Integrated Supply Chain Risk Management in Ready Mix Batching Plant

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Abstract

Current competition requires supply chain to be able to manage its risks proactively as one of the competitive advantage supporting factors. Supply chain risk management aims to develop various approaches to identify, assess, analyze, and deal with vulnerable and risky areas in the supply chain. This study was conducted to implement the integrated supply chain risk management in ready mix batching plant. We applied House of Risk (HOR) to identify risk events and risk agents. From HOR, we identified 22 risk events and 21 risk agents. Moreover, we utilized Interpretive Structural Modeling (ISM) to examine the interrelationship among the risks. In risk analysis phase, Analytical Network Process (ANP) was used to calculate the weight of risks by considering its interrelationship. Given the weights, Risk Priority Number (RPN) can be calculated as the multiplication of consequences and likelihood value of risk events. After we mapped the adjusted RPN in Pareto diagram, several risks that should be prioritized to be mitigated were E20, E9, E16, E18, E14, E6, E5, E10, E11, E1, E21, and E8. We recommend supply chain contract as the mitigation strategy to reduce the risks as well as to improve the supply chain profitability.

Keywords
Supply Chain, Risk Management, ISO 31000:2009, Supply Chain Contract

1. Introduction

In line with the development of business environment, the competition climate has transformed from inter-company into inter-supply chain competition (Faisal, 2006; Trkman and McCormack, 2009; Yoo, *et al.*, 2010). Therefore, supply chain management plays a significant role (Jain, *et al.*, 2010), particularly in terms of building, improving, and maintaining sustainable competitive advantage (Shukla, *et al.*, 2011). Effective supply chain management enables companies to improve their organizational competitiveness and performance (Khan and Burnes, 2007; Vanany, *et al.*, 2009), such as increase the inventory turnover, revenue, product availability, responsiveness, economic value added, and capital utilization. Furthermore, it also serving as an instrument in lowering costs, order cycle time, and time to market (Shukla, *et al.*, 2011).

A long and complex supply chain system reflects a dynamic and global market (Asbjørnslett, 2009). The increasing of business dynamics and uncertainties leads the organizational's focus on the importance of proactive supply chain management (Singhal, *et al.*, 2011; Zegordi and Davarzani, 2012). Unexpected risk sources enacting the risk management as a critical component in the successful supply chain management (Han and Chen, 2007; Lavastre, *et al.*, 2012).

Risk can be defined as an event that has negative and detrimental impacts that may occur over a period of time. Risk that occur in supply chain could seriously disrupt overall supply chain performance and satisfaction level of the

downstream companies and end consumers (Jüttner, *et al*., 2003, Carvalho, *et al*., 2012; Zegordi and Davarzani, 2012). Companies need to be be cautious with the risks that can harm the short-term and long-term performance of their supply chain, i. e. risks that could disrupt and delay the flow of material, information, and financial that could lead to decrease sales, increase costs, or both (Chopra and Sodhi, 2004, Pujawan, *et al*., 2009).

Supply chain risk management (SCRM) is a discipline that emerges as an intersection between risk management and supply chain management (Paulsson, 2004). Supply chain risks are managed through coordination and cooperation between parties, which apply strategic and operational insights to ensure the profitability and continuity in supply chain (Trkman and McCormack, 2009; Lavastre, *et al*., 2012). The generic framework of risk management is based on ISO 31000:2009. The ISO 31000:2009 standard proposes a risk management framework that embeds policies, procedures and practices throughout the organization (Chemweno, *et al*., 2015). This framework can be used by all types of organizations to deal with various risks attached to their activities, considering that the ISO 31000:2009 is a dynamic and can be tailored to the company context (de Oliveira, *et al*., 2017).

Construction is a dynamic industry compared to other industries, especially in developing countries such as Indonesia. The number of construction projects both small and large scale makes the existence of ready mix concrete is needed. As part of the construction industry, the ready mix company also adopts the specific characteristics of the construction industry; a risky business environment and full of uncertainty with low profits. In addition, ever-changing market conditions, relatively short construction periods, and unpredictable material price fluctuations require a reliable risk management system.

This research was carried out in a ready mix batching plant located in Samarinda, East Kalimantan. The company doesn't have a special department with specific job description to manage risk. Therefore, we applied an integrated risk management approach that adopts ISO 31000:2009. It classified risk management activities into three main processes, namely establishing the context, risk assessment, and risk treatment. Risk identification, analysis, and evaluation are incorporated in the risk assessment process (Chemweno, *et al*., 2015; de Oliveira, *et al*., 2017). In risk assessment, we performed the identification of risk events and risk agents by using House of Risk (HOR). HOR is an effective framework for proactive risk management. However, HOR ignored the interrelationship among risk events (Pujawan and Geraldin, 2009). In fact, it is possible that one risk could trigger the occurrence of other risks which possibly have higher consequence. Besides, the understanding of risk events dependency will assist the company in developing the efficient risk mitigation measures (Chopra and Sodhi, 2004; Kayis and Karningsih, 2010). Accordingly, to improve the utilization of HOR in risk identification, we added ISM to structure the relationship between risk events. Thereafter, we executed risk analysis by calculating the Risk Priority Number (RPN) as the multiplication between risk consequence and likelihood. Since we have considered the interrelationship between risk events in the previous step, hence we should take this into account while we calculate the RPN. We used Analytical Network Process (ANP) in determining the relative likelihood of related risk events. In the final stages of risk assessment, we evaluated which risks has to be addressed first with Pareto diagram. Afterwards, we proposed risk mitigation strategy to deal with risky area in the supply chain based on the risk assessment results.

The paper is organized as follow: in section 2, the research methodology and data collection process is described, followed by results and discussion in section 3, finally research summary and future research direction are highlighted in the conclusion.

2. Methodology

This paper is based on a case study of an integrated supply chain risk management in ready mix batching plant. Figure 1 depicted the risk management processes in accordance with ISO 31000:2009 and the approach taken at each stage of the process. The process for managing risk can be classified into 3 general processes, called establishing context, risk assessment, and risk treatment, that can be described in detail as follows:

2.1 Establishing Context

In this process, we defined the scope for risk management process and determine the criteria of risk assessment. The scope should be established within the context of the firm's organizational objectives. The selection of key objectives should be driven by an evaluation of the external and internal factors that may currently affect the firm (de Oliveira, *et al*., 2017). In order to gain an understanding of the firm's internal and external conditions, the perspective of the Supply Chain Operations Reference (SCOR) model can be expanded thereby it covering the risks that triggered by suppliers and consumers (Jüttner and Ziegenbein, 2009). Risk events were classified into 5

categories include plan, source, make, deliver, and return; which expected to present to present a systematic approach in capturing the risk behavior in supply chain (Ghadge, *et al*., 2013).
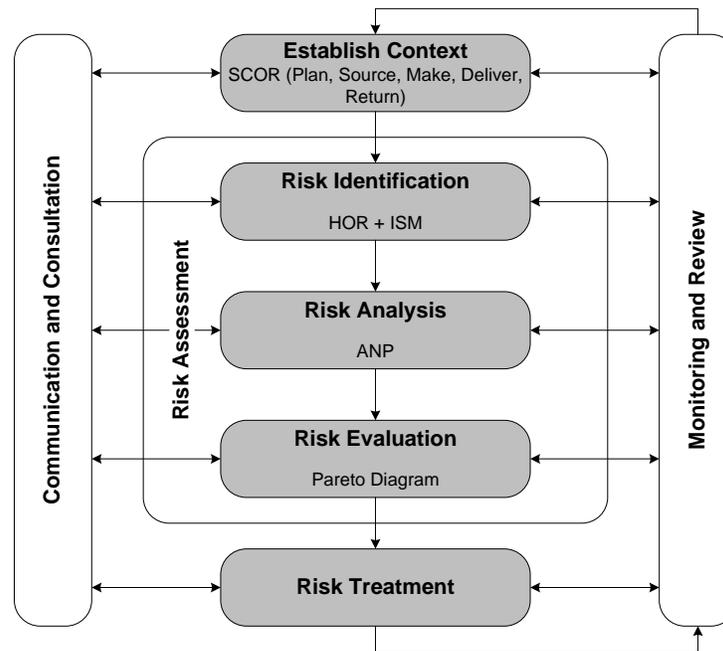

Figure 1. Research Methodology Based on ISO 31000:2009

2.2 Risk Assessment

According to ISO 31000:2009, risk assessment involves the subprocess of risk identification, analysis, and evaluation. The 3 activities were undertaken sequentially as follows:

(1) Risk identification

Risk identification is an initial subprocess of risk assessment, which aims to capture all risks that possibly hinder the supply chain objectives. We can employ a single approach or combine several approaches to identify risk indications, risk causes, and risk impacts (Profita, *et al*., 2014). In this paper, we integrated the HOR and ISM to identify the risk events and risk agents, and to observe the interrelationship among them. We limit the use of HOR only to HOR 1, since we only need to discover the risk events and risk agents before we proceed them with ISM.

Our research object has never perform risk management measures before, consequently we have to start from scratch. In the first place, we carried out an observations to mapping the supply chain processes based on SCOR model (plan, source, make, deliver, and return), then we identified the potential risks and its causes in each of those processes. Afterward, we clarified our observation result to the batching plant manager as our respondent. We also interviewed him to obtain the interrelationship among risk events as an input for ISM. Then, we proceed the HOR result with ISM through the following steps: (a) construction of structural self-interaction matrix (SSIM) by pairwise comparison, (b) developing a reachability matrix (RM) from the SSIM and checking for transitivity, (c) level partitioning of RM, (d) developing canonical matrix, (e) drawing diagraph, and (f) construction of ISM model (Atri, *et al*., 2013).

In the SSIM, there are 4 relationships between risk events that can be explained by the following symbols: (a) V = risk i triggers risk j, (b) A = risk i is triggered by risk j, (c) X = risk i and j affect each other, and (d) O = risk i and j are not related. The result of SSIM will be the input for RM, by converting 4 symbols into binary number 0 and 0 based on these rules:

(a). If the relation (i,j) is denoted as V, then the (i,j) entry in the RM becomes 1 and (j,i) becomes 0
(b). If the relation (i,j) is denoted as A, then the (i,j) entry in the RM becomes 0 and (j,i) becomes 1
(c). If the relation (i,j) is denoted as X, then the (i,j) entry in the RM becomes 1 and (j,i) becomes 1
(d). If the relation (i,j) is denoted as O, then the (i,j) entry in the RM becomes 0 and (j,i) becomes 0

(2) Risk analysis

Risk analysis is the second subprocess of risk assessment with the objective is to understand the nature, sources, and causes of the risks that we have identified. Moreover, risk analysis is necessary to determine the level of probability and the impact of supply chain risks systematically using either qualitative or quantitative methods, or both (Hallikas, *et al.*, 2004; Tang and Tomlin, 2009; Singhal, *et al.*, 2011). When the historical data is sufficient, then the quantitative risk analysis becomes more useful. If the opposite happens, certainly the qualitative approach becomes more appropriate to use (Singhal, *et al.*, 2011).

It is possible that the occurence of one risk is triggered by another risk event. Hence, we should consider those interactions by applying weight on any risk that relate to other risk. ANP can be utilized to figure out the weight which will be used to calculate the new likelihood for the interrelated risk events (Widiasih, *et al.*, 2015). The new likelihood and adjusted RPN can be calculated using equation (1) and (2) as follows:

$$L_{new} = L_{basic} + (L_{trigger\ 1} \text{ x } W_{trigger\ 1}) + (L_{trigger\ 2} \text{ x } W_{trigger\ 2}) + ... + (L_{trigger\ n} \text{ x } W_{trigger\ n}) \dots\dots\dots\dots\dots\dots\dots\dots\dots \quad (1)$$
$$\text{Adjusted RPN} = L_{new} \text{ x Consequences} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots \quad (2)$$

(3) Risk evaluation

The purpose of risk evaluation is to determine the priority of risk management measures based on the results of risk analysis that has been done previously. This evaluation can be performed through past experience, learning process, best practice, organization knowledge, and benchmarking with other industries as well as company's predetermined risk threshold. Based on risk evaluation, decision makers will be able to determine which risks that need special attention and further treatment (Ahmad, *et al.*, 2007).

Pujawan and Geraldin (2009) applied Pareto diagram to evaluate the degree of importance of reducing the occurrence probability of risk agent. In their study, they illustrated the use of Pareto to select the risk agents that account for about 75% of the total Aggregate Risk Potential (ARP). In this paper, we adopt the similar approach in evaluating risk since the company has not set its risk threshold.

2.3 Risk Treatment

Risk treatment as part of risk management process is based on risk analysis and evaluation. The objective is to mitigate the risk impact and decrease the probability of risk occurrence and/or avoid its consequence (Khan and Burnes, 2007; Mullai, 2009). In general, approaches in risk treatment are categorized into 4 main strategies, namely risk avoidance, risk reduction, risk transfer, and risk acceptance. The decision regarding the appropriate strategy is based on the risk evaluation and closely related to the nature of risk and behavior of decision makers (Ghadge, *et al.*, 2013; Profita, *et al.*, 2014).

In this paper, we focus on risk mitigation as our treatment strategy. Mitigation is a form of risk reduction strategy which focuses on preventive measures, such as the identification of potential risk and reduce the probability of risk occurrence (Profita, *et al.*, 2014). We developed mitigation efforts by considering risk associations with the assumption when the trigger risk event are successfully mitigated, then we can minimized the occurrence probability of the triggered risks. In addition, the developed mitigation strategies are not mutually exclusive. This means that a mitigation strategy can be used to overcome some risk events, and it is possible that one risk event can be mitigated through the implementation of several strategies.

3. Result and Discussion

This research was conducted in a national private company engaged in construction field, with the area of work covers architecture and civil. Located in Samarinda East Kalimantan, the company that has been established since 1977 is producing ready mix concrete. The company has a set of blending machine called batching plant. This batching plant has 2 silos with 130 tons capacity and 24 m^3 hopper material, with an average production capacity per day of 35 m^3 and a production target of 1000 m^3 per month. The company aims is to enhance their participation in development through the construction services sector by prioritizing precise quality, timely, and efficient services. The data in this research is obtained through observation and interview with batching plant manager with 28 years work experience. The complete stages of data collection and processing as well as discussion are shown in the following sections.

3.1 Establishing Context

As explained in Section 2.1, the risk management context must be built on the objectives of the company. In this case, the company aims to deliver services that are timely, efficient, and precise in quality. Therefore, everything that obstructs the achievement of this objective was categorized as risk. To structure the risk assessment process and accommodate risks occurring in the upstream and downstream of the company, then the risk events were classified according to the SCOR business process including plan, source, make, deliver, and return.

3.2 Risk Assessment

After we established the context, then we can proceed to the risk assessment process. This process was containing three stages namely risk identification, analysis and evaluation. We use various approaches at each stages, which can be seen clearly as follows:

(1) Risk identification

Risk identification was carried out through observation and interview with the respondent. By using HOR 1, we obtained 22 risk events which distributed into 5 SCOR business processes as shown in Table 1. In addition, we also identified the risk agents that we summarized in Table 2 as follows.

Table 1. Risk Event

Business Process	Code	Risk Event
Plan	E1	Error in raw material arrival scheduling
	E2	Low accuracy of forecasting
	E3	Delay in delivery planning to customer
	E4	Inaccurate of human resources qualification planning
	E5	Imprecise of equipment maintenance planning
Source	E6	Poor coordination with the suppliers
	E7	Difficulty to obtain raw materials
	E8	Inappropriate quality of raw materials
	E9	Delay in raw materials delivery by the suppliers
	E10	Raw materials shortage
	E11	Unavailability of raw materials according to required quality
Make	E12	Delay in production scheduling
	E13	Error in raw materials weighing process
	E14	Damaged products
	E15	Failed production
Deliver	E16	Breakdown of transportation equipment during shipment
	E17	Cancellation of customer order
	E18	Delay in delivery to customer
	E19	Coagulation of concrete during delivery process
	E20	Delay in customer payment
	E21	Price fluctuation
Return	E22	Product returns due to adjustment

Table 2. Risk Agent

Code	Risk Agent
A1	Sudden changes in customer demand
A2	Lack of integration among departments within the company
A3	Raw material shortage at a certain period
A4	Unavailability of the main raw material
A5	Error in maintenance planning
A6	Disruption during maintenance process of production and transportation equipment
A7	Supplier can't fulfill the demand
A8	Unexpected events
A9	Breakdown of machine/machine component
A10	Disruption of raw material scales

A11	Human error
A12	Error in writing the delivery orders
A13	Error in writing the execution instructions
A14	Lack of human resources
A15	Disruption of transportation equipment
A16	Unavoidable traffic congestion during delivery process
A17	Delay in transportation equipment
A18	Lack of transportation equipment
A19	Unfavorable weather
A20	Increase in indirect cost of production
A21	Inadequate condition of transportation equipment

The next step was to structure the relationship among risk events using ISM. As a first step, respondents were asked to fill out a questionnaire about the relationship of risk events. The type of relationship then translated into V, A, X, and O symbols as described in Section 2.2. For example, between E1 and E2 were given the symbol V which means the risk event E1 triggers the occurrence of E2. The result of questionnaires that have been processed into SSIM is presented in Appendix 1.

Next, we developed Reachability Matrix (RM) based on SSIM result. Afterward, we checked the RM values which called as transitivity. Transitivity is the basic assumption of ISM which used to compile the Final Reachability Matrix (FRM). It states that if variable A is related to variable B, and variable B is related to variable C, then implicitly variable A has a relation with variable C. Implementation of transitivity rule was done by examining RM cells which have 0 value. If the cells with 0 value have not fulfilled the transitivity rule, then we changed the value of the corresponding RM cells until they met the transitivity principle. Appendix 2 contains the complete result of the FRM.

Figure 2 below shows a diagram that combines the HOR 1 and ISM results. This diagram illustrates the relationship between risk events and risk agents. The top five risk agents generated from HOR 1 were connected to one or more risk events. For example, risk agent A16 (unavoidable traffic congestion during delivery process) may induce the risk event E18 (delay in delivery to customer). Risk agent A7 (supplier can't fulfill the demand) may trigger the risk event E9 (delay in raw materials delivery by the suppliers) and E12 (delay in production scheduling).
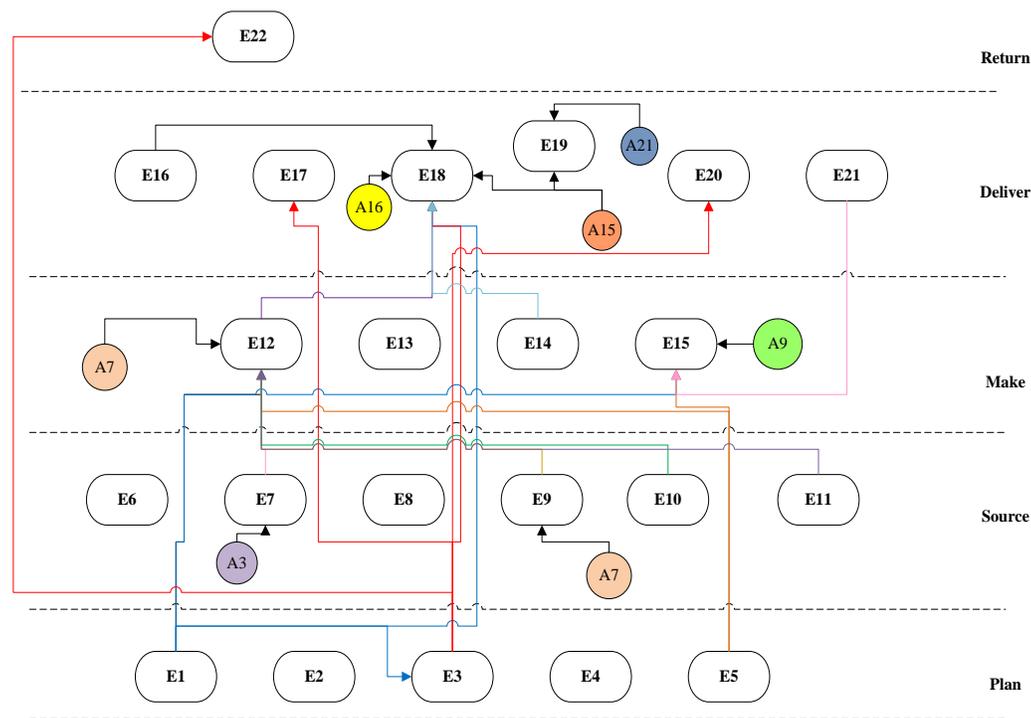

Figure 2. Integrated HOR 1 – ISM Model

(2) Risk analysis

The identified risks were analyzed at this stage. This analysis involved assessing the likelihood and consequence of each risk event. Using a questionnaire filled by an expert, likelihood and consequence were assessed on 1-10 scale with the "smaller the better" rule, as can be seen in Table 4.

After we obtained the likelihood and consequences values, we then calculated the likelihood weight for the interrelated risk events and risk agents. We utilized the ANP to calculate the weights. The initial procedure was to model risk interrelationships as in Figure 2. In order to obtain the weights, respondent was asked to fill the pairwise comparison questionnaire about the importance of risk events and risk agents. Consistency index is used to validate the questionnaire result. The expected inconsistency index is not more than 0.1, smaller value will be better. The following Table 3 shows the final result of weight with ANP method.

Table 3. The Weight of Risk Event and Risk Agent from ANP Calculation

Risk Event	Weight	Risk Event	Weight	Risk Agent	Weight
E1	0.00533	E12	0.19552	A3	0
E2	0	E13	0	A7	0
E3	0.00214	E14	0	A9	0
E4	0	E15	0.09688	A15	0
E5	0	E16	0	A16	0
E6	0	E17	0.00035	A21	0
E7	0.02669	E18	0.52073		
E8	0	E19	0.09375		
E9	0.05228	E20	0.00059		
E10	0	E21	0.00533		
E11	0	E22	0.00035		

With the weight generated from ANP, the new likelihood can be calculated using equation (1). This calculation involved the basic likelihood, as well as the likelihood and weight of the trigger risk event. For example, the new likelihood for E14 = 2 + (2 x 0.52073) = 3.04. If the trigger is a risk agent, then the likelihood for the risk agent is the basic likelihood. After the new likelihood was obtained, the adjusted RPN can be calculated as the multiplication between severity and new likelihood (equation (2)). The results are presented in Table 4 below.

Table 4. Calculation of Adjusted RPN

Risk Event	Severity	Likelihood	Risk Enabler(s)	New Likelihood	Adjusted RPN
E1	6	2	–	2	12
E2	3	1	–	1	3
E3	3	3	–	3	9
E4	3	3	–	3	9
E5	7	2	–	2	14
E6	5	3	–	3	15
E7	8	1	A3	1	8
E8	5	2	–	2	10
E9	7	3	E6, A7	3	21
E10	7	2	–	2	14
E11	7	2	–	2	14
E12	3	3	E5, E7, E9, E10, E11, A7	3.18	10
E13	6	1	–	1	6
E14	5	2	E18	3.04	15
E15	8	1	E5, E7, A9	1.03	8
E16	6	2	E18	3.04	18
E17	2	3	E3	3.01	6
E18	6	2	E3, E12, A15, A16	2.59	16
E19	6	1	A15	1	6

E20	7	4	E3	4.01	28
E21	5	2	E7, A21	2.03	10
E22	3	1	E3	1.01	3

(3)   Risk evaluation

In risk evaluation, adjusted RPN that have been calculated will be evaluated to determine which risk events that will be prioritized for handling. We utilized the Pareto diagram to find out the risk events that contribute about 75% of the total RPN. The Pareto diagram that contains the adjusted RPN value is shown in Figure 3 below.
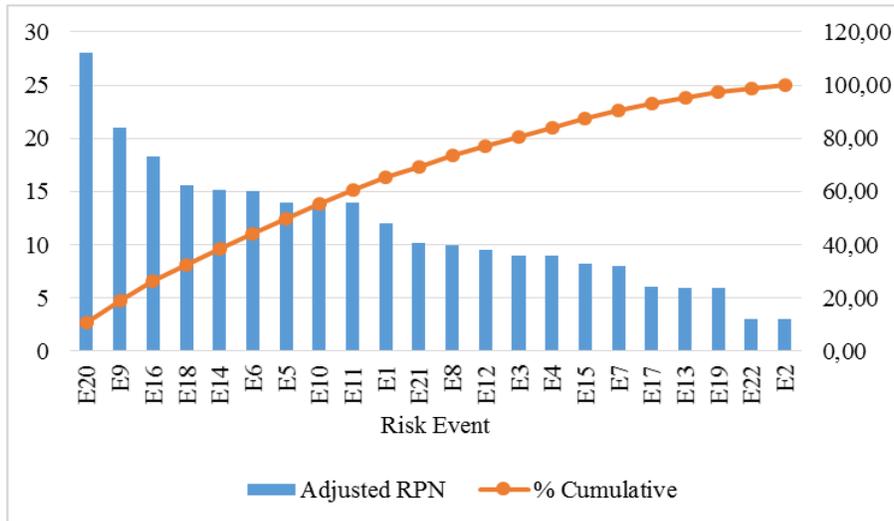

Figure 3. Pareto Diagram of Adjusted RPN Value

Based on the Pareto diagram, the risks that require handling were E20, E9, E16, E18, E14, E6, E5, E10, E11, E1, E21, and E8. From 12 risk events, its distribution according to SCOR business process were 2 plan, 5 source, 1 make, and 4 delivery, with percentage of 16.67%, 41.67%, 8,33% and 33.33% respectively. From these results, it can be seen that most risky activities were found in source and deliver processes. We can conclude that in the upstream and downstream of the company there were several risks that potentially disrupt the achievement of company objectives and endanger the overall supply chain of ready mix concrete, so these risks need to be treated appropriately.

3.3 Risk Treatment

The end results of risk assessment processes was 12 risk events that should be emphasized for its treatment. Several risk management strategies could our options, including risk avoidance, risk reduction, risk transfer, and risk acceptance. Nonetheless, in this article we focused on risk reduction strategy by developing mitigation measures to overcome the risk events in order to reduce the probability of occurrence and/or reduce the severity if these risk events occur.

Most risky activities were in the upstream and downstream of the company, where 74.8% of critical risk events occur in source and deliver business processes. Therefore, we offer a mitigation strategy through supply chain contract. Supply chain contract is a mechanism that facilitate the coordination in the supply chain by designing contract parameters so that every player in the supply chain acts towards the global optimal solution (Cachon and Lariviere, 2005). Supply chain contract ensures the achievement of global optimal solution through the increasing of supply chain profitability and risk sharing among players in a supply chain (Tsay, 1999; Chopra and Meindl, 2004).

Höhn (2010) suggest 11 contract clauses including specification of decision rights, pricing, minimum purchase commitments, quantity flexibility, buy-back or returns policies, allocation rules, lead time, quality, horizon length, periodicity of ordering, and information sharing. The clauses can be tailored to the conditions of the supply chain where the ready mix company is worked. However, in general, some risk events associated with clauses in the contract will be minimized. For example, risk events E6 (poor coordination with the suppliers) can be mitigated through information sharing clauses and E18 (delay in delivery to customers) can be minimized through lead time clause.

4. Conclusions

This research has successfully applied the integrated risk management approach referring to ISO 31000: 2009 in the ready mix batching plant. Using the SCOR model as the risk management context, we identified 22 risk events and 21 risk agents in the ready mix concrete supply chain. The integration of HOR 1 and ISM has also been able to structure the relationship between risk events and risk agents, as well as the interrelated weights have been calculated using ANP. These weights were involved in the adjusted RPN calculation, where the weights will affect the likelihood of risk events. The more triggers of risk events, the greater the likelihood value. Adjusted RPN was calculated as the multiplication of consequence and new likelihood, and the results were evaluated using the Pareto diagram. Based on the Pareto diagram, there were 12 priority risk events namely E20, E9, E16, E18, E14, E6, E5, E10, E11, E1, E21, and E8. This research proposed mitigation measures in the form of supply chain contract which is also beneficial to improve supply chain profitability in addition to minimize risk.

Although we have presented the whole stage of risk management process according to ISO 31000: 2009, we only briefly discussed the mitigation strategy through supply chain contract. Future research can attempt to determine the best type of supply chain contract in terms of the global optimal solution offered. In addition, the ISM method used still contains subjectivity so it needs additional steps to validate the results of its calculations.

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Appendix 1. Structural Self-interaction Matrix (SSIM)

Risk i	Risk j																					
	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	E11	E12	E13	E14	E15	E16	E17	E18	E19	E20	E21	E22
E1		V	V	O	A	A	A	V	V	V	V	V	O	O	V	A	O	V	O	O	O	O
E2			O	V	V	O	V	O	V	V	V	V	O	O	O	O	O	O	O	O	O	O
E3				A	A	O	A	O	A	A	A	A	A	A	O	A	O	X	A	V	O	O
E4					X	O	O	O	O	O	O	V	O	O	O	O	O	O	O	O	O	O
E5						O	O	O	V	O	O	V	V	V	V	V	O	V	V	O	O	O
E6							V	V	V	V	V	V	O	O	O	O	O	O	O	O	O	O
E7								V	A	A	A	V	O	O	V	O	O	V	O	O	V	O
E8									O	O	A	V	O	O	O	O	O	V	V	O	O	O
E9										A	A	V	O	O	V	O	O	V	O	O	O	O
E10											O	V	O	O	V	O	O	V	O	O	O	O
E11												V	O	O	O	O	O	O	V	O	O	V
E12													A	A	O	A	O	V	O	V	O	O
E13														O	O	O	O	V	O	O	O	O
E14															V	O	O	V	O	O	O	O
E15																A	O	O	O	O	O	O
E16																	O	V	V	V	O	O
E17																		O	O	O	O	O
E18																			V	O	O	O
E19																				O	O	O
E20																					O	O
E21																						O
E22																						

Appendix 2. Final Reachability Matrix (FRM)

Risk i	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	E11	E12	E13	E14	E15	E16	E17	E18	E19	E20	E21	E22
E1	■	1	1	0	0	1	1	1	1	1	1	1	0	0	1	1	0	1	0	0	0	0
E2	1	■	0	1	1	0	1	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0
E3	1	0	■	1	1	0	1	0	1	1	1	1	1	1	0	1	0	1	2	1	0	0
E4	0	0	1	■	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
E5	0	0	1	1	■	0	0	0	1	0	0	1	1	1	1	1	0	1	1	0	0	0
E6	1	0	0	0	0	■	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0
E7	1	1	1	0	0	1	■	1	1	1	1	1	0	0	1	0	0	1	0	0	1	0
E8	0	0	0	0	0	1	1	■	0	0	1	1	0	0	0	0	0	1	1	0	0	0
E9	1	0	1	0	0	1	1	1	■	1	1	1	0	0	1	0	0	1	0	0	0	0
E10	1	0	1	0	0	1	1	0	1	■	0	1	0	0	1	0	0	1	0	0	0	0
E11	1	0	1	0	0	1	1	1	1	0	■	1	0	0	0	0	0	0	1	0	0	1
E12	1	0	1	0	0	0	1	1	1	1	1	■	1	2	0	2	0	1	0	1	0	0
E13	0	0	0	0	0	0	0	0	0	0	0	0	■	0	0	0	0	0	1	0	0	0
E14	0	0	1	0	1	0	0	0	0	0	0	1	0	■	1	0	0	1	0	0	0	0
E15	0	0	0	0	0	0	1	0	0	0	0	0	0	1	■	2	0	0	0	0	0	0
E16	0	0	1	0	1	0	0	0	0	0	0	1	0	0	0	■	0	1	1	1	0	1
E17	0	0	1	0	0	0	1	0	0	0	0	1	0	1	0	0	■	0	0	0	0	0
E18	1	0	1	0	0	0	1	1	1	1	1	1	1	1	0	2	0	■	1	0	0	0
E19	0	0	0	0	0	0	0	1	0	0	1	0	1	0	0	2	0	0	■	0	0	1
E20	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	2	0	■	0	0
E21	0	0	0	0	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	■	0
E22	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	1	0	2	2	0	0	■