

SUPPLY CHAIN RISK MITIGATION USING SUPPLY CHAIN RISK MANAGEMENT (SCRM) APPROACH

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Abstract

Supply chain is an important factor in domestic and international trades, which determines the extent of the efficiency and effectiveness of the order, the production process until distribution of goods from production centers or import to the consumer level. PT. Barata Indonesia (Persero) uses Make To Order production strategies that has experienced problems in the supply of raw materials, especially non- acceptance by the target date. This research uses Supply Chain Risk Management (SCRM) approach, which identifies the impact of the risk event and probability of risk agents on the risk of supply, operational and demand. For identifying the risks, House of Risk (HOR) was used, which consists of two phases. The results of the first phase of risk assessment: there were 23 risk events and 17 risk agents covering 4 supply risk, 16 operational risk and 3 demand risk. From these results, the sequence of aggregate risk potential (ARP) is obtained, from the largest to the smallest. In second phase, the selected risk agents were correlated with the proposed of mitigation strategies, there were 9 supply chain risk mitigation strategies that were assessed level of relationship both of them, so mitigation strategy were selected.

Key word: SCRM, HOR, ARP, risk mitigation

1. INTRODUCTION

Supply Chain is the lifeblood of international and domestic trades, which determines the extent of the efficiency and effectiveness of the booking value, the production process to distribution of goods from centers of production or import to the consumer level. Supply chain that is effective and efficient allows the amount of procurement of goods, time, place, and the right quality and lowest cost.

PT. Barata Indonesia (Persero) is a company that uses Make To Order production strategies that has experienced problems in supply of raw materials, especially non- acceptance by the target date. The delay is caused by several factors, i.e. material stockout, payment systems and inappropriate specification orders. In addition, the production process also encounters some problems such as labor does not implement Standard Operational Procedure (SOP) and equipment (machine) that are old and have an impact on the next production process.

The result of deviations in arrival of raw materials will have an impact on the next production processes. It is certainly very detrimental to the company in terms of time and cost. Supply chain risk management is essential to be applied in any given company that does not rule out the possibility of risk event in the course of supply chain companies. The application of SCRM system needs team work in every line. In the process of handling disruption or risk, it is necessary to determine the priority of risks to be handled by varying amount of risk. Manuj and Mentzer (2008) in Global Supply Chain Risk Management explained that the only way to achieve maximum profits in the supply chain is by seeking a balance between productivity (efficiency) and profit (effectiveness).

The purpose of this research is to identify risk events and to propose mitigation strategies of supply chain using supply chain risk management (SCRM) approach for Bolster product. After identifying supply risk, operational and demand, it also necessary to define the aggregate risk potential (ARP) using house of risk (HOR) tool. This method is an extension to the failure mode and effect analysis (FMEA) so that we will get the order of risk, sources of risk that needs mitigation and proactive actions.

2. METHODS

This stage is divided into several steps which consist of field observations, formulation of the problem, determination of research and literatures. In this research methods the framework of previous studies is used. The data collected in this research include the form of supply chain activities, production processes, equipment or machine, materials used, type of work, historical data on the risks that have occurred and all data related to the research. Several stages of collection and processing data are as follows:

1. First phase; Risk Identification is to identify the symptoms of risk events. This stage is the process of identifying risk events based on two things, namely risk event and risk agent.
2. Two phase; Risk Assessment is to measure the impact that would cause risk. Before processing risk, the result of risk identification process requires validation of a questionnaire or risk assessment form.
3. Third Phase; Selecting the appropriate risk management by conducting risk analysis then performing a risk priority which shows the order of handling the risk.
4. Fourth stage; Eliminate risk with mitigation strategies and monitor the existing objects.

3. RESULTS AND DISCUSSION

In this stage, the results that are obtained from this research are explained. The result of identification of risk events with degree of impact (severity) can be seen in Table 1 .

Table 1. Identification of Risk Events

<i>Risk</i>	<i>Kode</i>	<i>Kejadian Risiko</i>	<i>Severity</i>
<i>Supply Risk</i>	E1	<i>Supplier</i> tidak dapat memenuhi order	5
	E2	Harga material tidak sesuai kontrak	1
	E3	Barang tidak sesuai waktu pengiriman	8
	E4	Spesifikasi barang tidak sesuai	7
<i>Operational Risk</i>	E5	Material (bahan baku utama dan pembantu) di gudang habis	5
	E6	Pemadatan pasir silica yang tidak rata	4
	E7	Pelapisan cairan cetakan (<i>coating</i>) yang tak rata	7
	E8	Kecacatan pada produk	8
	E9	Ketidaksinkronan dimensi model Bolster	8
	E10	Kesalahan dalam proses cetak	8
	E11	Mesin mengalami kerusakan (<i>trouble</i>)	7
	E12	Penumpukan elemen pada salah satu stasiun kerja	4
	E13	Kelayakan alat angkut dan transportasi	4
	E14	Penuangan cairan (<i>cor</i>) tumpah ke lantai	7
	E15	Kesalahan dalam pembuatan <i>mould</i> dan <i>melt</i>	8
	E16	Perulangan <i>Shout Blast</i>	3
	E17	Kesalahan dalam proses <i>assembling base</i> cetak	6
	E18	Produk berkarat /Korosi	3
E19	Keterbatasan mesin/alat angkut	3	
E20	Listrik padam	1	
<i>Demand Risk</i>	E21	Perubahan mendadak dalam <i>Master Schedule</i>	5
	E22	Molornya penjadwalan produksi	6
	E23	Kesalahan persepsi kontrak	2

After identifying the risk event, then the next step is to determine risk agents that cause risk events. The identified risk agents can be seen in Table 2.

Table 2. Identification of Risk Agents

Kode	Agen Risiko (Risk Agent)	Occurance
A1	Kelangkaan Material/ Bahan Baku	7
A2	Usia Peralatan/Mesin	5
A3	Keterlambatan Barang	8
A4	Pekerja/ karyawan banyak yang kurang berkompoten	3
A5	Kurangnya Koordinasi setiap divisi stasiun	6
A6	Pasokan listrik terhenti	4
A7	Kesalahan Prosedur	5
A8	Gangguan alam/ bencana alam, kebakaran	2
A9	Kurangnya perawatan mesin dan peralatan lain	3
A10	Perubahan rencana produksi	6
A11	Alat angkut/ transporter/ crane rusak	3
A12	Kualitas barang dari supplier tidak sesuai dengan standar	4
A13	Referensi harga material tidak akurat	5
A14	Kesalahan dalam memilih Supplier	2
A15	Verifikasi permintaan barang kurang tepat	4
A16	Permintaan yang mendadak	3
A17	Kelemahan dalam nota kesepakatan dengan supplier	3

3.1 First Phase of House of Risk

Identification results of severity (S) from risk event and occurrence (O) of risk agent would be the input of the first phase of house of risk (HOR). At this phase it will be found the correlations between risk events and risk agents, thus the value of aggregate risk potential (ARP) is obtained. The calculation of the first phase of HOR can be seen in Table 3.

Table 3. First phase of House Of Risk (HOR)

Risk	Kode	Risk Event (Ei)	Risk Agent (Aj)																	Severity of Risk
			A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16	A17	
Supply Risk	E1	Supplier tidak dapat memenuhi order	9												9	9		3	5	
	E2	Harga material tidak sesuai kontrak	3		1										9	9	3		1	
	E3	Barang tidak sesuai waktu pengiriman	9		9											9	1	3	8	
	E4	Spesifikasi barang tidak sesuai												9	3	9			7	
Operational Risk	E5	Material (bahan baku utama dan pembantu) di gudang habis	9		3						3								5	
	E6	Pemadatan pasir silica yang tidak rata				9			9										4	
	E7	Pelapisan cairan cetakan (coating) yang tak rata		3		9			9										7	
	E8	Kecacatan pada produk				9	3		9	1			9						8	
	E9	Ketidaksesuaian dimensi model Bolster				9			9										8	
	E10	Kesalahan dalam proses cetak				3			9			3							8	
	E11	Mesin mengalami kerusakan (trouble)	9		3				3	9									7	
	E12	Penumpukan elemen pada salah satu stasiun kerja					9		3			3						3	4	
	E13	Kelayakan alat angkut dan transportasi	9								9								4	
	E14	Penuangan cairan (cor) tumpah ke lantai				9	3		9										7	
	E15	Kesalahan dalam pembuatan mould dan melt				9	9		9										8	
	E16	Perulangan Shout Blast		1		3			3										3	
	E17	Kesalahan dalam proses assembling base cetak				9			9										6	
	E18	Produk berkarat /Korosi					3							9					3	
	E19	Keterbatasan mesin/alat angkut		9							3	9						3	3	
	E20	Listriik padam						9											1	
Demand Risk	E21	Perubahan mendadak dalam Master Schedule							3						9		9	5		
	E22	Molornya penjadwalan produksi	9		9			3	1				3	1		3		6		
	E23	Kesalahan persepsi kontrak	1								1							9	2	
Occurrence of Agent j			7	5	8	3	6	4	5	2	3	6	3	4	5	2	4	3	3	
Aggregate Risk Potential			1547	750	1136	1458	972	108	2730	42	321	228	153	648	135	396	476	324	99	
Priority Rank of			2	6	4	3	5	15	1	17	11	12	13	7	14	9	8	10	16	

The following stages of solution of the first phase of the house of risk are:

1. Identify risks that may occur Ei (risk events) on each process. It is conducted by mapping risk into supply risk, operational risk and demand risk.
2. Give assessment score with a scale of 1 to 10 to the severity Si (severity) as a result of risk event.

3. Identify the risk agents and give an assessment on the likelihood of the occurrence. A_j (risk agents) indicates risk agents and O_j (occurrence) demonstrates the possibility.
4. Find the matrix relationship (correlation) between each of risk agents and each risk. R_{ij} (relationship) $\{0,1,3,9\}$ with a value of 0 indicates no correlation and a value of 1, 3 and 9 shows a low correlation, moderate and high, respectively.
5. Calculate the Aggregate Risk Potential Of Agent J (ARP_j) which is the result of probability of agent j.

$$ARP_j = O_j \sum S_i R_{ij}$$

6. Create priority of risk agents based on the potential risk with greater value. After employing the first phase of house of risk (HOR), the results can be seen in Figure 1.

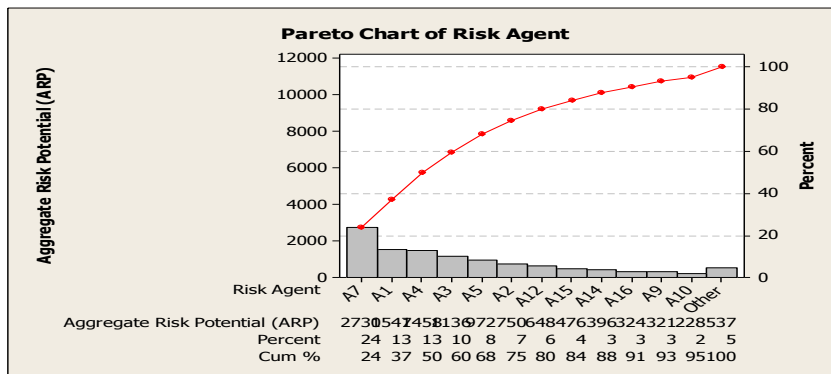


Figure 1. Pareto Diagram of selected risk agents

Based on the selected risk agents, then the strategies that are able to mitigate the risk sources according to the ability of the company are proposed. The selected risk agents are risk factors with highest value of aggregate risk potential (ARP). The selected risk agents will correlate with mitigation strategies that are needed. In linking risk agents with risk mitigation actions the same procedure as in the first phase of identification is used. The scale of correlation 9, 3 and 1 indicates strong correlation, medium correlation and weak correlation, respectively. The proposed strategies for risk mitigation can be seen in Table 4.

Table 4. Mitigation Strategies

Mitigation Strategy (Mk)	
M1	Pelatihan bagi pekerja yang kurang berkompeten
M2	Evaluasi harian <i>Work Sheet</i>
M3	Mengembangkan SOP serta mengawasi pelaksanaannya
M4	Menentukan <i>Supplier</i> yang lebih terpercaya
M5	Melakukan maintenance pada mesin dan peralatan lainnya secara berkala
M6	Pengadaan mesin dan peralatan baru
M7	Mengatur rencana produksi (Work Flow) yang tepat secara berkala berdasarkan demand
M8	Menjadikan lingkungan kerja yang kondusif
M9	Perbaikan kebijakan perusahaan terkait risiko yang terjadi

In selecting the strategies, it should also consider the company's ability to apply them in the supply chain process. The proposed strategies to be implemented for mitigating the risk are calculated based on the total effectiveness of the proposal. Effective suggestions would consider

the difficulty level of the assessed company. Therefore, grading scale levels of difficulty in the implementation of the proposal using a Likert scale can be used as a measure.

3.2 Second Phase of House of Risk (HOR)

The selected risk agents are the highest value of the aggregate risk potential (ARP). The highest aggregate score will be the input of the second phase of house of risk (HOR) namely the treatment phase. The second phase of House of risk (HOR) can be seen in Table 5.

Table 5. Second Phase of House of Risk (HOR)

	To be treated risk agent (Aj)	Mitigation Strategy (Mk)									Aggregate Risk Potentials (ARPj)
		M1	M2	M3	M4	M5	M6	M7	M8	M9	
A7	Kesalahan Prosedur	9	9	9						3	2730
A1	Kelangkaan Material/ Bahan Baku				9			9			1547
A4	Pekerja/ karyawan banyak yang kurang berkompeteren	9							3	3	1458
A3	Keterlambatan Barang				9			9			1136
A5	Kurangnya Koordinasi setiap divisi stasiun	3	9	3						3	972
A2	Usia Peralatan/Mesin		3			9	9				750
A12	Kualitas barang dari supplier tidak sesuai dengan standar		9		9						648
A15	Verifikasi permintaan barang kurang tepat		9		9					9	476
A14	Kesalahan dalam memilih supplier				9					9	396
A16	Permintaan yang mendadak							9			324
A9	Kurangnya perawatan mesin dan peralatan lain					9	3				321
A10	Perubahan rencana produksi							9		3	228
Total effectiveness of action k		40608	45684	27486	37827	9639	7713	29115	4374	24012	
Degree of difficulty		4	4	4	3	4	2	5	4	3	
Effectiveness to		10152	11421	6871.5	12609	2409.75	3856.5	5823	1093.5	8004	
Rank of priority		3	2	5	1	8	7	6	9	4	

The stages of selection in the treatment phase of House of Risk (HOR) are:

1. Sort risk agents with the highest aggregate score using pareto diagram (ARPj) which will be followed up on HOR2.
2. Identify any possible strategies to prevent the emergence of risk (Mitigation Strategy Mk).
3. Determine the correlation between preventive action and each of risk agents (Ejk). Ejk {0,1,3,9} with a value of 0 indicates no correlation and value of 1,3 and 9 show low, medium and high correlations. (Ejk) also demonstrates the effectiveness of mitigation actions to reduce the likelihood of risk agents.
4. Calculate the Total Effectiveness (TEK) of each action using the formula:

$$TE_k = \sum_j ARP_j \times E_{jk}$$

5. Give assessment of the degree of difficulty in performing mitigation actions (Difficulty Dk) using a Likert scale or other scales that describe funds or other resources required for mitigation actions.
6. Calculate the ratio of Total Effectiveness (TEK) with Difficulty (Difficulty Dk) using the formula:

$$ETD_k = \frac{TE_k}{D_k}$$

7. Determine the priority rating of each action (Rk), the first rank shows action with highest ETD.

The second phase of house of the risk (HOR) demonstrates the sequence of mitigation process that will be done first. The sequence process is carried out as a proposal to company and will be preventive measures that effective and efficient. Effectiveness of strategy can be seen during mitigation actions. The stages of mitigation strategies based on the level of ease or difficulty level that is determined by company. The Company may terminate or reduce the risk based on reference of this research.

4. CONCLUSION

Based on brainstorming process, forum group discussion (FGD), observation and questionnaires, the results of this research are; from supply chain risk identification based on three categories namely supply risk, operational risk and demand risk it is found that there are 23 risk events and 17 risk agents that covering 4 supply risk, 16 operational risk and 3 demand risk. From the first phase, it is revealed that several risk events can be caused by a single agency.

Based on the proposals that are processed in the second phase of house of risk, it can be stated that company must implement risk avoidance to mitigate the potential risks. Mitigation strategies proposed in this study are 9, they are conducting training for workers who are less competent, preparing work sheets, developing standard operational procedure (SOP) as well as overseeing in implementation, developing reliable suppliers, maintaining the machines, improving the procurement of machinery, organizing the work flow, creating the work environments that are conducive and comfortable and improving the company policies.

5. RECOMMENDATION

Some suggestions that can be considered in this study for next research is to calculate the probability of each risk events and agents to reduce the supply chain risk in company. Risk assessment can be developed according to the needs and ability of company in reducing the supply chain risk.

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