ANALISIS DAN MITIGASI MANAJEMEN RISIKO RANTAI PASOK DENGAN MODEL *SUPPLY CHAIN OPERATION REFERENCE* (SCOR) DAN METODE *HOUSE OF RISK* (HOR)

(Studi Kasus: PT. Perkasa Beton *Readymix*)

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Diajukan Sebagai Salah Satu Syarat
Untuk Memperoleh Gelar Sarjana Teknik Pada
Program Studi Teknik Industri

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Dengan ini ku persembahkan sebuah karya untuk Orang Tuaku tercinta

Yang telah meendo'a kan dan memberikan semangat kepada ku untuk menuntut ilmu

Dengan ridho dan do'a mu lah aku bisa menyelesaikan perkuliahan ini

Terimakasih selalu memberi semangat dan motivasi hingga aku bisa mencapai titik ini

Aku akan selalu berusaha untuk membuat Orang Tuaku bangga

Pekanbaru, 06 Juli 2023

Muhammad Hakim Azizan

KATA PENGANTAR

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ANALYSIS AND MITIGATION OF SUPPLY CHAIN RISK MANAGEMENT WITH SUPPLY CHAIN OPERATION REFERENCE (SCOR) MODEL AND HOUSE OF RISK (HOR) METHOD

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Abstract: One of the most important problems faced by companies is how to manage the right supply chain in order to minimize the risks that exist so as to have competitiveness in the industrial era 4.0. The company's problem in managing its supply chain is that it has not maximized the identification of risk sources for suppliers, raw materials, manufacturers, distributors, and consumers. Especially in the concrete production process that experiences risks such as the number of reject products. So that the predetermined production amount is not achieved. This research integrates the SCOR model used for mapping supply chain activities and the HOR method used to identify risks that can be caused and can provide proposals for mitigating these risks. The tools used include pareto diagrams, fishbone, and Probabillity Impact Matrix. The results of the research are 23 handling strategies for 15 dominant risk agents in the 5 main components of the Supply Chain Operation Reference Model so that the position of the danger level of the 15 dominant risk agents has decreased.

1. Introduction

The business competition is indicated by rapid technological developments, short product life cycles, and intensified global competitiveness. So that the development of supply chain management in the industrial world is currently very calculated. Good and correct supply chain management is one of the main focuses of the company to increase competitive selling power so that it can compete in Industry 4.0. Every company wants to make a product that is useful and well received by consumers. One of the indicators that can be used by companies in increasing competitive advantage is by creating an effective supply chain [1].

Perkasa Beton Readymix is a company engaged in concrete manufacturing that produces concrete electric poles, concrete piles, sheet piles, u ditches, box culverts, and other concrete products. The supply chain of Perkasa Beton Readymix Company has 3 flows, namely information flow, material flow, and financial flow. The supply chain of PT Perkasa Beton Readymix starts from the entry of customer purchase orders until the packaging of marketable products is carried out and reaches the customer.

Perkasa Beton Readymix Company has a problem in managing its supply chain. The long supply chain process can cause the company to suffer losses. One of the risks that occur at Perkasa Beton Readymix Company is the lack of identification of risk sources for suppliers, raw materials, manufacturers, distributors, and consumers. Especially in the concrete production process that experiences risks such as the number of reject products. To overcome this problem, Perkasa Beton Readymix Company has provided a tolerance limit of 2%. However, reject products often exceed the tolerance limit. So that the predetermined production amount is not achieved. There are several factors that can affect this, including problems with production machinery, employees who do not perform their duties optimally to various discrepancies contained in the date of production of poles with the facts that occur in the field.

Based on this, this study aims to analyze what things can pose a risk to the company in managing the supply chain by using the SCOR and HOR models these methods can be used to analyze what risks are caused by the supply chain process and can provide prevention efforts against the risks arising from the supply chain process.

Previous research on The results show that there are 36 risk events and 35 risk agents. 19 risk agents are categorized as priority risks and 11 preventive actions are proposed to be implemented by palm oil company. Three mitigation actions include improving the condition of the main garden road, expanding the current warehouse/building a new warehouse, and conducting routine checks on certain periods of the transportation/machinery unit. [2]. Research on there are 9 risk agents chosen from HOR1 and 8 preventive actions for the mitigation. Additionally, this research develop a monitoring system that may assist to monitor the occurring risks [3].

Previous research on the risks and causes of risks will facilitate handling so that supply chain performance can be improved. It is necessary to study appropriate risk mitigation actions so that risk events can be reduced [4].

Using SCOR, HOR and Pareto analysis, 16 mitigation actions were recommended. mitigation actions that are expected to mitigate the supply chain risk of coal hauling equipment trailer products [5]. Research on there are 29 risk events that occur and have the potential to occur which disrupt supply chain activities in the furniture industry. Based on the aggregate risk potential (ARP) value, there are 2 categories of risk sources (risk agents), namely priority risk sources (A) totaling 11 and non-priority risk sources (B) totaling 13 [6].

Previous research on the results of the study found 11 risk agents that became 80% of the problems in operational activities based on the Pareto Diagram. HOR 2 deals with determining the handling strategy of the selected risk sources. of the selected risks [7]. Research Of the 19 identified risk

agents, there are 6 (six) risk-causing agents that cover 80% of the company's risk impact [8].

2. Literature Review

2.1. Supply Chain Management

The supply chain is a network consisting of a series of facilities and distribution that carry out the functions of procuring materials, processing materials into semi-finished goods and final products, and allocating final products to consumers [9].

Supply chain management is an integrated network that provides information system support to management in terms of procuring goods and services for a company, as well as managing relationships between partners, to maintain an optimal level of availability of products and services needed by the company [10].

Managing supply chains involves balancing several different paradoxical tensions, such as those in performance goals, and organization of the supply chain structure and relationships[11].

2.2. SCOR (Supply Chain Operation Reference)

SCOR is used to measure and improve the performance of the total supply chain in a company. The aspects that are included in this model are the assessment of delivery and performance carried out to fulfill demand, production flexibility, assurance, process costs, and other aspects that are influential in assessing the performance of the entire supply chain [12].

SCOR divides the supply chain processes into 5 core processes is plan, source, make, deliver, and return [13]. The explanation of the functions of the five processes in SCOR is:

1. Plan
   Plan is a process that balances demand and supply to determine the best course of action to meet procurement, production, and delivery needs. Plan includes the process of estimating production needs, inventory planning and control, production planning, material planning, capacity planning, and adjusting the supply chain plan with the financial plan [14].
2. Source
   Source is the process of procuring goods or services to fulfill demand. The processes contained in this section are scheduling, shipping from suppliers, receiving, checking, authorizing payment for goods delivered by suppliers, selecting suppliers, evaluating supplier performance, etc. The type of process will differ based on whether the goods purchased are stocked, make-to-order, or engineer-to-order-products [15].
3. Make
   Make is the process that transforms raw materials into products desired by customers. Make activities can be done based on forecast results to meet stock targets (make-to-stock), based on orders (make-to-order), or engineer-to-order. The processes that occur in this section can be in the form of production scheduling, performing production activities, conducting quality testing, managing work-in-process, maintaining production facilities, etc [16].
4. Deliver
   Deliver is the process of fulfilling demand for goods or services. Activities that usually occur such as order management, transportation, and distribution. The processes that occur include handling orders from customers, selecting companies, handling finished product warehousing activities, and sending invoices to customers [17].
5. Return
   Return is the process of returning or accepting the return of products for various reasons. Activities that occur such as identifying product conditions, requesting a defect return authorization, scheduling returns, and making returns [18].

2.3 HOR (House of Risk)

House of risk is a model used as a framework that serves to proactively manage supply chain risks that are integrated between the FMEA model to analyze the level of risk from the calculation of the Risk Potential Number (RPN) with the HOQ model in the process of designing a product strategy to prioritize risk agents and determine the most effective actions against the risks that occur [19].

The models included in the House of Risk (HOR) are divided into 2 is:

2.3.1 HOR (House of Risk) Phase 1

House of Risk 1 serves to determine the priority level of risk agents or causes of risk so that preventive action can be taken [20]. HOR phase 1 can be done by going through the following steps:

1. Identify risk events that can occur in each business process using supply chain process mapping (plan, source, make, deliver, and return) and then identify what is missing or wrong in each process. There is a systematic way to identify and assess risks [21].
2. Assess the impact of several possible risk events (Si) using a scale of 1-10 where a value of 10 indicates extreme impact.
3. Identify the risk agent (Oj) a likelihood value to each risk agent (Oj). The scale set for this is 1-10, where 1 means it almost never happens and 10 means it happens frequently.
4. Develop a relationship matrix, i.e. the relationship between each risk source and each risk event, Rij (0, 1, 3, 9) where 0 indicates no correlation, and 1, 3, 9 represent low, medium, and high correlation respectively.
5. Calculate the risk potential (Aggregate Risk Potential of agent j = ARPj). ARPj is determined as the result of the likelihood of the occurrence of events from risk source j and the collection of causal impacts from each risk source caused by risk source j as in the following equation [22]:

$$ARP_j = O_j \sum S_i R_{ij} \quad (1)$$

6. Ranking risk sources based on the set of potential risks in order from greatest to lowest value. Details of Models of HOR Phase 1 can be seen in Table 1.

Table 1 Models of HOR Phase 1

Business process	(Ei)	Risk Agent (Aj)					Si
		A_1	A_2	A_3	A_4	A_5	
Plan	E1	R_{11}	R_{12}	R_{31}			S_1
	E2	R_{21}	R_{22}	R_{32}			S_2
Source	E3	R_{31}	R_{32}				S_3
Make	E4	R_{41}	R_{33}				S_4
	E5	R_{51}					S_5
Deliver	E6						S_6
	E7						S_7
Return	E8						S_8
Oj		O_1	O_2	O_3	O_4	O_5	
ARPj		ARP_1	ARP_2	ARP_3	ARP_4	ARP_5	
Rank							

2.3.2 HOR (House of Risk) Phase 2

House of Risk 2 serves to prioritize what strategies need to be mitigated and it is considered effective in decision making. Steps of HOR Phase 2 is [23]:

i. Select a number of risk sources with the highest priority ranking, which may be using Pareto diagram analysis of ARPj, stated in HOR phase 2.
ii. Identify actions deemed relevant to prevent the source of the risk.
iii. Determine the relationship between each countermeasure and each risk source, Ejk. This relationship is expressed by a value of (0, 1, 3, 9) which indicates, respectively, no correlation, low-medium, and high correlation between measure k and source j.
iv. Calculate the total effectiveness (TEk) of each action is:

$$TE_k = \sum ARP_j E_{jk} \quad (2)$$

v. Estimate the degree of difficulty (Dk) in performing each action. The degree of difficulty is indicated by a value scale of 1 representing very easy and 5 representing very difficult.
vi. The total value of the effectiveness to difficulty ratio (ETDk) is calculated:

$$ETD_k = \frac{TE_k}{D_k} \quad (3)$$

7. Assign the highest priority rank to each action (Rk) where rank 1 indicates the highest ETDk action. Details of Models of HOR Phase 2 can be seen in Table 2.

Table 2 Models of HOR Phase 2

Aj	Preventive Action (PA_k)					Si
	PA_1	PA_2	PA_3	PA_4	PA_5	
A_1	E_{11}					S_1
A_2		E_{22}				S_2
A_3			E_{33}			S_3
A_4				E_{44}		S_4
A_5					E_{55}	S_5
TEk	TE_1	TE_2	TE_3	TE_4	TE_5	
Dk	D_1	D_2	D_3	D_4	D_5	
ETDk	ETD_1	ETD_2	ETD_3	ETD_4	ETD_5	
Rank						

Severity is used to analyze and calculate the risk of how likely the impact arising from a failure that results in a failure effect [24]. Occurance is the level of frequency occurrence of damage or failure that calculates the chance level occurrence of a risk agent (A) [25].

The real impact of the risk can be measured quantitatively in lost revenue, the cost to repair the system, or the level of effort required to fix the problem caused by a successful threat action [26].

2.4 Probability Impact Matrix

Probability impact matrix is a method used to qualitatively analyze the likelihood of a risk occurring. The assessment of risk is based on the opportunity or probability and the consequences or benefits obtained [27].

Table 3 Risk Assessment Level

Level	(*Severity*)	(*Occurrence*)	Conversion Scale
1-Very Low (VL)	1-4	1-4	0-20%
2-Low (L)	5	5	20-40%
3-Moderate (M)	6	6	40-60%
4-High (H)	7-8	7-8	60-80%
5-Very High (VH)	9-10	9-10	80-100%

Table 4 Probability impact matrix

Occurrence	*Severity*				
	1–VL	2–L	3–M	4–H	5–VH
5 – VL					
4 – H					
3 – M					
2 – L					
1 – VL					

3. Methods

This research is descriptive research with survey techniques and uses quantitative and qualitative approaches [28]. The research used the stages of risk identification, risk analysis, risk evaluation, and risk mitigation [29]. The identification stage to the evaluation stage uses the House of Risk 1 model (HOR 1), while the mitigation stage uses the HOR 2 model [30].

The quantitative approach in this study is used for the calculation of ARP on risk sources, the calculation of Total Effectiveness of Action (TEk), and the calculation of Effectiveness to Difficulty Ratio (ETDk) on supply chain risk mitigation (HOR 2) in The Company of Perkasa Beton Readymix.

4. Results and Discussion

The first step in determining what risks exist in the supply chain activities at Perkasa Beton Readymix Company is to map the supply chain activities that have been obtained based on the risk identification of each business process in the form of plan, source, make, deliver, and return processes. After conducting the mapping stage using the SCOR model of supply chain activities in the company and identify the risks activities in Table 5 and risk agents in Table 6 of each business process, phase 1 house of risk data processing is carried out in each business process. This is followed by data processing of the house of risk phase 2 which aims to determine the best strategy for handling the risks in each business process at Perkasa Beton Readymix Company.

4.1 Supply Chain Activity Mapping to Risk Event and Risk Agent Identification 5 Key Components of SCOR

Identification of risk sources in the 5 main components of the SCOR model begins with mapping supply chain activities and identifying risks in business processes. There are 2 stages carried out to identify the 5 main components of the SCOR model, namely through interviews and filling out questionnaires by experts. The selected experts are experts related to the field to be studied.

Table 5 SCOR Mapping and Risk Identification in the Plan, Source, Make, Deliver, and Return Processes

SCOR	Activity	Risk Event	Code	Severity (Si)
Plan	Raw Material Procurement Planning	Delayed arrival of raw materials	E1	7
		Gap between available raw materials	E2	7
	Machine maintenance plan	Machine maintenance scheduling error	E3	6
	Production planning	Production quantity planning error	E4	8
		Sudden change in production plan	E5	7
	Distribution Planning	Delays in the supply of finished products	E6	7
Source	Procurement process	Suppliers cannot fulfill raw material needs	E7	7
		Logistics department mistakes in inspecting raw materials	E8	7
		Delayed arrival of raw materials	E9	8
	Supplier selection and contract	Mismatch in the number of requests to suppliers	E10	6
	Selection of raw materials according to standards	Difficulty in obtaining raw materials according to standards	E11	7
		Low capability of suppliers in meeting the quality of raw materials	E12	7
Make	Production is carried out according to plan	Unexpected demand from customers	E13	7
		Lack of raw material stock	E14	6
		Delay in production process	E15	7
		Production defects	E16	7
	Production process	Worker indiscipline	E17	6
		Worker's hand was pinched during the installation of the stressing tool	E18	8
	Quality inspection of finished products	Inspection of products is not thorough enough	E19	7
Deliver	Raw material arrival	Delayed arrival of raw materials	E20	7
	Product Delivery	Product damage during the product	E21	7

		delivery process		
		Delay in product delivery	E22	6
		Product pickup is not in accordance with the promised time	E23	6
	Product availability data information	Misinfor-mation about product availability data	E24	7
	Return of raw materials to suppliers	Delayed replacement of raw materials	E25	6
Return	Product Returns	The quality of the product is not in accordance with the wishes of the customer	E26	7

Table 6 List of Risk Agents and Occurrence Assessment of Plan, Source, Make, Deliver, and Return Processes

Business process	Code	Risk Agent	Occurrence
Plan	A1	Fluctuating number of product requests	7
	A2	The unpredictability of delivery time by expeditions	6
	A3	Shortage of raw material stock in the warehouse	5
	A4	Less intensive communication with suppliers	6
	A5	Machine maintenance planning errors	7
	A6	Supplier's inability to provide raw materials in quantity	6
	A7	Human error	7
Source	A8	Price mismatch with raw material quality	7
	A9	Suppliers experience obstacles when distributing raw materials	6
	A10	Raw materials below standard quality	7
	A11	Quality inspection errors during the raw material loading process	6
Make	A12	Poor warehouse management	6
	A13	Worker fatigue	8
	A14	Workers do not care about OHS	8
	A15	Delayed production process	7
	A16	Lack of coordination between the production department and the administration department	6
	A17	Quality Control of products is not good	7
	A18	Finished products are not in accordance with the order	6
	A19	The machine does not work optimally	7
	A20	Less capable workers	6
Deliver	A21	Bad weather	7
	A22	Poor road conditions	5
	A23	There is a shortage of raw materials	7
	A24	Product packaging is not good	7
Return	A25	Communication with customers is less intensive	8
	A26	Products that do not meet quality standards quality standards	7
	A27	Replacement of defective products	7

4.2 Potential Risk-Causing Events 5 Key Components of the SCOR Model With HOR Phase 1

Based on the calculations in HOR phase 1, 15 dominant risk agents were obtained from the 5 main components of the SCOR model. The recapitulation of the dominant risk agents of the 5 main components of the SCOR model before handling in Table 7.

Table 7 Summary Dominant *Risk Agent* 5 Main Components SCOR Model

Business Process	R	C	Risk Agent	ARP	O	S
Plan	1	A7	human error	1911	7	8
	2	A1	Fluctuating number of product requests	1827	7	7

	3	A2	Uncertainty time delivery by expedition	882	6	7
	1	A11	Error inspection quality during the loading process raw	1. 134	6	7
Source	2	A8	No accordingly price with quality material raw	882	7	7
	1	A20	Worker not enough competent	1. 512	6	7
	2	A17	Quality Control of product not enough Good	1.470	7	7
	3	A14	Worker not enough care against K3	1.176	8	6
Make	4	A13	Worker fatigue	1080	8	7
	5	A16	Lack of coordination between part production with part administration	1080	6	7
	6	A19	The machine does not work optimally	882	7	7
	1	A24	Product packaging not enough Good	1. 134	6	7
Deliver	2	A22	Condition road not enough Good	882	7	7
	1	A25	Communication with customer not enough intensive	1080	8	6
Return	2	A26	Products that are not fulfil standard specified quality	744	8	7

Table 8 shows the results of the recapitulation of the risk map before handling of the 5 main components of the SCOR.

Table 8 Recapitulation of Risk Maps Before Handling of the 5 Main Components of the SCOR Model

Occurrence	*Severity*				
	1–VL	2–L	3–M	4–H	5–VH
5–VH				A7, A1,A8, A17, A19, A16, A13, A22, A26	
4–H			A14, A25		
3-M					A2, A11, A20, A24
2–L					
1–VL					

Table 9 describes the description of the risk matrix of the 15 selected dominant risk sources before handling and the recapitulation of HOR phase 1 can be found in table 10.

Table 9 Summary Matrix Risk Dominant 5 Main Components SCOR Model

No	*Risk Agent*	C	S	O	*Matrix Zone*	R
1	*Human error*	A7				1
2	Fluctuating number of product requests	A1				2
3	Workers not enough competent	A20				3
4	*Quality Control* of product not enough Good	A17				4
5	Workers do not care enough about OHS	A14				5
6	Error inspection quality during the *loading* process raw	A11				6
7	Worker fatigue	A13				7
8	Lack of coordination between part production with part administration	A16				8
9	Communication with customers is not intensive enough	A25				9
10	Product packaging is not enough Good	A24				10
11	Condition road not enough Good	A22				11
12	Uncertainty time delivery by expedition	A2				12
13	No accordingly price with quality material raw	A8				13
14	The machine does not work optimally	A19				14
1 5	Products that do not fulfil standard specified quality	A26				1 5

Table 10 HOR Phase 1

Risk Agent (A)	Risk Event (E)																									ARP	Rank
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	
A1		9		9	9	9																					1.827	2
A2	9	9				3																					882	10
A3	9	9																									630	13
A4	9																										378	19
A5						3																					525	16
A6	3	3			1																						294	20
A7		9		9	3	9																					1.911	1
A8											9	9															882	10
A9							3		3	9																	594	14
A10								9																			441	18
A11								9			9	9															1.134	6
A12														9	9												702	12
A13													9					9									1.080	7
A14																3	9	9									1.176	5
A15													3		9	3											693	12
A16													9	9	9												1.080	7
A17													3		9	9			9								1.470	4
A18													3		3	3			3								504	17
A19															9	9											882	10
A20																9	9	9	9								1.512	3
A21																				9		3					567	15
A22																				9	9	9					900	9
A23																				9							441	18
A24																					9		3	9			1.008	8
A25																									9	9	1.080	7
A26																									9	3	744	11
A27																										9	441	18

4.3 Improvement Recommendations for Handling Risk Sources 5 Main Components of the SCOR Model with HOR phase 2

Recommendations for improving the handling of risk sources for the 5 main components of the SCOR model are made by creating a phase 2 HOR table for each component. The recommendations for improvement handling strategy can be seen in Table 11. The recapitulation of the selected dominant risk agents along with the handling strategy for each business process presented in Table 12.

Table 11 Handling Strategy and Difficulty Rating Scale for the 5 Main Components of the SCOR Model

Business process	Code	Handling Strategy	Dk
Plan	PA1	Make plan production period long (MRP)	3
	PA2	Handling *demand* and *forecasts* for orders	3
	PA3	Update customer requests regularly	3
	PA4	Provide an additional fee for each order change	4
	PA5	More intense communication between production and administration	3
	PA6	Confirm the agreement that has been made with the parties expedition	4
	PA7	Make stock additions	3
Source	PA8	Looking for new *suppliers*	3
	PA9	Make agreements with *suppliers* regarding the quality of raw materials	4
	PA10	Improving performance evaluation and periodic coordination related to raw materials	3
	PA11	Create a *maintenance schedule*	3
	PA12	Make *a check sheet* at each workstation	4
	PA13	Perform regular and periodic *maintenance*	4
	PA14	Affirmation and refinement of work SOPs	5
Make	PA15	Conduct regular *training in the production department*	4
	PA16	Employee performance evaluation	3
	PA17	Providing *rewards* and *punishments* to workers	3
	PA18	Assessing the effectiveness of production machines	3
	PA19	Look for alternative material delivery routes	4
Deliver	PA20	Increase the durability and strength *of packaging*	3
Return	PA21	Strengthening the memorandum of understanding with consumers	3
	PA22	Tighten QC system	3
	PA23	More intense communication with consumers	3

Table 12 Recapitulation Dominant *Risk Agent* and Strategy Handling

BP	R	Risk Agent	ARP	Oj	Si	Strategy Handling	Dk
Plan	1	A7	1911	4	5	PA2	3
						PA5	3
	2	A1	1827	6	5	PA1	3
						PA3	3
						PA4	4
	3	A2	882	3	3	PA6	4
						PA7	3
Source	1	A11	1.134	3	2	PA10	3
	2	A8	882	2	2	PA8	3
						PA9	4
	1	A20	1.512	3	2	PA15	4
	2	A17	1,470	3	4	PA12	4
	3	A14	1.176	6	4	PA14	5
Make	4	A13	1080	4	5	PA17	3
	5	A16	1080	2	3	PA16	3
						PA11	3
	6	A19	882	5	5	PA13	4
						PA18	3
Deliver	1	A24	1.134	2	2	PA20	3
	2	A22	882	3	4	PA19	4
Return	1	A25	1080	3	4	PA21	3
						PA23	3
	2	A26	744	4	5	PA22	3

The results of the recapitulation of the risk map of the 5 main components of the SCOR model after the handling strategy can be seen in Table 13 and the recapitulation of HOR phase 2 is displayed in Table 14. Describes about the description of the risk matrix of the 15 selected dominant risk sources after handling can be seen in Table 15.

Table 13 Recapitulation of Risk Maps After Handling of the 5 Main Components of the SCOR Model

Occurrence	*Severity*				
	1–VL	2–L	3–M	4–H	5–VH
5–VH					
4 – H					
3–M	A14	A1 A19			
2–L					
1–VL	A2, A11, A8, A20, A17, A16, A24, A22, A25,	A7, A13, A26			

Table 14 HOR Phase

Management strategy (PA)	Risk Agent (A)															TEK	ETD	Rank	Dk
	7	1	2	11	8	20	17	14	13	16	19	24	22	25	26				
PA1		9	3													19.089	6.363	8	3
PA2	3	9	3													24.822	8.274	5	3
PA3		9														16.443	5.481	11	3
PA4		9														16.443	4.110,75	15	4
PA5	9	9	9													41.58	13.86	2	3
PA6			9													7.938	1.984,5	20	4
PA7		9	9													24.381	8.127	6	3
PA8				3	9											11.34	3.78	16	3
PA9				9	9											18.144	4.536	14	4
PA10				9	9											18.144	6.048	9	3
PA11							9				9					21.168	7.056	7	3
PA12							9									13.23	8.274	5	4
PA13							9				9					21.168	5.292	13	4
PA14						3	9	9								28.35	5.67	10	5
PA15						9	9		9							36.558	9.139,5	4	4
PA16						9	9	9	9	9						56.862	18.954	1	3
PA17						9	3	9	9	3						41.562	13.854	3	3
PA18											9					7.938	2.646	18	3
PA19													9			7.938	1.984,5	20	4
PA20												9	9			18.144	6.048	9	3
PA21														9	9	16.416	5.472	12	3
PA22															9	6.696	2.232	19	3
PA23														9		9.72	3.24	17	3
ARP	911	1.827	882	1.134	882	1.512	1.470	1.176	1.080	1.080	882	1.134	882	1.080	744				

Table 15 Recapitulation of Risk Matrix After Handling of the 5 Main Components of the SCOR Model

No	*Risk Agent*	C	S	O	*Matrix Zone*	R
1	*human error*	A7				1
2	Fluctuating number of product requests	A1				2
3	Workers not enough competent	A20				3
4	*Quality Control* of product not enough Good	A17				4
5	Workers do not acare enough about OHS	A14				5
6	Error inspection quality during the *loading* process raw	A11				6
7	Worker fatigue	A13				7
8	Lack of coordination between part production with part administration	A16				8
9	Communication with customers is not intensive enough	A25				9
10	Product packaging is not enough Good	A24				10
11	Condition road not enough Good	A22				11
12	Uncertainty time delivery by expedition	A2				12
13	No accordingly price with quality material raw	A8				13
14	The machine does not work optimally	A19				14
15	Products that do not fulfil standard specified quality	A26				1 5

5. Conclusion

The findings of the research revealed the recommendation of 23 handling strategies for the 15 dominant risk agents across the 5 main components of the Supply Chain Operation Reference Model. Through the implementation of these strategies, the level of danger associated with the 15 dominant risk agents was observed to decrease. This outcome indicates the effective utilization of the SCOR model and House of Risk methodology in identifying and mitigating risks within the supply chain of Perkasa Beton Readymix Company.

The conclusion is this research demonstrates that the application of the SCOR model and the House of Risk method can serve as effective approaches in supply chain risk management. By identifying risk sources, analyzing potential risk-causing events, and designing appropriate handling strategies, companies can reduce risks associated with their business processes. The improvement recommendations resulting from this study can serve as guidance for Perkasa Beton Readymix Company in enhancing their risk management practices and optimizing their supply chain performance.

In facing the diverse challenges within the supply chain, it is crucial for companies to prioritize risk management. By understanding and addressing risks that arise in each main component of the supply chain, companies can enhance efficiency, minimize losses, and achieve competitive advantages. Therefore, this research makes a significant contribution to the field of supply chain risk management and can serve as a reference for other companies facing similar challenges.

6. Reference

[1] F. Jiroyah and N. Muflihah, "Integrasi Model SCOR dan House of Risk Untuk Menentukan Mitigasi Risiko Supply Chain Management pada Proses Produksi (Studi Kasus di CV. Ar Rouf)," *J. Ind. Teknol. SAMAWA*, vol. 3, no. 2, pp. 101–109, 2022.

[2] S. Kurniawan, D. Marzuky, R. Ryanto, and V. Agustine, "Risk and supply chain mitigation analysis using house of risk method and analytical network process," *The Winners*, vol. 22, no. 2, pp. 123–136, 2021.

[3] M. F. R. Dewantari, A. Y. Ridwan, and H. K. Pambudi, "Design mitigation and monitoring system of blood supply chain using SCOR (supply chain operational reference) and HOR (house of risk)," in *IOP Conference Series: Materials Science and Engineering*, IOP Publishing, 2020, p. 12058.

[4] D. Wahyuni, A. H. Nasution, I. Budiman, and N. Arfidhila, "Halal Risk Analysis at Indonesia Slaughterhouses Using the Supply Chain Operations Reference (SCOR) and House of Risk (HOR) Methods," in *Journal of Physics: Conference Series*, IOP Publishing, 2020, p. 12001.

[5] M. Ulfah, "Mitigasi risiko rantai pasok bar mill dan section mill menggunakan model house of risk," *J. Ind. Serv.*, vol. 4, no. 1, 2018.

[6] M. Ulfah, "Mitigasi risiko rantai pasok industri furniture dengan menggunakan metode house of risk di IKM Sinar Muda," *J. Ind. Serv.*, vol. 7, no. 1, pp. 93–99, 2021.

[7] I. Syahputra and A. A. Syarif, "Analisis Resiko Supply Chain Menggunakan Metode House Of Risk (HOR) Pada PT. Sumber Sawit Makmur," *J. Al Ulum LPPM Univ. Al Washliyah Medan*, vol. 10, no. 2, pp. 67–74, 2022.

[8] D. A. Sasongko, "Analisis Risiko dan Strategi Aksi Mitigasi pada Usaha Penjualan Mesin Teknologi Tepat Guna dengan Metode House of Risk (Studi

Kasus: Toko Sedia Mesin)," IENACO (Industrial Engineering National Conference) 6 2018, 2018.

[9] D. A. Lasse, "Manajemen Muatan Aktivitas Rantai Pasok di Area Pelabuhan," *Jakarta. Rajawali Pers*, 2012.

[10] R. Magdalena and V. Vannie, "Analisis Risiko Supply Chain Dengan Model House of Risk (Hor) Pada Pt Tatalogam Lestari," *J@ ti Undip J. Tek. Ind.*, vol. 14, no. 2, pp. 53–62, 2019.

[11] C. K. Hillmer, S. Roden, E. Vanpoucke, B. Son, and M. W. Lewis, "Radical innovations as supply chain disruptions? A paradox between change and stability," *J. Supply Chain Manag.*, 2023.

[12] R. R. Chotimah, B. Purwanggono, and A. Susanty, "Pengukuran kinerja rantai pasok menggunakan metode SCOR dan AHP pada unit pengantongan pupuk urea PT. Dwimatama Multikarsa Semarang," *Ind. Eng. Online J.*, vol. 6, no. 4, 2018.

[13] A. Defriyanti and D. Ernawati, "Analisis dan Mitigasi Risiko Pada Supply Chain dengan Pendekatan Metode House Of Risk (HOR) di PT. XYZ," *JUMINTEN*, vol. 2, no. 6, pp. 36–47, 2021.

[14] D. Apriyani, R. Nurmalina, and B. Burhanuddin, "Evaluasi Kinerja Rantai Pasok Sayuran Organik dengan Pendekatan Supply Chain Operation Reference (SCOR)," *Mix J. Ilm. Manaj.*, vol. 8, no. 2, pp. 312–335, 2018.

[15] R. A. O. Hariyono, A. Y. Ridwan, and F. Yulianti, "PERANCANGAN MITIGASI RISIKO PADA GUDANG BAHAN BAKU KEMASAN DENGAN MENGGUNAKAN METODE FAILURE MODE AND EFFECT ANALYSIS DAN ANALYTICAL HIERARCHY PROCESS," *Telkatika J. Telekomun. Elektro Komputasi Inform.*, vol. 1, no. 2, 2022.

[16] A. Chopra, D. Golwala, and A. R. Chopra, "SCOR (SUPPLY CHAIN OPERATIONS REFERENCE) MODEL IN TEXTILE INDUSTRY," *J. Southwest Jiaotong Univ.*, vol. 57, no. 1, 2022.

[17] E. Nugraha and R. M. S. A. Yunan, "Development Strategies Analysis Using the SCOR Method: A Case Study from a Medical Device Company," 2022.

[18] G. E. Delipinar and B. Kocaoglu, "Using SCOR model to gain competitive advantage: A Literature review," *Procedia-Social Behav. Sci.*, vol. 229, pp. 398–406, 2016.

[19] M. Rozudin and N. A. Mahbubah, "Implementasi Metode House Of Risk Pada Pengelolaan Risiko Rantai Pasokan Hijau Produk Bogie S2HD9C (Studi Kasus: PT Barata Indonesia)," *JISI J. Integr. Sist. Ind.*, vol. 8, no. 1, pp. 1–11, 2021.

[20] J. A. Hadi, M. A. Febrianti, G. A. Yudhistira, and Q. Qurtubi, "Identifikasi risiko rantai pasok dengan metode house of risk (HOR)," *Performa Media Ilm. Tek. Ind.*, vol. 19, no. 2, 2020.

[21] D. A. Wibowo and E. Ahyudanari, "Application of house of risk (HOR) models for risk mitigation of procurement in the Balikpapan Samarinda Toll Road Project," *IPTEK J. Proc. Ser.*, no. 1, pp. 172–177, 2021.

[22] W. N. Tanjung, R. S. Khodijah, S. Hidayat, E. Ripmiatin, S. A. Atikah, and S. S. Asti, "Supply chain risk management on wooden toys industries by using house of risk (HOR) and analytical network process (ANP) method," in *IOP Conference Series: Materials Science and Engineering*, IOP Publishing, 2019, p. 12086.

[23] M. Marimin and M. I. Muzakki, "PENINGKATAN KINERJA DAN MITIGASI RISIKO RANTAI PASOK AGROINDUSTRI NANAS DI PT GREAT GIANT PINEAPPLE," *J. Teknol. Ind. Pertan.*, vol. 31, no. 2, pp. 153–163, 2021.

[24] F. Hendra and R. Effendi, "Identifikasi Penyebab Potensial Kecacatan Produk dan Dampaknya dengan Menggunakan Pendekatan Failure Mode Effect Analysis (FMEA)," *SINTEK J. J. Ilm. Tek. Mesin*, vol. 12, no. 1, pp. 17–24, 2018.

[25] D. I. Situngkir, "Pengaplikasian FMEA untuk mendukung pemilihan strategi pemeliharaan pada paper machine," *FLYWHEEL J. Tek. Mesin Untirta*, vol. 1, no. 1, pp. 39–43, 2019.

[26] H. T. I. Driantami and A. R. P. Suprapto, "Analisis Risiko Teknologi Informasi Menggunakan ISO 31000 (Studi kasus: Sistem Penjualan PT Matahari Department Store Cabang Malang Town Square)," *J. Pengemb. Teknol. Inf. dan Ilmu Komput. e-ISSN*, vol. 2548, p. 964X, 2018.

[27] F. Lestari, A. Mas'ari, S. Meilani, I. N. Riandika, and A. B. A. Hamid, "Risk mitigation via integrating house of risk and probability impact matrix in halal food supply chain," *J. Tek. Ind.*, vol. 22, no. 2, pp. 138–154, 2021.

[28] Y. Nursyanti, "Penentuan Penyedia Jasa Trucking di PT Yicheng Logistics Dengan Menggunakan Metode SAW (Simple Additive Weighting)," *J. Teknol. dan Manaj. Ind. Terap.*, vol. 1, no. 3, pp. 210–222, 2022.

[29] A. A. Purba, M. L. Hamzah, and M. Rizki, "Risk Mitigation to Minimize Distribution Delays and Empty Stock at Industrial Jakarta Gas Station," in *2022 International Conference on Data Analytics for Business and Industry (ICDABI)*, IEEE, 2022, pp. 1–5.

[30] S. Ratnasari, M. Hisjam, and W. Sutopo, "Supply chain risk management in newspaper company: House of risk approach," in *AIP Conference Proceedings*, AIP Publishing LLC, 2018, p. 30016.

Letter of Acceptanced

Dear Mr. Muhammad Hakim Azizan:

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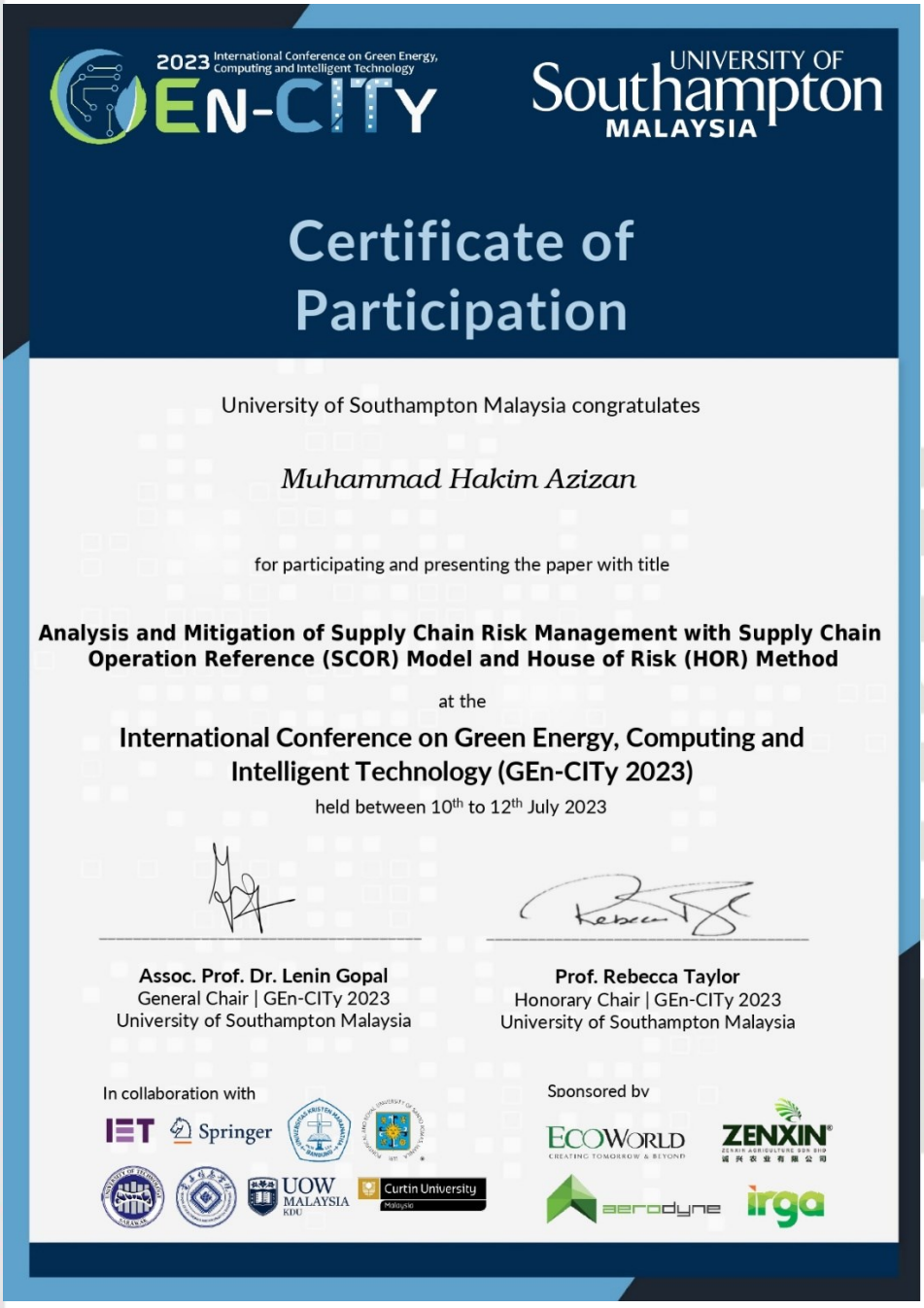

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