JRSSEM 2025, Vol. 4, No. 12
E-ISSN: 2807 - 6311, P-ISSN: 2807 - 6494

Risk Management Design for Light Vehicle Unit in Rental Company

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Abstract. This study aims to design risk management for a vehicle rental company in East Kalimantan using the Enterprise Risk Management (ERM) approach and the House of Risk (HOR) model. The transportation industry, particularly vehicle rentals, faces various risks that can disrupt the company's operations and performance. These risks include vehicle damage, delays in spare parts delivery, and payment issues from customers. This research will design Risk Management by applying Enterprise Risk Management (ERM) using the ISO 31000:2018 approach. In this study, the HOR method is used to identify, analyze, and prioritize risks and risk agents. This research combines the Failure Mode and Effect Analysis (FMEA) and Quality Function Deployment (QFD) methods to provide an integrated framework in risk management analysis. The results of the study indicate that the implementation of structured risk management can improve the company's operational effectiveness and efficiency. The proposed mitigation strategies include enhancing vehicle maintenance, staff training, and developing better monitoring systems. By implementing ERM and HOR, it is expected to manage risks more effectively, reduce the negative impact of occurring risks, and achieve the company's objectives more efficiently.

Key words: Risk Management; House of Risk; Rental Company; Vehicle Damage; Risk Mitigation

INTRODUCTION

The transportation industry is one of the few sectors that faces diverse and often unpredictable risks on a daily basis. One such business within this sector is the rental *light vehicle* (LV) industry (Jarašūnienė et al., 2024). According to data from the Central Bureau of Statistics (*Badan Pusat Statistik*, BPS), the transportation sector is one of the key drivers behind national economic recovery (Gaikindo, 2022). Transportation plays a crucial role in supporting individuals and companies in their daily operations, especially in the mining sector, which requires vehicles with specific specifications. As the transportation industry rapidly grows, businesses must provide high-quality and well-maintained vehicles to remain competitive.

PT. X is a transportation company specializing in LV rentals, operating in the Kalimantan region. Its primary clients are mining companies in the area. PT. X consistently strives to meet customer rental demands to the best of its ability. However, in providing optimal service, the company frequently faces unpredictable issues that negatively impact operations and profitability. These issues often stem from various factors, including human error (drivers/operators/mechanics), the unavailability or poor quality of spare parts and tools, and environmental factors (Fadilah et al., 2022; Kamaruddin et al., 2016). Inadequate preventive maintenance and skill gaps in operational staff contribute to reduced fleet reliability (Firoozian et al., 2019). Moreover, transportation companies in remote regions often face logistical delays and supply chain disruptions, which further complicate maintenance schedules (Zuraidah et al., 2021). A recurring problem is delayed payments from customers, which constrain the company’s financial capabilities, resulting in suboptimal repair and maintenance services (Fitriani & Nugroho, 2020). Payment delays have been shown to reduce service quality and hamper asset utilization in capital-intensive sectors like transport (Syamsudin et al., 2023). Such conditions highlight the urgent need for integrated financial and operational risk management frameworks in rental-based logistics operations (Setiawan & Purnomo, 2021).

These challenges lead to numerous risks. The first is unit breakdowns, caused by factors such as

rough vehicle usage, non-genuine spare parts, unavailability of tools causing delayed repairs, poor fuel quality leading to engine failure, workplace contamination affecting engine components, and unclear standard operating procedures (Aljumaili & Abdulbaqi, 2019; Okoh et al., 2021). Poor maintenance practices and environmental contamination are among the primary causes of unexpected vehicle failures in fleet-based operations (Li et al., 2015). The use of counterfeit or low-grade spare parts can severely compromise equipment reliability and lifespan (Gupta & Jain, 2017). Furthermore, lack of diagnostic tools and inadequate SOP implementation contributes to delayed troubleshooting and service response (Kim & Park, 2018). Additionally, the company may face fleet shortages due to contractual obligations requiring unit replacements, limiting availability for new customers (Nordin et al., 2020). Managing fleet availability becomes even more complex in industries with rigid service level agreements and operational redundancy requirements (Rahman et al., 2022). An example is in August, where several units had to be reserved as backup for existing clients, highlighting the need for predictive scheduling and optimized resource allocation (Zhou et al., 2023).

Manpower shortage is another critical risk. When multiple issues arise simultaneously, PT. X's mechanics may be stretched thin, attending to different clients at the same time, leading to delays and reduced repair quality. The worse the damage, the higher the repair costs, resulting in budget overruns and decreased asset value. Financial risks also affect the supply chain; delayed customer payments lead to delayed procurement of parts. Table 1.2 shows the August *Statement of Account* (SOA) with several overdue payments.

Currently, PT. X only responds reactively to these risks, without structured identification or systematic mitigation efforts. This reveals a lack of effective internal control, even though these risks are inseparable from organizational and operational processes. Proper risk management can enhance operational efficiency and effectiveness by identifying, measuring, and minimizing risks (Muhammad Asir et al., 2023). Therefore, a structured and proactive risk management system is urgently needed.

To address this, the research adopts the *Enterprise Risk Management* (ERM) approach, which helps organizations identify potential operational disruptions and implement preventive measures. This study specifically utilizes ISO 31000:2018 as its foundation and integrates the *House of Risk* (HOR) model to identify, analyze, evaluate, and handle risks. HOR combines *Failure Mode and Effect Analysis* (FMEA) and *Quality Function Deployment* (QFD) (Pujawan and Geraldin, 2009), with the added inclusion of financial variables to assess company profitability and losses. The advantage of this method lies in its comprehensive risk management framework.

The HOR model consists of two main phases. The first phase, based on QFD, involves identifying and prioritizing risk events and their causes (*risk agents*). The second phase, based on FMEA, focuses on handling prioritized risks through the identification of relevant preventive actions. Relationships between actions and *risk agents* are assessed, along with the effectiveness and difficulty levels of each mitigation strategy. The integration of ERM and HOR enables better, faster decision-making by management in addressing risks (Wibowo and Ahyudanari, 2021).

This research aims to design a risk management framework that aligns with ISO 31000:2018 to support PT. X in overcoming business risks appropriately. The problem formulation is: "How to design a risk management framework for PT. X using the *House of Risk* (HOR) method?" The objectives of the study are: (1) to develop a risk management framework applicable to PT. X, (2) to provide insights into key risks that may arise in PT. X, and (3) to analyze risk mitigation strategies and offer recommendations for risk handling improvements. This research provides various benefits for various parties, including companies, the academic world, and the industry as a whole. For companies, this research can improve operational efficiency, reduce the financial impact of risks, and strengthen internal controls through measurable mitigation strategies. For academics, this research contributes literature on the application of the integration of *Enterprise Risk Management* (ERM) and *House of Risk* (HOR) in the transportation industry, especially vehicle rental, so that it can be a reference for future research.

For the industry, the results of this research can be a reference for similar companies in managing operational and financial risks systematically. Thus, this research is expected to support PT. X in achieving business goals more effectively and sustainably.

MATERIALS AND METHODS

This research uses a qualitative and quantitative approach by combining several methods to design comprehensive risk management at PT. X. The main methods used are *Enterprise Risk Management* (ERM) based on ISO 31000:2018 standards and the *House of Risk* (HOR) model.

The object of this research is the risk associated with business management activities at PT. X, a transportation company specializing in *light vehicle* rentals operating in East Kalimantan. The company serves clients in the mining sector and faces various operational challenges that require structured risk management. This study aims to identify, assess, and mitigate business risks within PT. X using a systematic approach to risk management.

This research uses two types of data: primary and secondary. Primary data is obtained directly by the researcher through field observations, interviews, and questionnaires given to PT. X's management. Interviews are conducted with respondents who are knowledgeable about the risks within the company. Secondary data, on the other hand, is collected from existing sources to complement the primary data. These sources include previous studies, books, journals, and articles relevant to the topic.

The research framework outlines a systematic process for identifying, analyzing, and mitigating risks in the supply chain using the *House of Risk* (HOR) method. The first phase of HOR involves identifying and measuring risks to determine dominant risk events and *risk agents* through *Aggregate Risk Potential* (ARP) calculation. These dominant risks are further analyzed to design mitigation strategies. The second phase calculates the *Effectiveness to Difficulty Ratio* (ETD) to prioritize risk mitigation actions based on their impact and implementation difficulty. This phase includes collecting data through interviews and questionnaires to support the analysis.

Business process mapping is conducted to understand the current condition of PT. X. Observation, a key data collection method according to Sugiyono (2018), is used to study non-verbal behaviors and directly observe the business processes. This step allows researchers to perform an initial identification of ongoing problems in the field. *Business processes* reflect the activities carried out after thorough planning within the company and help pinpoint potential sources of risk.

Interviews serve as a vital method to gather qualitative data from employees and management at PT. X. The selected respondents include individuals in key positions such as the Director, Head of Sales & Marketing, Head of Logistics & Warehouse, Head of Operations, Head of Procurement, and Head of Finance. These interviews help provide deep insights into the day-to-day challenges and risks faced by each department.

Questionnaires are designed to further identify and quantify risks by engaging respondents involved in business activities. These questionnaires are based on the previously mapped *business processes* and help in identifying, assessing, and prioritizing risks through the *House of Risk* Phase 1 methodology. Following the data collection through interviews and questionnaires, a risk assessment is conducted to determine which risks need immediate action based on their priority ranking.

Lastly, data processing and analysis are carried out using the *House of Risk* model. According to Pujawan and Geraldin (2009), HOR emphasizes proactive risk management through preventive measures aimed at reducing the likelihood of risk sources. By addressing these sources, several risk events can be avoided altogether. It is thus essential to identify not only the risk events but also the underlying *risk agents* that may trigger multiple events. This integrated approach allows PT. X to make better-informed decisions for risk mitigation and business continuity.

RESULTS AND DISCUSSION

The scope is focused on Light Vehicle units owned by rental companies that operate in the Kalimantan region and support the mining sector. These units play an important role because they support mobility, logistics distribution, and smooth operations in mining areas that have high levels of risk and difficult terrain. Therefore, designing risk management based on Enterprise Risk Management (ERM) is very important to ensure safety, efficiency, and operational sustainability. The implementation of ERM allows companies to systematically identify, analyze, and manage various risks that may arise in the management of Light Vehicle units. In this study, the approach used refers to the ISO 31000:2018 standard, which provides a structured framework based on the best principles in risk management. The main purpose of preparing this risk management is to identify potential risk events that can disrupt unit operations, as well as analyze the triggering factors (risk agents) that cause them. Once the risk triggers are identified, the next step is to design the right mitigation strategy to reduce the impact of the existing risks. The mitigation strategies designed in this study are focused on risk triggers and the results of the Aggregate Risk Potential (ARP) rating. The process of identifying and designing mitigation is carried out through a brainstorming method with the manager/expart of PT. X and has received approval from the internal party. This mitigation planning also includes the estimated costs required so that the company can effectively allocate the budget for risk control.

Risk Identification Analysis

Based on the results of data collection carried out on the business process of PT. X, various types of risks and their triggers that have the potential to disrupt the smooth operation of the company. These risks are analyzed through risk events and risk agents, each of which is identified based on the business stage of the company's processes. The core process business of PT. X includes customer demand planning, maintenance planning, parts procurement, parts distribution and quality control.

The results of the risk identification carried out on the business of PT. X shows that each stage of the process has potential risks that need to be further analyzed. These risks not only arise separately in each process, but they can also be interrelated and affect each other. In addition, before risk identification, an analysis of the objectives of each business process has been carried out. This goal is the basis for assessing whether a risk can hinder the achievement of the company's targets. Thus, the results of the identification are not only descriptive, but also provide a strategic overview of the areas that require special attention in risk management.

Risk Event Identification Analysis

Identify risk events at PT. X was carried out through literature study and brainstorming with the company's management. This process is carried out at the data collection stage as part of an effort to comprehensively understand potential events that can interfere with the operational continuity of PT.X. The results of the identification process resulted in as many as 29 risk events which were divided into 5 stages of PT.X's business process. In the process of procurement of spare parts, there are 7 risk events, in the process of distributing spare parts there are 5 risk events and in the process of quality control there are 6 risk events.

Each risk event identified shows that the risk in the process business of PT. X is interdependent (dependent). This means that the occurrence of risks at one stage of the process can affect or worsen the risk at other stages. For example, delays in the procurement of spare parts can have a direct impact on the customer's unit maintenance schedule. To gain a deeper understanding of the impact of each risk event, severity was measured through filling out questionnaires conducted in discussions with managers/exparts of each relevant department. This assessment aims to determine the priority of risk management based on the degree of its influence on the achievement of the company's operational objectives.

Risk Agent Identification Analysis

Risk agents are factors that cause or trigger risk events in a business process. By identifying and understanding risk agents appropriately, companies can design more effective mitigation strategies to prevent or minimize the possibility of risks that can disrupt smooth operations. The risk agent identification process begins by tracing each risk event that has been found, then further analyzed to reveal the underlying causative factors. Each risk event can have one or more risk agents that contribute to its emergence. The analysis was carried out through brainstorming with the manager/expart of each department.

Based on the results of the analysis, a total of 36 risk agents were obtained spread across 5 stages of the business process, with details of 5 risk agents in the customer demand planning process, 6 risk agents in the maintenance planning process, 10 risk agents in the parts procurement process, 8 risk agents in the parts distribution process, and 7 risk agents in the quality control process. Each risk agent that has been identified is then further identified to measure the probability of its occurrence. This measurement is carried out through a questionnaire in a joint discussion with the manager/expart of each department. This assessment aims to determine how likely each risk agent is to trigger a risk event, so that it can be used as a basis for determining risk mitigation priorities. With this, PT. X is expected to have a more comprehensive understanding of the sources of risk in its business processes.

Calculation Analysis of ARP (Aggregate Risk Potential)

Aggregate Risk Potential is an indicator used to measure the overall level of risk in a system or process. The ARP value is obtained through a calculation process that multiplies the occurrence of these risks (occurrence). Severity reflects the amount of losses that can be caused, both in terms of finance and in terms of disruption to the achievement of the company's performance targets if the risk really occurs. The rating scale for severity is divided into 5 categories, namely very low, low, medium, high and very high. Meanwhile, the probability of risk (occurance) is also classified into 5 levels, namely very rare, rare, possible, has happened before, and often occurs. These two scales can be seen in detail in Table 4.7 of the Severity Assessment Results and Table 4.8 of the Occurrence Assessment Results which contain the results of each aspect.

This ARP value is then used in the first stage of the House of Risk (HOR) method, which aims to identify and prioritize risk agents. In HOR phase 1, the ARP calculation is carried out by considering the severity and occurrence scales, as well as the level of correlation between each risk event and the relevant risk agent. This correlation is assessed using a scale of 1, 3, 9 which shows the level of relationship between these variables. The final results of the ARP calculation are shown in Table 4.10, which presents a recapitulation of the ARP values for each risk agent. This table also compiles risk agents based on the highest to lowest ARP ratings. Based on the analysis of the pareto diagram and brainstorming with the management of PT. X, it is determined that the top 16 risk agents will be made the top priority for preventive actions to minimize the potential negative impact on the company's operations.

Risk Evaluation Analysis

The risk evaluation stage is carried out to determine risk agents that need to be addressed immediately through mitigation measures. This determination is based on the pre-calculated ARP value. In this process, the House of Risk phase 2 approach is used, which aims to identify the most effective mitigation measures for the most influential risk agents. Based on the 80/20 pareto principle, the top 16 risk agents were selected which cumulatively accounted for about 80% of the total risk. This risk agent is the top priority to be followed up.

This approach allows companies to focus resources and attention on the risks that have the most impact on the company's achievements. By identifying and addressing the risk agents that account for

the most potential losses, companies can improve efficiency in risk management. The following is an explanation of each of the selected risk agents:

a. RA6 – Inaccurate budget planning, late payments from customers, and unanticipated unexpected expenses

   This risk can lead to a company's financial imbalance, when the budget is not prepared properly, the company can lack funds when needed. In addition, late payments from customers worsen cash flow, and sudden unplanned expenses can disrupt the company's operations

b. RA11 – Unexpected treatment that is not scheduled.

   Sudden unplanned maintenance can disrupt the planned schedule (repair / maintenance). This can result in service delays, increased operational costs and decreased work efficiency due to sudden shifting of resources

c. RA 31 – The quality of the installed components/parts/materials is no longer feasible (cheating occurs in the field).

   The use of unsuitable components, especially due to cheating, is very dangerous. This can cause system damage or work accidents. Fraud itself can occur from company employees (mechanics) or from users in the field.

d. RA8 – There is an accident in the field or damage to one of the components/parts.

   A work accident or component malfunction may stop operational activities, as this requires further investigation. In addition to material losses, this risk also concerns the safety of workers in the field and can incur additional costs for repairs and compensation.

e. RA1 – Inaccurate budget planning, late payments from customers, and unanticipated unexpected expenses

   This risk can lead to a company's financial imbalance, when the budget is not prepared properly, the company can lack funds when needed. In addition, late payments from customers worsen cash flow, and sudden unplanned expenses can disrupt the funds that will be planned for customer requests.

f. RA32 – Lack of training related to quality standards and tool use

   Without proper training, workers can misuse tools or not understand the quality standards that must be met. This can lead to unspecified work results, equipment damage, and even work accidents.

g. RA12 – Error in ordering to supplier (specifications/quantity)

   Errors in the order cause delays in procurement and waste of costs. If the incoming goods are not as needed, the work process may be delayed or may have to be reordered.

h. RA 3 – Lack of regular communication with customers, dependence on large customers without diversification.

   Irregular communication can lead to misunderstandings and lower customer satisfaction. Reliance on one large customer is also at high risk if business relationships are disrupted or if customers have problems with payments

i. RA13 – Supplier is wrong in canceling orders

   Mistakes on the part of the supplier can cause delays in the operational process, because they have to wait for parts/materials to be returned and re-supplied. These delays can hinder the maintenance process and affect customer satisfaction

j. RA10 – Delay in submitting needs to the procurement team.

   If the needs are not submitted on time, the procurement process will be delayed. This can lead to stock shortages, delays in the implementation of maintenance according to schedule, so that the company's operational activities become inefficient

k. RA4 – Unscheduled communication frequency, lack of customer services/sales performance.

   Unstructured communication and poor customer service can lower customer trust and

satisfaction. This can also lead to a loss of business prospects and a declining reputation of the company

l. RA9 – Lack of manpower for maintenance.
Labor shortages in the field led to delayed treatment. Sometimes some unplanned things happen so that the workforce that should be doing maintenance according to the schedule has to do other work with higher urgency first, other schedules are delayed and cause work overload.

m. RA2 – Lack of customer service training, absence of response time standards, ineffective customer communication system
Slow response in customer requests and complaints can reduce customer satisfaction and can eliminate business opportunities. Often communication is also inefficient because there is no 1-door communication

n. RA5 – Incomplete customer request documents, absence of specification verification procedures, lack of coordination between sales and operational teams
Irregularities and incompleteness in documentation and coordination led to errors in the fulfillment of requests. This can lead to incorrect delivery (for example, the specifications of accessories between customer a and b may be different, e.g. customer a needs a deep roll bar, while customer b does not)

o. RA7 – Error in requesting needs to the procurement team
Errors in demand for needs cause inappropriate procurement (can be quantity or specifications). This can slow down the operational process and increase the workload of the procurement team

p. RA28 – Error in positioning parts/materials when to be distributed
Wrong placement of parts/materials during the distribution process can cause damage, there are some parts/materials that cannot be stacked with other materials, or objects that contain liquids such as oil (prone to leakage).

Mitigation Action Analysis

The risk agent variables that are the output of the phase 1 House of Risk model have each preventive action arranged in the phase 2 House of Risk. The preventive actions shown in Table 4.13 Selected Risk Agent Mitigation Actions are the result of brainstorming with the management/expart of PT.X. After the preventive action is determined, the next step is to determine the correlation of the 16 selected risk agents with the existing preventive actions. Determination of correlation by grading using a scale of {0, 1, 3, 9}, the explanation of each value is as follows:

- 0 > no correlation between preventive action and risk agent
- 1 > weak correlation between preventive action and risk agent
- 3 > moderate correlation between preventive action and risk agent
- 9 > strong correlation between preventive action and risk agent

The scale of this correlation is also determined together with the management/expart of PT.X. Furthermore, in HOR phase 2, an assessment is also carried out on how difficult preventive actions are realized as shown in table 4.14 of the HOR Matrix phase 2. This assessment uses a Likert scale of 1 – 5 with the following explanation:

- 1 > mitigation actions are very easy to implement
- 2 > mitigation actions are easy to implement
- 3 > mitigation actions are quite easy to implement
- 4 > mitigation actions are difficult to implement
- 5 > mitigation actions are very difficult to implement

The results of correlation and analysis of how easy or difficult preventive actions are

implemented can be the Correlation Value of Risk Agent with Preventive Action and the Level of Difficulty. Furthermore, a calculation process will be carried out on the total effectiveness of each preventive action. The goal of this stage is to obtain an effectiveness to difficulty ratio value, known as ETD (Effectiveness to Difficulty Ratio). This ratio is calculated by dividing the total effectiveness of a preventive measure by the level of difficulty in its implementation. The ETD assessment serves as a tool in determining the priority of implementing preventive measures. By knowing the ETD value of each preventive action, management can identify which actions are prioritized. This is especially important in a risk mitigation strategy, as it allows companies to focus on actions that have maximum impact. The results of each ETD preventive action can be seen in Table 5.2 Recapitulation & Ranking of Preventive Action.

The first preventive action that is a priority based on the HOR phase 2 model is AM1, which is to design and implement an operational finance control board (*Operational Finance Control Board*) in the form of a large physical board installed in the financial room or operational room, which displays: Customer payment status (green, yellow, red), Realization budget vs plan (manual bar chart), List of unexpected expenses that occur in the current month. This action has an ETD value of 1710 and a difficulty level of 3 which means it is quite easy to implement. AM1 is designed to reduce risk agents such as RA1 and RA6 related to inaccurate budget planning, late payments from customers, and unanticipated unexpected expenses. In the current conditions, there is no unified visualization that is able to provide real-time information that can be monitored together by finance and operational teams. Therefore, the implementation of AM1 will be a strategic first step in building a stronger control culture. The implementation of this action is the equipment described in Table 1 Details of *the Operational Finance Control Board Equipment*

Table 1. Detailed Equipment of Operational Finance Control Board

Description	Estimated Cost
Whiteboard 120 x 240 cm	Rp 750.000
Color Markers	Rp 83.000
Magnetic Indicator (round/colorful triangle)	Rp 40.000
Labels/Whiteboard Stickers	Rp 60.000
Eraser	Rp 20.000
Total	Rp 953.000

Source: The results of the analysis and calculation of costs by the researcher based on the needs of PT. X, with input from the company's management

The second priority precaution is AM2, which is to create a new contract format that lists late penalties and on-time payment incentives. This action also has an ETD value of 1710 and a difficulty level of 3. AM2 is effective in reducing the risk agents RA1 and RA6, which are related to late payments from customers. Currently, the company is still using a standard contract format that does not include any *discounts*/penalties for late payments. The implementation of AM2 can be calculated with a 5% discount scheme in the 4th month after timely payment in 3 consecutive months. Then, currently the company applies 30 days *Term of Payment*, and a penalty will be imposed when the delay is more than 30 days/1 month, the penalty will be imposed in the *range* of 0.5-0.7% per month (according to the customer)

Furthermore, AM3 is a mitigation action that aims to diversify the customer base to reduce dependence on large customers. This action has an ETD value of 1282.5 and a difficulty level of 4, which shows that the implementation is quite easy to implement. AM3 reduces the risk agents RA1, RA3, and RA6. The difficulty level of value 4 in this action is because especially in the Kalimantan region itself, mining is the majority industry with the use of Light Vehicles, so to enter the market of other industries is quite a difficult challenge. In the current conditions, the company is still very dependent on several large customers, this implementation of course requires market research so that the company can find out what field the market can be developed in the company (customer).

Then, the AM14 mitigation action has an ETD of 990 with a difficulty level of 3. This action conducts weekly inspections by supervisors to check compliance with schedules. AM14 also reduces the risk agent RA11. Regular checks will help detect potential schedule delays early and can provide immediate feedback to the mechanic team. It has been implemented but with an indeterminate frequency of checks, it is only carried out if there are issues that arise. To implement this action, the management of PT. X can give direction to the supervisor to schedule regular checks once a week in the future to report to management.

Furthermore, AM18 conducts periodic material inspections with ETD 864 and difficulty level 3. This action can reduce the risk agent RA31 related to the quality of unsuitable components. While in the field, many things can happen, one of which is that there are several individuals who use unit materials for other purposes (exchanged for other materials or taken for granted). This action can be carried out by utilizing internal labor and does not require significant costs, it's just that currently it has not been carried out regularly. In the future, it is hoped that this action can be implemented regularly so that existing materials can be monitored for feasibility and can monitor the situation in units in the field.

AM13 Mitigation Action has an ETD value of 742.5 with a difficulty level of 4. This action establishes a PIC (Person in Charge) for several units and implements a warning system/light warning if maintenance is not carried out as scheduled. AM13 reduces the risk agent RA11. The designation of a PIC will increase individual responsibility for the managed unit. This action is expected so that each PIC can focus more according to the area of the unit that is their responsibility.

Furthermore, AM19 with an ETD value of 648 and difficulty level 3. This action implements quality standards and the use of appropriate tools and conducts training for the use of the necessary tools. AM19 reduces the risk agent RA32 related to lack of training on quality standards and tool use. The current condition at PT. X there are some important tools that are not owned, only rented if needed or repaired elsewhere, but based on expenditure data it is increasingly ineffective because tools are increasingly needed, so it is better for PT. X has personally the necessary tools. For the implementation of this action, a cost is required with details as shown in Table 2 Planning Procurement Tools

Table 2. Planning Pengadaan Tools

Equipment	Function	Estimated Cost
Scanner	Detecting damage to vehicle Electronic Systems (transmission, airbags, ABS, etc.)	3.000.000 - 6.000.000
Common Rail Injector Repair Tools	Cleaning, testing, repairing, calibrating the injector	50.000.000-65.000.000
Engine Stand	Machine mount for repair and overhaul	2.000.000 - 4.500.000

Source: Data on equipment needs and cost estimates from the operational department of PT. X, compiled by researchers

Furthermore, AM15 with an ETD of 594 and a difficulty level of 3. This action designed and implemented a print-based Supplier Order Verification Checklist that must be filled out before the order is placed. AM 15 reduces the risk agent RA12 related to errors in ordering to suppliers. This checklist will be a simple but effective tool to ensure that the specifications and order quantities are appropriate.

AM9 mitigation action, with an ETD value of 486 with a difficulty level of 5. This action sets a threshold for maximum unit operating hours and a thorough technical inspection before reuse, such as checks that are carried out every 200 hours of use and multiples apply. But this is quite difficult to implement because it depends on the conditions on the ground. The density of customer operational activities in the field can hinder this action, and it requires communication and adjustment from many

parties. AM 9 is used to reduce the risk agent RA8, aiming to reduce accidents in the field. Furthermore, AM5 Mitigation Action with an ETD value of 479.25 and a difficulty level of 4. This action aims to increase the frequency of communication with customers, which has a direct impact on risk agents RA2, RA3 and RA4. More intensive communication will build better relationships and increase customer loyalty, such as holding weekly meetings or lunch together, but this also depends on the time match that the PT team has. X or customer availability time. AM7 mitigation action with an ETD value of 477 and difficulty level 3. This action implements a system of verifying customer request documents before processing, which reduces RA4 and RA5 risk agents. This system will help ensure that each customer request is verified before being forwarded to the next process, reducing the potential for errors, and improving operational efficiency. Because for the current situation, often new completeness is checked when there is a need, so it is too late to find out the shortcomings.

The AM4 mitigation action has an ETD value of 364.5 and a difficulty level of 4 This action sets clear response time standards and implements a more effective customer communication system. AM4 reduces the risk agents RA2 and RA4, which are related to the lack of customer service training and effective communication systems, as communication often does not go through a single door and triggers misunderstandings. It should be done as soon as possible to respond to customers, because it is a business opportunity, for the implementation of this action it is necessary to provide customer service training/communication training with an estimated training cost of Rp. 4,000,000/person

AM16 Mitigation Action has an ETD of 342 and a difficulty level of 3. This action creates and runs a quarterly supplier evaluation program by holding face-to-face meetings. AM16 can reduce RA13 risk agents related to shipping errors by suppliers. Periodic evaluations will improve supplier communication and accountability for their performance. Furthermore, AM12 Mitigation Action has an ETD value of 330 with a difficulty level of 3. This action integrates preventive treatment schedules into digital reminder systems such as Google Calendar. AM12 can reduce the risk agent RA11 related to unexpected maintenance that is not on schedule, with this system the maintenance schedule can be controlled and the track record can be seen, and it can make it easier for mechanics to carry out maintenance. AM11 Mitigation Action with an ETD value of 276 with difficulty level 3. This action implements a digital reminder system for submitting needs to the procurement team and setting a clear deadline for each need. AM11 reduces the risk agent RA10 related to the delay in submission of requirements. This system will assist the operational team in setting priorities and avoiding delays that impact the operational/maintenance process of the unit.

AM6 Mitigation Action with an ETD value of 261 and difficulty level 3. This action increases the frequency of internal communication through regular meetings and periodic evaluations of customer service and sales performance. AM6 reduces the risk agent RA4. In the current conditions, internal communication is still ad-hoc. With regular meeting schedules and evaluations, companies can improve coordination of function lines, and customer satisfaction can increase because customer service and sales are departments that are directly in contact with customers.

Furthermore, AM8 Mitigation Action with an ETD value of 216 and difficulty level 3. This action implements a needs verification system before being sent to the procurement team and conducts internal training on the correct request procedures. AM8 reduces the risk agent RA7. This will improve demand accuracy and procurement efficiency.

AM10 Mitigation Action with an ETD score of 189 and difficulty level 4. This action aims to increase the workforce for maintenance as needed and conduct regular technical training. AM10 may reduce the risk agent RA9 associated with a lack of manpower for treatment. In the current conditions, the workload of the operational team is quite high so that it is at risk of negligence or delay in maintenance. The addition and technical training will improve operational performance, but this will still be adjusted to the needs and financial conditions of the company.

AM17 Mitigation Action with an ETD of 162 and a difficulty level of 4. This action provides

more adequate packing equipment and sorts the position of transporting parts so that they do not overlap with other parts. AM18 reduces the risk agent RA28 associated with errors in material arrangement during distribution. Although it does not require a digital system, it does require the procurement of physical equipment and light technical training.

Selection of Preventive *Action*

In the process of preparing *preventive actions* at PT. X, not all plans can be executed immediately. This is due to various obstacles such as budget limitations, available time allocation, and conditions in the field. Therefore, of the 19 mitigation actions designed, the results of discussions and brainstorming with the management of PT. X shows only the top 8 actions according to the ranking that are considered the most priority and possible to be implemented immediately. These actions were chosen because they are believed to have a significant impact on the reduction of operational risks of PT. X, 8 of these mitigation actions can be seen in table 3 Selected Mitigation Actions

Table 3. Selected Mitigation Actions

Ranking	Mitigation Actions	
	Code	Description
1	AM1	Designing and implementing an Operational Finance Control Board in the form of a large physical board installed in the financial room or operational room, which displays: Customer payment status (green, yellow, red), Realization budget vs plan (manual bar chart), List of unexpected expenses that occur in the current month.
2	AM2	Create a new contract format that includes: Late penalty (e.g. 2% of the bill value per week of delay). On-time payment incentives (e.g. 1% discount if paid before maturity)
3	AM3	diversify the customer base to reduce dependence on large customers.
4	AM14	Have weekly checks by your supervisor to check for schedule compliance.
5	AM18	Conducting regular material quality inspections
6	AM13	establish a PIC (person in charge) for some units, and apply a system of light penalties (e.g. written reprimands) if maintenance is not carried out as scheduled.
7	AM19	Establish clear standards for quality and tool use, as well as conduct training on the use of tools & procurement of necessary tools
8	AM15	Design and implement a print-based Supplier Order Verification Checklist that must be filled out before an order is placed.

Source: Results of mitigation priority evaluation using the House of Risk (HOR) Phase 2 method, based on ETD calculation

This research provides significant contributions to the operational risk management of PT. X, particularly in the light vehicle (LV) rental business serving the mining sector. By employing the Enterprise Risk Management (ERM) approach based on ISO 31000:2018 and the House of Risk (HOR) method, the company can systematically identify, analyze, and mitigate risks in a structured and measurable way. First, PT. X must integrate a structured risk management system into its core business processes, including periodic risk identification, impact and probability assessment, and regular evaluation of mitigation effectiveness, enabling the company to anticipate potential threats before they significantly disrupt operations. Second, based on the HOR analysis, eight top-priority mitigation actions were selected using the Effectiveness to Difficulty Ratio (ETD); management is advised to focus on actions with high impact and low implementation difficulty while allocating resources efficiently. Third, since many risks stem from weak interdepartmental coordination, PT. X should strengthen internal controls by establishing clear communication SOPs, conducting routine interdepartmental performance evaluations, and increasing the frequency of coordination meetings and cross-training. Fourth, the development of financial and operational monitoring systems—such as implementing an operational finance control board and new contract formats with penalties and incentives—is essential

to enhance financial transparency, encourage customer payment compliance, and reduce cash flow and budgeting risks. Lastly, risks related to work quality and equipment usage underline the need for periodic technical training, appropriate tool procurement, and the establishment of measurable work quality standards to improve human resource competency and operational effectiveness.

CONCLUSIONS

The research successfully developed a structured risk management framework for PT. X, encompassing risk identification (*risk events* and *risk agents*), risk analysis (severity, occurrence, and correlation assessments), risk evaluation (calculation of *Aggregate Risk Potential*/*ARP* and *Effectiveness to Difficulty Ratio*/*ETD*), and mitigation planning (preventive actions). The study adopted the *Enterprise Risk Management* (ERM) approach based on ISO 31000:2018 and applied the *House of Risk* (HOR) method consisting of two phases. Phase 1 was used to identify and prioritize risk sources based on ARP values, while Phase 2 determined mitigation actions based on ETD values. A total of 29 *risk events* were identified across five core *business processes*, along with 36 *risk agents*. From these, the top 16 *risk agents* were prioritized, contributing to nearly 80% of total risk exposure. Nineteen mitigation actions were proposed, evaluated by their effectiveness and implementation difficulty. After discussions with PT. X management, the top eight mitigation actions were selected for immediate implementation, including the design of an *Operational Finance Control Board*, revised contract formats with penalties and incentives, customer base diversification, weekly schedule compliance checks, periodic material inspections, *PIC* assignments with penalty systems, training on standardized tool use, and the introduction of a *Supplier Order Verification Checklist*. These actions are intended to strengthen PT. X's operational resilience by addressing its most critical vulnerabilities.

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