



## Operational Supply Chain Risk Management on Apparel Industry Based on Supply Chain Operation Reference (SCOR)

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### Abstract

The occurrence of uncertainty requires proper handling to avoid the adverse effects called risk. Risk tends to arise in the supply chain process called supply chain risk. The purpose of this research is to identify the possible level of risk that occurs and has the potential to disrupt supply chain activities, determine priority risk sources based on Supply Chain Operation References (SCOR). The object of this research is the apparel industry, which is a company engaged in fashion and apparel production. This study uses a qualitative and quantitative approach, the value of the instrument is assessed based on the results of the Aggregate Risk Potential (ARP) calculation in the House of Risk method phase 1. The results showed that there were 39 correlations between risk events and risk agents, with 22 correlations with a high scale and 1 correlation with a low scale, and 15 correlations on a medium scale.



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## 1. Introduction

The industrial world is increasing, giving rise to problems that often occur, namely uncertainty in business processes. Uncertainty in business process activities is often found in all aspects of business activities. The occurrence of uncertainty requires appropriate handling to avoid adverse effects, which are called risks [1]–[4]. Risk tends to arise in the supply chain process called supply chain risk. Supply chain risk is an event that has a negative impact on business processes caused by damage or disruption [5], [6]. Supply chain risk is an event that has a negative impact on business processes caused by damage or disruption [7]–[10]. There are several risk factors in the supply chain in the industrial world [11], [12], including the occurrence of losses in the procurement of raw materials and the supply of raw materials not according to the company's request [13]–[16]. In addition, there are factors that influence risk [17]–[19], including problems with production results that are not in line with targets, to delays in product delivery to consumers [20], [21]. Therefore, it is important for companies to plan a concept

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recommendation to address supply chain risks [1], [22], [23]. In risk management, there are 5 supply chain risk management processes including risk identification [24], risk measurement [22], risk mapping [25], developing alternative risk management and monitoring and controlling risk management [1], [26], [27].

The industry that the writer will examine is the apparel industry in Indonesia, which is a company engaged in fashion and apparel production [28]–[30]. Along with consumer demand and fashion retail, which is followed by rapid technological developments, providing convenience for transactions. According to [31] fashion brands Adidas, Benetton, C&A, Levi Strauss, and Nike, in recent years there have been risks in terms of safety issues in factories and minimum wages for employees causing concern for company owners.

Research related to sustainability by [32] conducting case studies in the food industry applied in Indonesia based on Supply Chain Operations Reference (SCOR) [33]–[37]. Research of supply chain risk management by using the House of Risk model [38], [39] to determine priorities for handling strategies based on SCOR [9], [40], [41].

This study aims to identify the possible level of risk that occurs and has the potential to interfere with supply chain activities, determine priority risk sources based on the Supply Chain Operation Reference (SCOR) using the House of Risk method based on the ARP or Aggregate Risk Potential [42] value.

## 2. Method

In this study using descriptive techniques with qualitative and quantitative approaches. Descriptive research in this study aims to provide an overview of events in the present and the past [43]. The stage of this research can be shown in Figure 1.

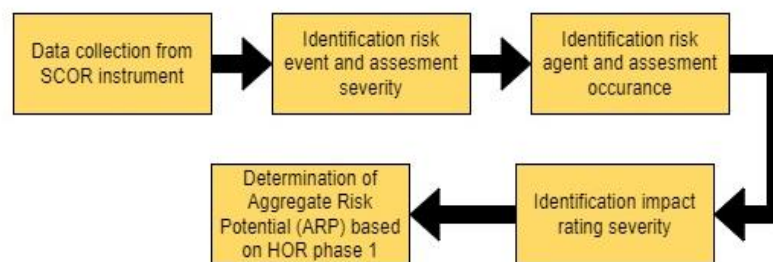


Figure 1. Stage of research using SCOR approaches

The survey technique in this study uses a questionnaire as a research instrument that is used to determine the value of the severity of risk (severity) [44], the value of the frequency of events from the source of risk (occurrence), and the value of the correlation between risk events (risk event) and the source of risk (risk agent) in HOR phase 1 [45]–[47].

The qualitative approach in this study was used to conduct interviews through questionnaires distributed online to the company. The quantitative approach in this study is used to calculate the Aggregate Risk Potential (ARP) [48], [49] at the source of the risk.

The Aggregate Risk Potential (ARP) is based on the HOR phase 1 [50]. At this stage, the experts assessed the correlation between the risk event and the risk agent. The proposed correlation value was on a scale of 0 (no correlation), 1 (low correlation), 3 (medium correlation), and 9 (high correlation). Furthermore, the results of this assessment were used to determine ARP. The ARP was calculated based on the formula presented in equation (1).

$$ARP_j = O_j \sum_i S_j + R_{ij} \quad (1)$$

Furthermore, determine the severity and occurrence values at the risk level, determined by the level and scale, can be seen in Table 1.

Table 1. Severity and occurrence value to risk level

Level	Severity	Occurance	Scale
Very Low	1-4	1-4	0-20%
Low	5	5	20-40%
Moderate	6	6	40-60%
High	7-8	7-8	60-80%
Very High	9-10	9-10	80-100%

The risk value level is determined and calculated based on the results of the distribution of questionnaires to apparel company members based on SCOR mapping.

### 3. Results and Discussion

#### 3.1. Risk event identification analysis

Assessment of risk events (risk event) gives a rating to find out how big the impact is, or the severity of each risk event based on the severity scale. The level of severity or severity of risk is presented in Table 2.

Table 2. Severity value of Apparel Industries supply chain risk events

Business Process	Sub Process	Risk Event	Code	Severity
Plan	Production planning	Sudden changes in production planning	E1	6
		Uncertainty of orders from consumers	E2	6
	Purchase of raw materials	Raw materials are not met by the supplier	E3	8
		Unavailability of raw materials from suppliers	E4	6
		The supplier sends the goods outside the request	E5	6
Source	Receipt and inspection of raw materials	Delay in arrival of raw materials	E6	5
		The quality of the raw materials does not match the demand	E7	5
	Raw material storage	There was damage to the raw material of the fabric	E8	6
		Termites eat cloth raw materials	E9	8
		Over stock of raw materials	E10	4
Make	Production Process Implementation	Size error on the product made	E11	6
		Defective/damaged/inappropriate product	E12	5
	Production control	The production process is hampered	E13	5
		Production results that do not meet the target	E14	6
		Work accidents during the production process	E15	5
	Production Machine Maintenance	Machine Failure	E16	6
		The production machine is damaged	E17	6
Delivery	Delivery of products to consumers	Delay in delivery of goods to consumers	E18	5
		Item was damaged during shipping	E19	6

Business Process	Sub Process	Risk Event	Code	Severity
	Item availability information	An error occurred in the item availability information	E20	6
	delivery provider selection	There was a unilateral cancellation with the delivery provider	E21	6
Return	Product returns	Product does not meet specifications	E22	6
		Delays in product delivery	E23	5
	Product handler	Product handling delay	E24	5
		There are additional expenses	E25	6

Based on the risk event identification process there are 25 risk events that occur, there is 1 risk event that has a severity value of 4 (very low), 8 risk events that have a severity value of 5 (low), 14 risk events that has a severity value of 6 (medium), and 1 risk event which has a value of 8 (very high).

### 3.2. Risk source identification analysis

Assessment of risk sources (risk agent) is giving a rating to determine the level of frequency of risk sources (risk agents) based on the occurrence scale shown in Table 3.

Table 3. Occurrence value of phase 1 HOR

Business Process	Risk agent	Code	Occurrence
Plan	The number of sudden requests from consumers	A1	5
	Raw materials do not match the quality	A2	5
	Scarcity of raw materials	A3	5
	Contracts/approvals with suppliers are not good	A4	4
	Price discrepancy with the quality of raw materials	A5	4
Source	Delayed delivery of raw materials	A6	3
	Out of raw materials	A7	3
	An error occurred when checking the quality of raw materials	A8	4
	Purchase of raw materials that are not in accordance with the needs	A9	3
Make	Lack of accuracy in product measurement	A10	4
	No engine repair scheduling	A11	5
	Human error	A12	3
	Workers do not have adequate skills	A13	4
	Workers do not apply SOP	A14	4
Deliver	Transportation accidents at the time of delivery	A15	5
	Bad weather	A16	4
	Limited means of transportation	A17	3
	There is no update of item availability information	A18	3
	Product packaging is not good	A19	4
Return	Reject product delay	A20	5

Business Process	Risk agent	Code	Occurrence
	Contracts/agreements with consumers are not good	A21	3
	Consumers are wrong in giving the size to the company	A22	7
	Lack of handling of product rejects	A23	2

Based on the risk agent identification process, there are 23 sources of risk that occur in the Apparel Industry. The frequency of the risk agent (risk agent) is then assessed by expert judgment. Of the 23 risk sources, there is 1 risk source that has an occurrence value of 2 (very low frequency), 8 risk sources that have an occurrence value of 4 (very low frequency), 6 risk sources that have an occurrence value of 5 (low), and 1 risk source. which has an occurrence value of 7 (high).

### 3.3. Correlation analysis between risk events and risk sources

After identifying risk events and risk sources, then the correlation between risk events and risk sources is carried out. Correlation mapping was carried out using the Aggregate Risk Potential (ARP) scale based on phase 1 (first) HOR. The proposed correlation value is on a scale of 0 (no correlation), 1 (low correlation), 3 (medium correlation), and 9 (high correlation). From mapping the correlation between 25 risk events with 22 risk sources, a total of 29 correlations were obtained. The correlation between risk events and risk sources, can be shown in Table 4.

Table 4. HOR phase 1

	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16	A17	A18	A19	A20	A21	A22	A23	Severity	
E1	1			9																				6	
E2	9	3																							6
E3				1																					8
E4			9																						6
E5		9			3																				6
E6						9																			5
E7								9	3																5
E8								3																	6
E9						3	9																		8
E10									9																4
E11										9			3												6
E12										3		9		3											5
E13												3													5
E14													9												6
E15														9											5
E16											9														6
E17											9														6
E18															9	3	9	3	3						5
E19															9				9						6
E20																			9						6
E21																	3								6
E22																						3	9		6
E23																				9			3		5
E24																				9					5
E25																									6
Occurrence	5	5	5	4	4	3	3	4	3	4	5	3	4	4	5	4	3	3	4	3	5	7	2		
ARP	30	36	27	24		20	21	25	15	27	54	18	28	24	49		18	20	27	27		37			
Priority Rank	A1	A1	A2			A1	A1	A1		A2			A1				A1	A1	A1		A2		A1	A2	
Rank	1	5	2	A2	A1	3	9	0	A3	0	A8	A4	4	A7	A6	8	7	2	A9	1	A5	6	3		

### 3.4. House of risk analysis phase 1

After the correlation value between risk events and risk sources is collected, then the data is processed in HOR phase 1 to determine the priority of risk sources to be mitigated. The output of HOR phase 1 is

the ARP value. The ARP value is the result of multiplying the severity value by multiplying the occurrence with the correlation value. ARP acts as a determinant of the sequence of risk sources that are prioritized to be resolved first. there are two categories of risk sources, namely priority risk sources (A) and non-priority risk sources (B). Where the priority risk source (A) has a value of 0-80% and the non-priority risk source (B) has a value > 80%. This risk priority classification is based on the principle of the Pareto diagram, namely 80% of problems are caused by 20% of causes [15]. After sorting the ARP values, the next step is to identify proactive actions/mitigation actions. the following is a proactive action table, can be shown in Table 5.

Table 5. Proactive action

Code	Proactive action
PA1	Schedule regular machine repairs
PA2	Schedule vehicle repairs
PA3	Confirm orders to consumers
PA4	Planning purchases as needed
PA5	Update item availability information
PA6	Conducting tests on prospective employees
PA7	Do packing neatly and safely
PA8	Carry out supervision and training
PA9	Provide safety stock of raw materials
PA10	Looking for alternative raw materials
PA11	Always inform the status of rejected goods
PA12	Make good agreements with suppliers regarding the quality of raw materials
PA13	Make an agreement with the delivery provider
PA14	Make an agreement with the delivery provider
PA15	Making SOPs when making deliveries

#### 4. Conclusion

This study shows that the strategic mapping of the halal food supply chain based on the SCOR model has provided an overview of the business processes of suppliers, producers, logistics, and consumers. This study identified 25 risk events and 23 risk agents. From risk events and risk agents, 39 correlations were found between risk events and risk agents. From the correlations found 22 correlations which have a scale of 9 (high correlation), 2 correlations with a scale of 1 (low correlation), and 15 correlations with a scale of 3 (medium correlation). The implication of this research is in the form of recommendations to the apparel industry management in mitigating the sources of risk in every business process. In addition, further research is recommended to adjust the risks found in the apparel industry in Indonesia.

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