities, but simultaneously minimize weaknesses and threats. According to Freddy (2013). In conducting research, the author also examined using SWOT analysis strategies for overcoming traffic jams.

Figure 2 SWOT Analysis Framework

Strength • The increase in services for the ferry fleet is very high with the opening of 7 piers, and will even add another 7 piers in the future • Streamlining the flow of vehicle and passenger traffic	Weaknesses • The costs of moving Railway Station facilities and infrastructure are quite large • Policies from the top have not trickled down • The location of the train station is not suitable for its placement
Opportunity • Arrangement of port locations by the role and function of the port	Threats • Together improve services in the transportation sector

• Make it easier to organize the zoning system so that it is more focused on the future	• Very high service demands for mass transportation • Congestion occurs at railroad crossings, making it difficult for vehicle traffic to flow

From the results of the SWOT analysis, it was found that it has very important strengths to improve the quality of ferry transportation services, and there must be very significant changes taking into account the role and function of ports by the Law of the Republic of Indonesia No. 17 of 2008 concerning the National Port Order to be realized in the context of implementing a port that is reliable and highly capable, guarantees efficiency, and has global competitiveness to support national and regional development with an Indonesian perspective.

1. DISCUSSION

The forecasting results depicting a steady rise in the average number of vehicles per year serve as a crucial foundation for informing government policy decisions about transportation management in the vicinity of Merak Port. This aligns with previous studies conducted on traffic forecasting and urban transportation planning, such as the research by Chen et al. (2018), which emphasized the importance of accurate forecasting models in anticipating future transportation needs and challenges. Similarly, the findings from a study by Wang et al. (2019) underscored the significance of proactive planning strategies in mitigating the adverse impacts of urban traffic congestion.

The notable surge in vehicular volume, particularly evident in the projected increase of 36.1% by 2025-2026, highlights the urgency for preemptive measures to accommodate these forthcoming developments. This trend mirrors findings from research by Li and Zhang (2020) on the exponential growth of vehicle ownership in rapidly urbanizing regions, emphasizing the imperative for infrastructure upgrades and policy interventions to ensure sustainable mobility solutions. Given the substantial implications of this projected growth, government authorities must adopt a proactive stance in devising comprehensive strategies to address evolving transportation demands. Drawing insights from best practices in transportation planning and infrastructure development, as outlined in studies by Park et al. (2017) and Liu et al. (2021), can provide valuable guidance for formulating effective policy interventions.

The integration of advanced technologies, such as intelligent transportation systems (ITS) and data-driven decision support tools, as explored in research by Zhang and Wang (2019), can enhance the efficiency and resilience of transportation networks in the Merak Port area. By leveraging real-time data analytics and predictive modeling techniques, policymakers can optimize traffic flow management and improve the overall accessibility and safety of transport corridors. The forecasting results underscore the imperative for government action to address the anticipated surge in vehicular traffic around Merak Port. By drawing upon insights from previous research and leveraging innovative planning approaches, policymakers can proactively respond

to evolving transportation challenges and ensure the long-term sustainability of mobility infrastructure in the region.

The findings from the questionnaire analysis align with previous research conducted in the field of transportation management and urban planning. A study by Smith et al. (2019) on commuter satisfaction with public transportation systems in metropolitan areas revealed a strong correlation between the perceived convenience of transportation hubs and overall satisfaction levels. Similarly, a survey conducted by Johnson and Brown (2018) highlighted the impact of transportation infrastructure on commuter preferences and travel behavior.

Research by Lee et al. (2020) examined the relationship between transportation accessibility and economic development in port cities, emphasizing the pivotal role of efficient transportation networks in facilitating trade and commerce. Their findings underscored the importance of integrated transport systems in enhancing regional connectivity and fostering economic growth. Building upon these prior studies, the current analysis of the questionnaire responses further emphasizes the critical need for infrastructure improvements around Merak Port. The overwhelming consensus among respondents regarding the inadequacy of existing conditions signals a pressing demand for transformative interventions. By relocating the Railway Station to a strategically aligned area within proximity to the port, policymakers can address the identified shortcomings while capitalizing on the synergies between different modes of transportation.

Insights gleaned from previous research on transportation planning methodologies, such as scenario forecasting and SWOT analysis, can inform the decision-making process regarding the proposed relocation. By incorporating evidence-based approaches and leveraging empirical data, policymakers can devise comprehensive strategies to optimize the transportation infrastructure serving Merak Port and accommodate the projected increase in vehicular traffic. The integration of findings from the questionnaire analysis with insights from previous research underscores the urgency and importance of addressing the identified challenges in transportation management around Merak Port. By adopting a holistic approach that combines stakeholder engagement, empirical research, and evidence-based decision-making, policymakers can formulate effective solutions to enhance the efficiency and resilience of transportation systems in support of regional development goals.

The integration of SWOT analysis further fortifies the rationale for implementing changes in the transportation infrastructure around Merak Port. This analytical framework, as evidenced by studies conducted by Xu et al. (2019) and Li et al. (2020), offers a systematic approach to identifying internal strengths and weaknesses, as well as external opportunities and threats, thereby informing decision-making processes in urban transportation planning.

By leveraging SWOT analysis to evaluate the potential relocation of the train station, policymakers can gain valuable insights into the feasibility and implications of such a strategic move. Research by Yang et al. (2018) demonstrated how SWOT analysis can assist in identifying key considerations and trade-offs associated with infrastructure projects, enabling decision-makers to optimize resource allocation and mitigate risks effectively. The proposal to

align the train station with the integrated terminal for transport vehicles represents a strategic intervention that capitalizes on identified strengths and opportunities while mitigating weaknesses and threats. This approach resonates with findings from studies by Chen and Wang (2017) and Zhao et al. (2021), which underscored the importance of enhancing multimodal connectivity and intermodal transfer facilities to improve the overall efficiency and resilience of transportation systems.

Decision-making informed by forecasting data, questionnaire results, and SWOT analysis empowers the government to adopt a holistic and evidence-based approach to transportation planning. By synthesizing insights from diverse sources, policymakers can formulate targeted strategies to address pressing challenges and capitalize on emerging opportunities in the transportation landscape. The integration of SWOT analysis enhances the robustness of decision-making processes in transportation management around Merak Port. By systematically assessing internal and external factors and aligning proposed interventions with identified strengths and opportunities, policymakers can optimize the effectiveness and sustainability of transportation infrastructure investments. This holistic approach, coupled with strategic planning informed by forecasting data and stakeholder feedback, positions the government to proactively address the evolving needs of transport users and accommodate the anticipated growth in vehicle traffic with agility and foresight.

IV. CONCLUSION

From the forecasting results, there has been an increase in vehicle traffic traveling to the ship. In 2025 - 2026 it will be 36.1%, therefore the government needs to think about future developments. From the results of the discussion analysis using a questionnaire, it was found that 75% of people strongly disagreed. This is of course to strengthen the reason that very significant changes are needed, to support the smooth running of ship service activities there is a need for a proposal to move the location of the train station to another area which is still close to the Merak Ferry port area. From the results of the SWOT analysis, it was found that there were changes in the location arrangement so the Center proposed a shift in the location of the train station which is parallel to the integrated terminal for transport vehicles.

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