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Analysis of Supply Chain Risk Management in The Lubricant Industry Using the House of Risk (HOR) Method

Muthia Putri Hidayati[1*], Iwan Vanany[2]
Institut Teknologi Sepuluh Nopember
Email: hidayatimuthia@gmail.com[1*]
*Correspondence

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ABSTRACT

PT.X is a company engaged in lubricant manufacturing. Based on the results of field studies, several risks hinder the company's supply chain process, and PT.X has never conducted a risk assessment. Therefore, risk analysis and mitigation are needed to minimize the risks that arise in the company's supply chain. This research uses the Supply Chain Operation Reference (SCOR) model to map the company's supply chain activities and the House of Risk (HOR) method to identify risks in the supply chain, including risk events, risk agents, and their correlations. The results reveal a total of 32 risk events and 26 risk agents. Then, a Pareto diagram calculation is conducted, identifying 3 priority risk agents that need to be addressed: supplier inability to provide raw materials, lack of work supervision, and inadequate workforce competence. From these 3 priority risk agents, 8 risk mitigation measures have been determined: evaluating supplier performance, establishing contracts with suppliers, planning alternative supplier selection, conducting periodic supervision, establishing company standard operating procedures, providing skills training and work discipline, recruiting workers more selectively and rigorously, and placing workers according to their expertise.

Introduction

The company's ability to face competition against its competitors in the industrial world is very important. The essence of competition between companies lies in how companies produce products that are better in quality, cheaper in price, and always have the availability of these goods. This can all be achieved with good supply chain management so that the company's activities can run effectively and efficiently. A supply chain includes all stages, directly or indirectly, of meeting customer demand. The supply chain includes not only manufacturers and suppliers but also parties involved in transportation, warehousing, retailers, and the customers themselves (Chopra & Meindl, 2001; Haial et al., 2020). In any organization, the supply chain includes all functions involved in fulfilling customer demand.

Supply Chain Management is a series of activities that manage the supply chain which includes procurement, production, inventory, and delivery of products to consumers. The main objective of managing the supply chain is to align customer needs with the flow of materials from suppliers to provide a balance between what are often seen as conflicting objectives of high customer service, low investment in inventory and low unit costs. The design and operation of an effective supply chain is essential for any company.

Good cooperation between suppliers, manufacturers and distributors can achieve all of this. Therefore, a supply chain management system is needed to manage all these stakeholders. In its application in the manufacturing world, SCM must be able to meet customer satisfaction, incur low costs in inventory and product delivery, develop timely products, and run the industry carefully and flexibly.

The benefits of supply chain management in a company are very important, including customer satisfaction, increasing revenue, reducing costs, and making the company stronger. Because of the various benefits of SCM, the company will progress if it manages the supply chain well. Therefore, good supply chain management is necessary in a company.

However, sometimes, this supply chain management does not work as expected. Every activity carried out by the company cannot be separated from the risks that can affect the flow of materials and components in the supply chain. Risk is a potential adverse event caused by uncertainty over the occurrence of an event, where uncertainty is a condition that causes the growth of risks originating from various activities (Suryatika et al., 2021). Based on research conducted by Hendriks and Sinhal (2003) in (Gurgoglione et al., 2023), it is found that disruption to the supply chain has a long-term negative impact on the company and many companies are unable to recover quickly from this negative impact. And based on data from the Center for Risk Management Studies (CRMS) Indonesia in 2019, it states that the maturity level of risk management implementation in Indonesia is 76%. This high figure shows that the implementation of risk management in Indonesia is increasingly mature, but the implementation of risk management on increasing the effectiveness and efficiency of the company's supply chain is only 33%. This means that many companies have not paid attention to risk management in the supply chain.

PT.X is a subsidiary established on September 23, 2013 and spun-off the Lubricants Business Unit of PT. A on October 30, 2013. PT. X's line of business is to produce, distribute and market lubricants, grease and specialties products. In order to support these business activities, PT. X built four Production Units, seven Sales Regions, and established various other supporting facilities such as Depot Supply Point (DSP), Bulk Terminal, and Production Laboratory. The total production capacity of PT. X is 540,000 KL/year, with a total domestic production capacity of 480,000 KL/year and overseas production capacity of 60,000 KL/year.

Based on the results of field studies conducted at PT.X, several risks were obtained that could hinder the supply chain process. One of the problems is the quality of

raw material receipt which is quite fluctuating where the expected quality of raw materials is in the middle of the specification limit but not a few raw materials received are on the borderline of the minimum or maximum specification limit. Although based on the provisions of the raw material specifications can be accepted, it will cause a shift in results during the blending process to produce products. In addition, there are also several risks that occur along the supply chain flow, including products experiencing Off Spec which requires a rework process, delays in shipping finished products, shortages of raw materials and many other risks that often occur along the supply chain flow which cause supply disruptions to end consumers to the detriment of all stakeholders in the supply chain. If these risks occur and are not handled, it will cause losses or reduce profits for the company. Until now, PT.X has never conducted a detailed risk assessment for handling these obstacles.

Risk assessment is an effort to find out, analyze, and control risks in every industrial activity with the aim of obtaining higher effectiveness and efficiency (Darmawi, 2016). Therefore, an analysis is needed to identify, measure, and handle the occurrence of obstacles or risks at PT.X.

In addition, based on the results of research that has been conducted on 209 companies in Asia, it explains that there are still many company owners who have not realized the presence of a risk and still have the mindset that the risk will not happen to them (Adeyele & Osemene, 2018; Balasubramanian, 2022). The results of the study are relevant to what happened at PT.X considering that the company is also still not optimal in understanding risks, as well as how to control the risks themselves even though they understand in detail the business processes they do. This is the basis for this research so that the company better understands the importance of managing existing risks, by providing an explanation of the risks in the supply chain process from upstream to downstream, identifying the risks that exist in the company and providing risk mitigation strategies for companies based on risks that may occur now or in the future to maximize the performance of the company so that the vulnerable points of risk occurrence can be known and minimized (Settembre-Blundo et al., 2021).

Risks in the supply chain can be reduced when a company implements Supply Chain Risk Management. The framework consists of several stages or phases, namely risk identification, risk measurement, risk assessment, risk evaluation, risk mitigation & contingency plans, and risk control & monitoring Tummala & Schoenherr, (2011) in (Pradita et al., 2020). Risks in the supply chain can be minimized if the company applies good supply chain rules, one of which is by applying SCOR (Supply Chain Operation Reference) modeling. SCOR is a reference model of the supply chain that is able to map the parts of the supply chain which aims to measure the performance of the supply chain itself. The implementation of the SCOR model at certain limits is quite flexible and can be adjusted to increase productivity to meet consumer needs (Darojat & Wuryaningtyas, 2017; Haial et al., 2020). The SCOR model is used to identify supply chain activities carried out at PT.X based on five different management processes, namely plan, source, make, deliver and return from suppliers to consumers, where the processes in the SCOR

model have represented all activities in SCM from upstream to downstream in detail, so as to explain and classify the processes that build the measurement indicators needed in measuring SCM performance. The advantage of SCOR compared to other models is the performance measurement that applies a balance between financial and non-financial factors.

Then the House of Risk (HOR) method is used to identify risks along the PT.X supply chain flow. The HOR method is divided into two phases, phase 1 begins with the process of identifying risks based on activities that have been mapped with the SCOR model. Furthermore, phase 2 by processing the risk agent and risk event matrix to prioritize the source of risk that will be treated, then re-processing the risk cause matrix with preventive action and the final result is the risk mitigation priority as the output of HOR. The approach with the HOR method presents the final result, namely the priority of risk mitigation actions. Broadly speaking, the priority of risk mitigation is only determined by the correlation between preventive action and risk agent, but there are several criteria desired by policy makers in prioritizing risk mitigation actions (Mohsin et al., 2022; Pescaroli, 2018).

Based on the formulation of the problem that has been prepared, this research aims to identify the risks that occur in the supply chain flow at PT. X. In addition, this study also aims to determine an effective risk mitigation strategy to reduce the potential for risks in supply chain activities at PT X. Therefore, it is necessary to conduct research on the supply chain activities of PT.X, especially in the Gresik Production Unit. In identifying risks and designing handling strategies to reduce the probability of occurrence of risk agents by providing preventive measures to risk agents in the supply chain at PT.X which can hinder the supply chain process, the HOR (House of Risk) method is used. Thus it is hoped that the risks faced by PT.X can be overcome properly so as to create sustainable company development towards operation excellence.

Methods

The object of research is supply chain activities at PT X, especially the Gresik production unit, with a focus on risk analysis to determine priorities and mitigation required. Primary data was obtained directly from the source through interviews, questionnaires, and brainstorming, including supply chain activity mapping, risk event data, risk agents, and mitigation priority assessment. Secondary data, such as company annual reports and literature, complemented the primary data and provided additional information.

The data collection process was conducted through direct observation and interviews with PT X workers. The research flow begins with problem identification, followed by literature and field studies, problem formulation, goal setting, supply chain activity mapping using the SCOR method, risk identification and assessment, risk agent prioritization evaluation with Pareto diagrams, and risk mitigation strategy assessment. The analysis and discussion stage compares field results with scientific theory, ending with conclusions and suggestions. Tools such as Microsoft Visio and Excel are used to

support the research, which aims to determine the priority of risk mitigation that should be implemented immediately.

Results and Discussion

Analysis of Risk Identification Results of PT.X

Based on the results of business process mapping with the SCOR model that has been carried out in each PT.X supply chain process both from the supplier stage to the customer. The supply chain process starts with the plan process which includes planning for customer order fulfillment, raw material procurement planning, production planning, and delivery planning. At the customer order fulfillment stage, an agreement is made regarding the design, specifications, and price of the product desired by the customer. Then after there is an agreement between the company and the customer, the company will carry out the production procurement planning stage which is the stage where the company orders the raw materials needed for the production process. This stage is carried out after receiving an order from the customer because PT.X implements a combined production system between Made to Stock (MTS) and Made to Order (MTO) where the company produces products to fulfill stock and based on orders received so that it affects the stock of raw materials owned by the company. The PT.X source process includes receiving raw materials and storing raw materials. In the activity of receiving raw materials, checking the quantity and quality of raw materials sent from suppliers is carried out whether it is in accordance with orders from the Company and in quality conditions in accordance with predetermined specifications. The make process includes the implementation of production activities, inspection of finished products, and storage of finished products. Inspection of finished products is very important considering that the products produced by PT.X are lubricant products that are used both in vehicle engines, industrial machinery and others. In the product delivery process (deliver) is carried out by the delivery method by the TPL (Third Party Logistics) company. In the PT.X return process includes returning finished products from & to the customer and returning raw materials to the supplier.

In the activity of returning finished products from and the customer will be carried out when the customer makes a claim about the defect of the product received. Then the company will take the defective product that has been received by the customer and immediately replace the defective product according to the agreement with the customer.

This is done in order to maintain trust and service to customers. And also if in the receipt of raw materials there is a mismatch between the order and the raw materials that come, the company will immediately return the raw materials to the supplier.

Based on the results of risk identification that has been carried out by interviews and direct observation of the reality of the problems that occur in the company, 32 risk events and 26 risk causes (risk agents) are obtained. In the House of Risk (HOR) phase 1, an assessment of the risk event is carried out based on the level of impact caused (severity) of the risk event and an assessment of the risk agent based on the level of probability of occurrence and the level of correlation or relationship between the risk

agent and the risk event (Hamka et al., 2021). After the assessment, the ARP value is calculated. Of the 26 risk agents that have been assessed, A3 is obtained as the risk agent that has the highest ARP value of 4095. Then testing is done with a pareto diagram that uses the 80/20 principle where 20% of the risk can minimize 80% of the risk occurrence. Based on the tests that have been carried out using pareto diagrams, the 3 largest risk agents are obtained which are explained as follows: (Anvari et al., 2021)

1. Supplier inability to provide raw materials (A3): Supplier inability to provide raw materials is the biggest risk at PT.X with an ARP value of 4095. This risk greatly affects the production process and occurs quite often. The types of products produced by PT.X have many variations, this causes the raw materials needed by the company to also have many and varied types. The same type of product does not necessarily have the same raw material because the specifications of each product are different and for ATPM (Single Agent Brand Holder) customers are made based on the needs or desires of the customer. One example of raw materials that usually experience constraints in supply capability is the main raw material base oil because the supply of base oil is highly dependent on the operation of the Refinery Unit, if the Refinery Unit is experiencing a shutdown then the supply of base oil will be disrupted. This causes a shortage of raw materials so that PT.X must find another supplier who has the desired raw materials. Looking for other suppliers who have the raw materials the company wants is what takes a lot of time for the production process. Often companies get raw materials from locations that are quite far away, for example, companies get imported base oil which causes a long delivery time for raw materials and also requires high shipping costs which burden production costs. Therefore, the inability of suppliers to provide raw materials is the biggest risk agent and causes the following risk events:

Table 1. Impact of Risk agent A3

Code	Risk Event	Explanation
E3	Increase in raw material prices	The inability of suppliers to provide raw materials causes an increase in raw materials, this is because suppliers who usually provide raw materials to the company cannot meet demand so the company must find other suppliers to meet production needs. Often replacement suppliers sell more expensive raw materials.
E4	Running out of raw materials	This problem is also caused by the inability of suppliers to provide raw materials. If raw materials run out, it takes longer for the company to complete orders from customers. Production that exceeds the agreed deadline can have an impact on customer satisfaction, thus worsening the company's image.
E9	Delayed arrival of raw materials	This problem is also caused by the inability of suppliers to provide raw materials in accordance with the wishes of the company, especially the availability of raw materials and the delivery time of raw materials. Usually this delay is caused by

Code	Risk Event	Explanation
		suppliers who are late in sending raw materials to the company or the company must find other suppliers who have the required raw materials. This causes delays in the arrival of raw materials.
E11	Raw material quality is not up to standard	Several times it has happened that the quality of raw materials sent is not in accordance with company standards, for example, base oil raw materials sent OFF SPEC so that the company has to wait for replacement raw materials or in urgent conditions make special treatment that makes production time late
E12	Raw materials that do not arrive according to the order	Sometimes raw materials come not in accordance with the order given, this usually happens to the quantity of goods that come, for example, it happens to the arrival of additive drums, additives that come are less than the order given to the supplier.
E16	Production stops	Raw materials are the most important thing in the production process, if raw materials are not available, the company cannot carry out the production process.
E18	Less raw materials	The lack of raw materials is also caused by the inability of suppliers to provide raw materials in accordance with the required quantity.
E22	Delay in production process	Delays in the production process are caused by many things, one of which is the inability of suppliers to provide raw materials so that raw materials that arrive late cause delays in the production process.
E28	Delayed delivery process	This is the last effect caused by the supplier's inability to provide raw materials. Raw materials that are sent late by the company cause the production process to take longer so that the ordered products will also experience delays in the delivery process.

2. Lack of work supervision (A9): The lack of work supervision is the third largest risk at PT.X which has an ARP value of 3861. The lack of work supervision causes workers to often not do work during working hours. Often workers carry out rest activities during working hours so that they can cause delays in the production of a product. The absence of work supervision also causes workers to carry out activities that they should not do while at work, besides not wearing personal protective equipment in accordance with the SOP when doing quite dangerous work such as not wearing safety hardness when climbing into tanks to take samples, this has the potential to cause work accidents that can be experienced by workers. The following is a risk event caused by the lack of work supervision:

Table 2. Impact of Risk agent A9

Code	Risk Event	Explanation
E13	Raw materials delivered are not checked	Lack of supervision during the arrival of raw materials sometimes makes workers not check the quality and quantity of raw materials sent by the supplier.
E15	Work accident occurs	Work accidents can occur due to weak supervision of workers, causing workers to ignore the rules in doing a risky job.
E17	Raw materials are wasted	The use of raw materials should be done efficiently so as not to burden production costs. In its application, sometimes workers do not use raw materials efficiently, this often happens when putting drum additives into blending tanks, even though they have used an automatic process, there are still additives left in the drum.
E20	Machine/equipment breakdown	Damage to a machine or equipment is caused by a lack of work supervision which makes workers use a machine or equipment available regardless of the applicable SOP.
E21	Delay in production process	Worker indiscipline is also caused by the lack of work supervision which makes workers work not according to the targets that must be achieved at that time, causing the production process to take a relatively long time.
E25	Many defective products	The lack of work supervision in the production line can cause every stage of work carried out not according to procedures so that the products produced have defects.

3. Incompetent labor (A8): Incompetent labor is the second biggest cause of risk at PT.X which has an ARP value of 3822. Incompetent labor can hinder the ongoing production process because workers do not have the skills and experience of what they will do and how they use the available production tools. This is due to the absence of skill requirements needed to apply for existing jobs in the company. For example, a person can work for the company even if they do not have any special skills, so they will be assigned to work stations that do not require special skills. And also, in looking for workers, the company prioritizes partners from workers who have already worked at PT.X and also the surrounding community who do not have jobs. The following is a risk event caused by incompetent labor:

Table 3. Impact of Risk agent A8

Code	Risk Event	Explanation
E2	Contracts are not implemented properly	This problem can also be caused by workers who do not understand the details of the order from the customer so that the contract that has been agreed between the company and the customer is not implemented properly.
E10	Raw material quantity miscalculation	Errors in calculating the amount of raw materials needed usually occur because workers do not understand the details of a product order so that there is an error in conveying information to the owner of the company who later orders raw materials to the supplier.

Code	Risk Event	Explanation
E17	Work accident occurs	Lack of knowledge of the importance of personal protective equipment when doing risky work or workers who do not have experience in using certain tools and machines can cause work accidents. An example of an incident is splashing lubricant products during the filling process to packaging
E21	Machine/equipment breakdown	This problem usually occurs due to workers' ignorance of how to use a machine or tool that can cause damage to the machine or tool.
E22	Delay in production process	Incompetent workers cause the stages of work carried out to take a long time due to lack of work expertise, for example in the work of cleaning tanks or pipe manifolds.
E25	Product checking is not thorough	This problem is also caused by the lack of worker expertise to inspect the finished product whether it is suitable to be sent to consumers or whether improvements are still needed on the product.
E26	Many defective products	Workers' lack of understanding of the steps involved in making a product can cause the product being worked on to be defective.
E27	Product damaged in storage	Sometimes in storing finished products, workers are less careful, resulting in damage to the stored products due to the absence of protection that protects the product, such as leaks in doos caused by forklift forks.

Risk Mitigation Strategy Analysis of PT.X

In phase 2 of the House of Risk, the design of risk mitigation strategies is determined based on prioritized risk agents. Risk mitigation strategy planning is the process of developing options and actions to reduce the impact of risk and reduce the rate of occurrence of a risk. In House of Risk phase 1, the results of 3 priority risk agents with the largest ARP value based on the 80/20 pareto diagram rule were obtained. After determining the risks to be mitigated, the process of planning risk mitigation strategies that can be implemented in the company is carried out. The risk mitigation strategy planning process is based on literature review and discussions with experts in entrepreneurship. Based on these stages, 8 risk mitigation strategies were determined based on 3 risk agents. Meanwhile, to determine the validity of risk mitigation strategies, discussions were held with research subjects to determine the ability to implement risk mitigation which includes readiness in terms of costs and human resources so that after determining the strategies, the prioritization of risk mitigation strategies was carried out. The following are the prioritized risk mitigation strategies based on the results of the House of Risk phase 2 and its explanation:

1. Make a plan in determining alternative suppliers (PA3): Making plans in determining alternative suppliers is one of the ways used to overcome the inability of suppliers to provide raw materials in terms of quality, quantity and arrival time of raw materials. Raw materials are an important component in the production process. Making plans in determining alternative suppliers is done by collecting data related to alternative

suppliers that provide the required raw materials, both the price of raw materials and shipping costs, so that when the raw materials run out the company does not waste time surveying alternative suppliers. The reason for choosing this strategy is that often companies only entrust their raw material needs to raw material suppliers without thinking about existing risks such as raw material unavailability.

2. Conduct skill training and work discipline (PA6): Workers who work at PT.X usually come from local residents and partners of workers who have worked before, therefore not all workers have special skills. The work performed is usually very flexible and does not have a fixed jobdesc. Then the level of worker discipline is considered to be lacking because workers are often found not doing work during working hours and the production floor is messy which often causes work accidents. Therefore, there is a need for skill training and work discipline that aims to improve the quality of human resources and the quality of business from the company.
3. Placement of workers in accordance with expertise (PA8): Placement of workers according to their expertise is considered quite important so that workers can maximize their expertise in order to minimize the risks that might occur. This strategy was chosen because in its implementation there is no clear job description for each worker, so the company must be sensitive enough to the expertise or competence of each worker.
4. Making contracts with suppliers (PA2): The cooperation between suppliers and PT.X is bound by a short contract that must be renewed every certain period, so it is often late to order raw materials because the contract has not been extended. Problems that often occur are delays in the delivery of raw materials, errors in the type of raw materials sent, and stock vacancies of raw materials on the supplier's side. Therefore, a long-term contract is needed that binds cooperation between the company and the supplier to avoid this from happening.
5. Conduct regular supervision (PA4): At PT.X, sometimes workers do not follow the applicable rules. During working hours, workers sometimes do not do work but rest. In addition, many workers do not wear personal protective equipment when working and the production floor is messy, so work accidents often occur due to worker indiscipline. Therefore, regular supervision needs to be implemented so that it is expected to minimize the risks that can occur. Periodic supervision was chosen because it can also be a benchmark for assessing each worker in doing their job so that the company can find out which workers deserve appreciation and workers who must receive a warning.
6. Conducting more selective and strict recruitment of workers (PA7): More selective and rigorous recruitment of workers was chosen because previously the company mostly accepted workers from partners and local residents without considering their skills. This meant that new workers could not immediately carry out activities with specific skills. Therefore, more selective recruitment of workers is needed so that new workers can immediately work professionally and can minimize existing risks.

7. Establishment of standard operating procedures for the Company (PA5): Considering the unclear job descriptions that must be carried out and the lack of discipline of workers, it is important to develop standard operating procedures. Currently, there is a standard operating procedure for each activity, but to improve workers' understanding, a pictorial standard operating procedure will be created. This strategy serves as a work guideline so that worker performance is more directed so that workers will know what to do and what not to do when working. And also the creation of pictorial company operational standards also functions as a work discipline controller with consequences in the form of sanctions, automatically making workers more disciplined in doing their work.
8. Evaluate supplier performance (PA1): Suppliers are an important component in the smooth running of the company's supply chain because they are one of the stakeholders in the supply chain. Supplier performance in providing raw materials is an important assessment in supplier selection, so an evaluation is needed to assess how well each supplier is performing. Supplier performance assessment can be based on the level of quality, quantity, and availability of raw materials.

Cost Benefit Analysis

Table 4. Cost Benefit Analysis

Mitigation Strategy	Mitigation plan	Cost	Positive Impact	Benefit
Make a plan in determining alternative suppliers	1. Conduct a dual supplier procurement system for raw materials used in large quantities 2. Increase the resilience of raw material stocks 3. Raw material contracts are made with price adjustment formula clauses 4. Strategic partnership plan within a certain period	Plan Cost: $20,000.	1. Reduce risks associated with dependence on a single supplier including the risk of supplier bankruptcy, drastic price changes, and supply chain disruptions Alternative suppliers may have different technologies or production methods that can be utilized for product innovation and production process improvements Relationships with multiple suppliers can create a stronger and more stable support network for the company in the long term.	● Procurement Cost Reduction: 10%. ● Annual Expenditure on Procurement: $200,000. ● Savings: $200,000 * 0.10 = $20,000 per year. ● Total Profit in 5 Years: $20,000 * 5 = $100,000. ● ROI (Return on Investment): ($100,000 - $20,000) / $20,000 = 400%.
Conduct skill training and work discipline	1. Make a routine training schedule both external and internal	● Training	1. Skills training and work discipline help employees work more efficiently and effectively, which in turn	● Productivity Improvement: 10%. ● Annual Income: $120,000,000.

Mitigation Strategy	Mitigation plan	Cost	Positive Impact	Benefit
	2. Apple/Briefing before starting work 3. Digitization of inter-shift changeover form	Costs: $30,000 per employee. ● Number of Employees: 600. ● Total Training Cost: $30,000 * 600 = $18,000,000.	increases the overall productivity of the company Employees who feel valued and have the opportunity to grow tend to be more loyal to the company, reducing turnover rates and recruitment costs Employees trained in new skills can bring fresh ideas and innovative solutions, which promote company development and growth	● Profit from Productivity Improvement: $120,000,000 * 0.10 = $12,000,000 per year. ● Total Profit in 5 Years: $15,000,000 * 5 = $60,000,000. ● ROI (Return on Investment): ($60,000,000 - $18,000,000) / $18,000,000 = 233%.
Placement of workers according to expertise	1. Refreshment of worker competencies according to the competency matrix	● Placement Fee: $10,000 per position. ● Number of Positions: 20. ● Total Placement Cost: $10,000 * 20 = $200,000.	1. When workers perform work they are good at, the quality of work tends to be better, reducing errors and resulting in increased customer satisfaction 2. Workers who are experts in their field are faster and more effective in identifying and resolving problems, reducing downtime and increasing operational efficiency.	● Turnover Reduction: 15%. ● Replacement Cost per Employee: $15,000. ● Number of Employees Replaced Each Year: 10. ● Savings from Turnover Reduction: $15,000 * 10 * 15% = $22,500 per year ● Profit from Turnover Reduction in 5 Years: $22,500 * 5 = $112,500.
Establishing long-term contracts with suppliers	1. Make a partnership contract with a longer period 2. Conduct a mandatory audit of the items that have been determined by PT.X before the long-term partnership	● Contract partnership fee: $100,000.	1. Long-term contracts ensure a consistent supply of goods or raw materials, reducing the risk of supply shortages that could disrupt business operations 2. Long-term contracts allow companies to better plan for growth and expansion, as they can rely on consistent support from suppliers.	● Cost Savings: 5% of $1,000,000 = $50,000 per year. ● Profit from Savings in 5 Years: $50,000 * 5 = $250,000. ● ROI (Return on Investment): ($250,000 - $100,000) / $100,000 = 150%

Mitigation Strategy	Mitigation plan	Cost	Positive Impact	Benefit
	contract process 3.		3. Suppliers often offer discounts or incentives to customers willing to sign long-term contracts, which can reduce overall purchasing costs	
Conduct regular supervision	1. Real-time digitization of every quality check point 2. Digitalization of shift change form 3. Anti-counterfeit fight against the circulation of counterfeit products 4.	● Supervision Fee: $3,000,000 per year.	1. By conducting regular surveillance, problems or errors can be detected early before they become larger and more difficult to resolve, thereby reducing repair costs and operational disruptions 2. Regular surveillance ensures that company assets, such as equipment and machinery, are used and maintained properly, which extends the life of the assets and reduces maintenance costs 2.	● Cost Savings: 5% ● Annual operating costs = $30,000,000. ● Penghematan=1,500,000 ● Profit from Savings in 5 Years: $1,500,000 * 5 = $7,500,000. ● ROI (Return on Investment): ($7,500,000 - $3,000,000) / $3,000,000 = 150%
Conduct more selective and rigorous recruitment of workers	1. Recruitment of workers through subsidiaries whose fields are related to human resources 2. Recruitment of workers is prioritized who have experience in the appropriate field or have certification in the appropriate field	● Recruitment Fee: $15,000 per position.	1. Rigorous selection helps ensure that the company gets employees with skills, experience and personalities that match the company's needs and culture Employees who have the right skills and experience will adapt more quickly to new roles and responsibilities.	● Turnover Reduction: 10%. ● Replacement Cost per Employee: $10,000. ● Number of Employees Replaced Each Year: 20. ● Savings from Turnover Reduction: $10,000 * 20 * 10% = $20,000 per year. ● Profit from Turnover Reduction in 5 Years: $20,000 * 5 = $100,000. ● ROI (Return on Investment): ($100,000 - $15,000) / $15,000 = 567%
Establishment of standard	1. Pictorial SOPs that are easily accessible and	SOP Creation	1. Consistency and Quality Standards 2. Well-documented	● Cost Savings: 2% ● Annual operating

Mitigation Strategy	Mitigation plan	Cost	Positive Impact	Benefit
operating procedures	understood by workers, especially operators 2. Review/Creation of checklists related to work activities 3. Digitalization of the SOP review process in the Company to make it easier if there is an update.	Cost: $20,000.	procedures help reduce operational errors and risks as employees follow established steps	costs = $30,000,000. ● Savings=600,000 ● Profit from Savings in 5 Years: $600,000 * 5 = $1,200,000. ● ROI (Return on Investment): ($1,2000,000 - $20,000) / $20,000 = 5900%
Evaluate supplier performance	1. Conduct performance assessment to suppliers based on 5 criteria 2. Annual supplier audits 3. Providing rewards and punishments to suppliers based on performance assessments 3.	Supplier Performance Evaluation Cost: $100,000 per year.	1. Supplier performance evaluation helps ensure that the products received meet the desired quality standards By ensuring consistent and reliable supply quality, companies can better meet customer expectations, increasing customer satisfaction and loyalty Data and information from supplier performance evaluation provide a solid basis for better decision-making regarding supply chain management and supplier selection	● Supply Risk Reduction: 20%. ● Cost of Loss due to Supply Risk: $200,000. ● Savings from Performance Evaluation in 5 Years: $200,000 * 20% = $40,000 per year. ● Profit from Savings in 5 Years: $40,000 * 5 = $200,000. ● ROI (Return on Investment): ($200,000 - $100,000) / $100,000 = 100%

The following is a comparison of the benefits and costs of the mitigation strategies carried out,

Mitigation Strategy	Cost	Profit	% (profit/cost)	Profit Ranking
Make a plan in determining alternative suppliers	20,000	100,000	400%	3
Conduct skill training and work discipline	18,000,000	60,000,000	233%	4
Placement of workers according to expertise	200,000	112,500	-44%	7

Establishing long-term contracts with suppliers	100,000	250,000	150%	5
Conduct regular supervision	3,000,000	7,500,000	150%	5
Conduct more selective and rigorous recruitment of workers	15,000	100,000	567%	2
Establishment of standard operating procedures	20,000	1,200,000	5900%	1
Evaluate supplier performance	100,000	200,000	100%	6

From the CBA study, 3 mitigation strategies were obtained that have the potential to generate large profits with small costs, namely making the Company's standard operating procedures, recruiting more selective and strict workers and making plans in determining alternative suppliers. By carrying out 3 mitigations in the process, it is hoped that it can represent the completion of risk events as a whole.

Conclusion

Based on the results of research that has been conducted at PT.X, it can be concluded as follows: From the results of mapping business process activities based on the SCOR model at PT.X, the plan process includes planning for customer order fulfillment, raw material procurement planning, production planning and delivery planning. The source process includes receiving raw materials and storing raw materials. The make process includes the implementation of production activities, inspection of finished products and storage of finished products. The deliver process includes shipments made by the company and shipments made by logistics providers. The return process includes the return of finished products from and to the customer and the return of raw materials to the supplier. Based on the results of risk identification at PT.X, 32 risk events and 26 risk agents were obtained. Then processed with a pareto diagram through the 80/20 principle which means dealing with 20% of the causes of risk can minimize 80% of the risks that occur at PT.X, based on the 3 largest ARP values, 3 priority risk agents have been determined, namely the inability of suppliers to provide raw materials, lack of work supervision and workforce competence.

Based on the results of the House of Risk, 8 risk mitigation strategies were obtained which were then ranked from the highest to the lowest effectiveness to difficulty value, namely making plans in determining alternative suppliers (PA3), conducting skill training and work discipline (PA6), placing workers according to their expertise (PA8), making contracts with suppliers (PA2), conducting regular supervision (PA4), recruiting more selective and strict workers (PA7) and making standard operating company procedures (PA5). By taking into account the Cost Benefit Analysis (CBA), 3 mitigation strategies were obtained that have the potential to generate large profits at a small cost, namely making the Company's standard operating procedures, recruiting more selective and strict workers and making plans in determining alternative suppliers.

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