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OPERATIONAL RISK ANALYSIS OF VEHICLE EMBARKATION AND DISEMBARKATION USING THE ENTERPRISE RISK MANAGEMENT (ERM) METHOD AT ASDP MERAK

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Abstract: Pelabuhan merupakan bagian penting dari infrastruktur logistik dan transportasi yang berfungsi sebagai titik temu antara moda transportasi laut dan darat. Proses naik dan turun kendaraan merupakan salah satu kegiatan operasional inti yang memiliki tingkat kompleksitas tinggi serta potensi menimbulkan risiko yang berkaitan dengan keselamatan, kelancaran pelayanan, dan kualitas operasional secara keseluruhan. Dalam konteks PT ASDP Indonesia Ferry Cabang Merak, kegiatan ini berlangsung secara intensif setiap hari sehingga memerlukan pengelolaan risiko yang terstruktur dan komprehensif. Penelitian ini bertujuan untuk menganalisis risiko operasional dalam proses naik dan turun kendaraan menggunakan pendekatan Enterprise Risk Management (ERM) sebagai kerangka strategis yang mampu mengidentifikasi, menilai, dan mengendalikan risiko secara holistik. Metode penelitian yang digunakan adalah deskriptif kualitatif berdasarkan prinsip ERM. Hasil penelitian menunjukkan bahwa terdapat sepuluh risiko operasional yang teridentifikasi, terdiri atas enam risiko kategori sedang, dua risiko kategori rendah, dan dua risiko kategori sangat rendah. Upaya pengendalian risiko diprioritaskan pada risiko kategori sedang karena berpotensi mengganggu keberlangsungan operasional dan memengaruhi kepuasan pengguna jasa. Temuan ini menegaskan pentingnya penerapan manajemen risiko berbasis ERM untuk meningkatkan keselamatan, efektivitas operasional, dan kualitas pelayanan dalam proses naik dan turun kendaraan di pelabuhan.

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Kata Kunci: *Enterprise Risk Management* (ERM); Risiko Operasional; Pelabuhan; Manajemen Risiko

Abstract: *Ports are an essential part of logistics and transportation infrastructure, functioning as a meeting point between sea and land transport modes. The embarkation and debarkation of vehicles constitute one of the core operational activities with high complexity and the potential to create risks related to safety, service smoothness, and overall operational quality. In the context of PT ASDP Indonesia Ferry Merak Branch, these processes occur intensively on a daily basis, requiring structured and comprehensive risk management. This study aims to analyze operational risks in the vehicle embarkation and debarkation process using the Enterprise Risk Management (ERM) approach as a strategic framework capable of identifying, assessing, and controlling risks holistically. The research method employed is descriptive qualitative analysis based on ERM principles. The findings indicate that ten operational risks were identified, consisting of six moderate risks, two low risks, and two very low risks. Risk control efforts are prioritized for moderate-risk categories as they have the potential to disrupt operational continuity and affect customer satisfaction. These results highlight the importance of implementing ERM-based risk management to enhance safety, operational effectiveness, and service quality in the vehicle embarkation and debarkation processes at the port.*

Keywords: *Enterprise Risk Management (ERM); Operational Risk; Port; Risk Management*

I. INTRODUCTION

Ports are a vital component of logistics and transportation infrastructure, serving as a key element in the movement of goods, vehicles, and people. As strategic infrastructure, ports play a significant role in ensuring smooth mobility, which directly contributes to economic and industrial development [1]. Behind this essential role in supporting various sectors such as international trade, inter-island distribution of goods, and public mobility there are numerous risks that may arise at any time.

Risk refers to the possibility of an event occurring that may cause deviations between the expected outcomes and actual conditions, thereby potentially hindering the achievement of organizational objectives. This aligns with the Enterprise Risk Management (ERM) framework established by COSO [2] , which defines risk as the possibility of an event occurring that negatively affects the accomplishment of organizational goals. Therefore, it is crucial for companies to manage the risks they face. In minimizing risks, organizations are required to implement risk management practices that can reduce potential disruptions. One method commonly used is Enterprise Risk Management (ERM). ERM represents an organization's capability to anticipate and manage risks comprehensively [3].

PT ASDP Indonesia Ferry Merak Branch is one of the operational units of PT ASDP Indonesia Ferry (Persero), responsible for ferry services and port management in the Merak region of Banten. Merak Port serves as the primary transportation gateway connecting Java and Sumatra across the Sunda Strait through the Merak–Bakauheni route. One of the key operational activities at Merak Port is the embarkation and debarkation of vehicles, which serves as a critical element in ensuring smooth ferry operations, particularly in a port with high mobility and passenger volume. Although the increasing number of service users indicates strong demand, it also presents challenges in managing port operations. The embarkation and debarkation process is among the most significantly affected activities, as it constitutes a crucial point for maintaining service efficiency.

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As the volume of vehicles and passengers increases, the likelihood and severity of operational risks also escalate. If unmanaged, these risks have the potential to disrupt operations, cause financial losses, and negatively impact the company's reputation. Therefore, a comprehensive assessment of the risks associated with vehicle embarkation and debarkation at Merak Port is required. Such an assessment is essential for enabling port management to understand risk exposure and develop appropriate mitigation strategies, particularly through the Enterprise Risk Management (ERM) approach.

Based on this background, the problem formulation in this research focuses on three main aspects. First, identifying potential risks that arise in the vehicle embarkation and debarkation activities at PT ASDP Indonesia Ferry (Persero) Merak Branch. Second, analyzing and assessing the level of risks associated with these activities to determine the likelihood and potential impact on operational continuity. Third, formulating appropriate mitigation measures to minimize these impacts so that the vehicle loading and unloading processes can run safely, efficiently, and in accordance with the company's risk management principles.

II. METHOD AND LITERATURE REVIEW

2.1 Method

This study employs a qualitative method with a descriptive approach. The research was conducted at PT ASDP Indonesia Ferry (Persero) Merak Branch, focusing on vehicle embarkation and disembarkation activities. Research data were collected through three techniques: documentation of operational data and records, direct observation in the port area, and interviews with relevant personnel who possess knowledge of the vehicle loading and unloading processes. Data analysis was carried out using the Enterprise Risk Management (ERM) method.

Risk assessment in this study was conducted through two stages. The first stage involved measuring the frequency of occurrence (Occurrence/O) and the severity of impact (Severity/S) based on interviews with four key respondents: the Risk PIC, the Operational Assistant Supervisor, the Chief Security Officer, and the Gate Staff. Each respondent provided assessments based on operational experience and actual field conditions. These scores were then averaged to obtain the Occurrence (O) value, which reflects how frequently the risks occur, and the Severity (S) value, which indicates the magnitude of impact associated with each risk. The second stage involved calculating the Risk Score (RS), derived from the multiplication of these two values.

$$RS = O \times S$$

Note :
RS = Risk Score
O = Occurance
S = Severity

2.2 Literature Review

1. Risk

Risk is defined as the dispersion or deviation between actual results and expected outcomes; it may also be interpreted as the probability of an outcome differing from what is anticipated [4]. Risk can be understood as a condition of uncertainty regarding future events, where decisions are made based on various considerations available at the present time [5].

2. Operational Risk

Operational risk generally originates from internal issues within a company, where such risks arise due to weaknesses in the management control system implemented by the organization. Operational risk refers to the risk resulting from inadequate and/or malfunctioning internal processes, human errors, system failures, and/or external events that affect the company's operations[6].

3. Risk Management

Risk management is a systematic approach aimed at identifying, analyzing, and controlling risks that arise in every organizational activity to support the optimal achievement of operational effectiveness and efficiency. The implementation of risk management enables organizations to identify, design, and prepare for various potential events that may occur when facing adverse situations. Therefore, risk management functions as a long-term protective mechanism for ensuring organizational sustainability [4].

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4. Enterprise Risk Management (ERM)

Enterprise Risk Management (ERM) represents an organization's capability in responding to and managing risks. ERM reflects the organization's ability to understand and control risk levels in alignment with the execution of business strategies, accompanied by accountability for those risks. One of the key benefits of implementing ERM is that it provides a broader perspective and strengthens the organization's focus on risk management across all operational levels [3].

5. Port

Ports play a crucial role as key infrastructure within a country's goods distribution chain. In archipelagic nations such as Indonesia, ports function as primary gateways that facilitate the smooth flow of interregional goods distribution [7]. A port is a designated area specifically constructed and utilized as a berthing location for vessels. This area serves as a transit or stopover point for ships before continuing or completing their voyages, as well as a site for loading and unloading activities [8].

6. Embarkation and Disembarkation

Disembarkation refers to the process of unloading passengers and cargo from a sea or air transportation mode upon arrival at their destination, while embarkation is the process of boarding passengers and loading cargo prior to departure using the same mode of transport. The disembarkation–embarkation process is an inseparable activity within maritime operations. Over time, this process has encountered various issues that affect the performance of vessel operations during clearance activities [9].

III. RESULT AND DISCUSSION

The results of the interview analysis conducted during the study indicate that the risk identification process at PT ASDP Indonesia Ferry (Persero) Merak Branch is carried out using the Enterprise Risk Management (ERM) approach to manage various emerging risks. The implementation of risk management follows the core stages of ERM, which include risk identification, risk assessment based on impact and likelihood, and the determination of appropriate control or mitigation strategies. These three stages were selected because they represent the primary processes in operational risk management and align with actual implementation conditions in the field. Risk management is then directed toward risks categorized as high and medium priority, allowing control measures to be implemented more effectively and supporting the smooth operation of vehicle embarkation and disembarkation activities at the port.

3.1 Risk Identification

In the risk identification stage of this study, the focus is directed toward various operational risks that arise during vehicle loading and unloading activities at the port. These risks were identified based on information gathered through interviews with several informants who are directly involved in the operational processes at ASDP Merak Port.

Table 1. Identifikasi Risiko

Risk Type	No.	Risk	Cause of Risk
Operational Risk	R1	Incorrect route on the ticket (Bakau–Merak)	Passenger negligence in paying attention to the ticket route.
	R2	Inaccurate manifest data	Passenger non-compliance with established procedures.
	R3	Mismatch in ticket check-in time	Passengers failing to complete the check-in process on time.

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	R4	Incorrect vehicle classification on the ticket	Passenger negligence and lack of understanding regarding vehicle classification.
	R5	Unauthorized individuals or vehicles entering restricted areas	Weak access control and low compliance among unauthorized individuals.
	R6	Risk of bribery practices in port operations	Weak internal supervision and opportunistic behavior by staff exploiting procedural loopholes.
	R7	Vehicle collisions during embarkation and disembarkation	User negligence due to lack of focus and rushing while driving within the port area.
	R8	Vehicles cutting the queue	User non-compliance with operational procedures.
	R9	Falling into the sea or slipping on the dock	Adverse weather conditions and overloaded cargo.
	R10.	Damage to port facilities	Overloaded vehicles being forcibly allowed to enter the port area.

Source: processed by the researcher (2025)

3.2 Risk Assessment

At the risk assessment stage, the evaluation in this study was carried out through two steps. The first step involved measuring the frequency of occurrence (Occurrence/O) and the severity of impact (Severity/S) based on interviews with four key respondents (Risk PIC, Operational Assistant Supervisor, Chief Security, and Gate Staff). Each respondent provided an assessment based on their operational experience and real conditions in the field. These scores were then averaged to obtain the Occurrence (O) value, which reflects the frequency of each risk, and the Severity (S) value, which represents the magnitude of its impact. The second step was to calculate the Risk Score (RS), obtained by multiplying the two values (RS = O × S). The RS value indicates the overall level of risk, where a higher score signifies a risk that requires greater attention and control.

Table 2. Risk Assessment

Risk Type	Risk Type	Risk	O	S	RS (O×S)
Operational Risk	R1	Incorrect ticket route (Bakau–Merak)	4	2	8
	R2	Inaccurate manifest data	4	2	8
	R3	Mismatch in ticket check-in time	4	1	4
	R4	Incorrect vehicle class on ticket	2	1	2
	R5	Unauthorized individuals or vehicles entering restricted areas	4	2	8
	R6	Risk of bribery practices in port operations	1	3	3
	R7	Vehicle collisions during embarkation and disembarkation	2	4	8

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	R8	Vehicles cutting the queue	1	2	2
	R9	Falling or slipping into the sea at the pier	1	5	5
	R10	Damage to port facilities	1	4	4

Source: processed by the researcher (2025)

The values were then mapped into a risk matrix to determine the severity level and likelihood of each identified risk. The risk matrix serves as a visual tool to categorize risks, thereby facilitating decision-making in relation to appropriate mitigation strategies. The matrix used in this study follows the categories of low, medium, and high risk.

Table 3. Risk Matrix

Significance		Dampak/*Severity*				
		1	2	3	4	5
		Insignificant Impact	Minor Impact	Moderate Minor	Major Impact	Major Impac to Large
Likehood	5 Almost Certain					
	4 Likely	**R3**	**R1,R2,R5**			
	3 Moderate					
	2 Unlikely	**R4**			**R7**	
	1 Rare		**R8**	**R6**	**R10**	**R9**

Source: processed by the researcher (2025)

3.3 Risk Control

Risks categorized as moderate are prioritized for control because they have a significant potential to disrupt the smooth operation of vehicle embarkation and disembarkation. The control measures implemented by PT ASDP Indonesia Ferry (Persero) Merak Branch aim to minimize both the impact and likelihood of these risks, as described below:

1. The risk of incorrect ticket routing (R1) is classified as an administrative risk that remains within the company's internal control; therefore, the response applied is risk reduction. Control is carried out through the implementation of an automatic reminder system in the Ferizy application, which requires users to review the selected route before making payment or activating the ticket. This control aims to reduce user negligence that may lead to check-in failures and operational disturbances.
2. The risk of inaccurate manifest data (R2) is an administrative risk that remains within internal control, so the response used is risk reduction. It is mitigated through double-checking procedures and data validation by manifest officers prior to departure. This step ensures the accuracy of vehicle and passenger data, enabling the correction of potential errors before the crossing process begins.

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3. The risk of unauthorized individuals or vehicles entering the sterile area (R5) is addressed with a risk reduction response, as its potential impact on operational security can still be controlled internally. Control measures include enhanced supervision by security officers and restricted access through the installation of barriers and warning signs. This ensures that only authorized personnel can enter the wharf area, thereby minimizing operational disruptions.
4. The risk of vehicle collisions during embarkation and disembarkation (R7) is an operational risk related to safety, thus the response applied is risk reduction. Control is implemented through structured vehicle lane arrangements, speed limits, and the placement of traffic controllers at critical points. These measures help maintain orderly traffic flow and reduce the likelihood of collisions at the wharf.
5. The risk of falling or slipping at the wharf (R9) is a safety-related operational risk and is mitigated through risk reduction. Control measures include the installation of safety railings, enhanced oversight by officers, and the provision of safety equipment such as life buoys and rescue ropes. These actions help reduce the likelihood of accidents caused by wharf conditions or individual negligence.
6. The risk of port facility damage (R10) is addressed with a risk sharing response, considering that the potential financial losses can be transferred to another party through specific mechanisms in accordance with company policy. Control is implemented through routine inspections and periodic maintenance of infrastructure by the facilities division. This preventive approach aims to detect early signs of damage, thereby preventing operational losses.

Based on the operational risk analysis conducted using the Enterprise Risk Management (ERM) framework, this study successfully identified ten operational risks that have the potential to disrupt the smooth execution of vehicle embarkation and disembarkation activities at the port. The assessment results, using the parameters of likelihood and severity, indicate that several of these risks fall into the moderate category, requiring targeted mitigation strategies to prevent an escalation of risk levels in the future. Risks within this category are considered to have significant disruptive potential if not properly managed, particularly those related to data inaccuracies, unauthorized access to restricted areas, vehicle movement on the dock, and the safety of passengers and personnel. By employing the ERM framework, the processes of risk identification, assessment, and control provide a more systematic overview of risk priorities, allowing risk management efforts to be focused on the most urgent areas.

The ERM framework has been shown to be effective in comprehensively mapping risks and identifying the most critical control points. This study is also consistent with Haryani & Risnawati (2018) in their research titled “Analisis Risiko Operasional Berdasarkan Pendekatan Enterprise Risk Management (ERM) pada PT Swakarya Indah Busana Tanjungpinang,” which confirms that ERM facilitates more structured risk identification and prioritization through a comprehensive risk assessment process. However, their study focuses on the manufacturing sector, which does not fully capture the operational dynamics of port environments that involve different complexities, particularly those related to vehicle mobility, passenger flows, and dock conditions.

The implications of this study are significant for port management. By understanding the risks categorized as moderate, management can design more targeted mitigation strategies to enhance safety, efficiency, and the reliability of operational performance. Implementing focused controls on these priority risks has the potential to improve service quality and strengthen stakeholder trust in the long term.

IV. CONCLUCION

This study concludes that the implementation of Enterprise Risk Management in the vehicle embarkation and disembarkation activities at PT ASDP Indonesia Ferry (Persero) Merak Branch successfully identified ten potential risks and determined six priority risks that require intensive mitigation. The novelty of this research lies in the application of Enterprise Risk Management within the operational context of vehicle embarkation and disembarkation at a ferry port, a topic that has received limited scholarly attention. This study produces a more specific and priority-based risk mapping, thereby providing a more targeted foundation for mitigation efforts to enhance safety and operational efficiency at the port. The implications of this research highlight the need for consistent implementation of ERM as an integral component of port operational management to support service effectiveness and minimize potential operational disruptions.

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