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A Conceptual Model on Integrating Supply Chain Operations Reference (SCOR) into Disaster Response Service Supply Chain FMEA

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Abstract — Becoming country prone to the occurrence of natural disasters, determination on risk variables affecting successful operation of disaster response service supply chain using supply chain FMEA (Failure Mode and Effect Analysis) is undeniably important to support successfulness of humanitarian operation. However, scientific studies concerning on integrating SCOR into Risk evaluation of disaster response supply chain is rarely found in references. To response such gap, this paper presents a conceptual model on integrating disaster response supply chain FMEA with Supply Chain Operational Reference (SCOR) to determine a conceptual risk-based performance evaluation model in disaster response supply chain. A framework on integrating Service Supply Chain FMEA with SCOR is presented coupled with a decision support model for evaluating criticality of risk-based performance index and followed with discussions and new opportunity for further investigations.

Keywords—Service Supply Chain, FMEA, SCOR, Disaster Response, Risk.

I. INTRODUCTION

During the last two decades, the world is witnessing the increasing number of global disastrous events. In the era of 1980s, the yearly average number of disastrous events was 180, however, in 2010 the number is increasing to 384, indicating three times increase [1]. The impact of that disaster is very huge, as for the year of 2011 alone as the example, total economic losses are reaching US $ 109.3 Billion Dollars. In terms of the disasters' victim, during the past three decades, the number of reported disasters have increased fourfold, and around 6.1 billion people have been affected by disasters with an estimated damage of almost 2.3 Trillion dollars [2]. Among countries suffered from the natural – made global disastrous events, Indonesia, together with US, India, China, and The Philippines was among the five most frequent disaster sufferers. Considering large amount of its potential number of disaster's victim and unbearable economic impact, advancement of tools and methodology/techniques to improve quality of response in disaster relief operations is obviously very important for sustaining development of a country. According to [3], research intended to prevent failure in disaster relief operation is still becoming top priority in disaster prevention discipline and very rare references discussing developing a framework on embedding SCOR into disaster response risk assessment method within supply chain framework. Motivated by this discrepancy, the goal of this study in concerning on proposing a conceptual model on integrating a conceptual model on integrating SCOR (Supply chain Operation Reference) model into disaster response supply chain to guide failure prevention in operation of disaster response services. The structure of the paper is in followings. In section II, an overview of SCOR and Supply Chain FMEA is introduced and followed with a conceptual model on embedding SCOR concept into disaster response service supply chain FMEA in section III. Section V related to a risk-based decision support model for evaluating risk variables in disaster response Supply chain FMEA. Conclusions and new inquiries for further

investigation are provided in section VI.

II. SCOR AND SERVICE SUPPLY CHAIN FMEA-AN OVERVIEW

A. Supply Chain Operational Reference

Developed by the supply chain council, the SCOR model is a kind of reference model in operationalizing a typical supply chain. As the reference model, the major of supply chain process within SCOR framework are consisting of plan, make, source, deliver and return [4]. The use of the SCOR model enables decision makers to drive supply chain operation to reach the intended performance of the disaster response supply chain.

Figure 1. Schematic model of SCOR

B. Service Supply Chain Failure Mode and Effect Analysis

Service supply chain FMEA, as its name implies is a kind of failure mode and effect analysis model applied into supply chain level. Different from design and manufacturing type FMEA, the scope of service supply chain FMEA is exceeding companywide level with coverage on information, material and financial flow among suppliers, distributors and end customers. Becoming the risk appraisal tool in supply chain, service supply chain FMEA utilizes the risk priority number as product of adverse event probability occurrence level and estimated severity of its consequences in evaluating criticality of risky events. An exemplar on appraising the risk within supply chain can be referred into [5]. By implementing FMEA in service operation, decision makers enable to take any preventative measures to prevent the re-occurrence of adverse events derail operability of disaster response supply chain.

III. A FRAMEWORK ON INTEGRATING SCOR INTO DISASTER RESPONSE SERVICE SUPPLY CHAIN FMEA

Integrating Risk Assessment method into SCOR enabling decision makers to prevent any preventative measures against the occurrence of any factors affecting disruptions in the operation of disaster response supply chain. A representation of framework in integrating Service Supply Chain FMEA into SCOR is presented in Figure 1.

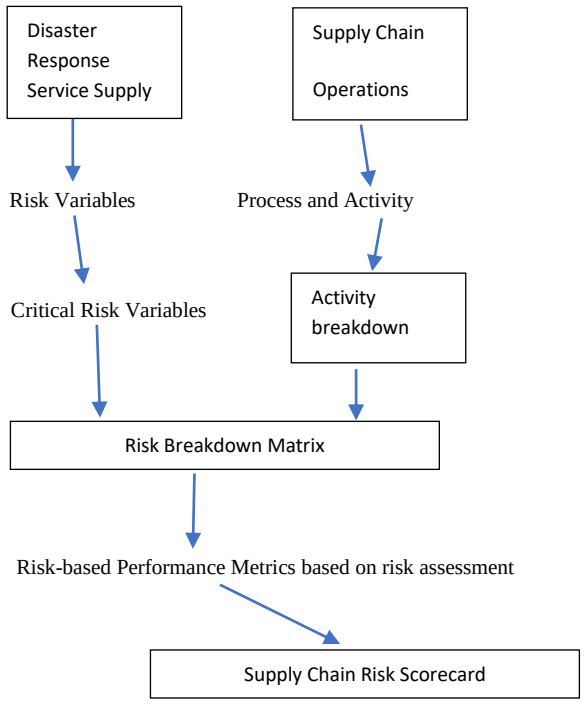

Fig. 1. Integrating SCOR into Disaster Response Service FMEA

In Figure 1, disaster response service supply chain structures are used to map potential risk modes of disaster response supply chain. The result of this approach is the critical risk variables. At the other side, the SCOR model is used to determine related activity of disaster response supply chain. The outcome of

mapping disaster response supply chain is the structure of relevant activity responding to disaster effect. Linking critical risk variables and activity structure will enable to determine the score of the supply chain risk variables in the form of Supply Chain Risk Score.

In attempt to properly linking SCOR into disaster response supply chain, it is necessary to identify relevant the SCOR elements and their corresponding risk indicators and affected supply chain performance dimensions. Using scientific study of [6], [7] and [8] as references, the linkage of the SCOR element with its risk variables and their affected Supply Chain performance in a typical disaster response supply chain is presented into the Table 1.

Table 1. Linking SCOR Elements into SC Risk Variables and Affected Performance Dimensions

First Layer Factors	Second Layer Factors	Exemplar of Potential Risk Variables	Affected Performance Dimension
Plan	Strategy	Inconsistent Strategic Objectives	Reliability
	Culture	Weak risk awareness	Flexibility
	Demand	Uncertain demand	Agility
Source	Purchasing	Low quality of purchased goods	Reliability
	Supply	Unreliable suppliers	Reliability
Make	Environment	Politics, economics and social Risk	Reliability
	Production	Technical production problems	Reliability
	Control	Inappropriate service control	Reliability
Deliver	Relation	Distrusted partners	Reliability
		Increasing commodity prices	Cost
	Transportation	Inappropriate distribution method	Reliability
	Origination	Improper delegation of supply chain authority	Responsiveness
Return	Return Way	Lack of consensus with customers	Responsiveness
	Return Procedure	Imperfect return process and rules	Responsiveness

Linking the SCOR elements of disaster response supply chain with their performance dimensions will enable decision makers to identify which SCOR elements correspond to the performance dimensions of disaster response supply chain. In Table 1, relationship among SCOR, risk variables and performance dimensions of supply chain is presented. Among other dimensions of supply chain, reliability is becoming the prime variables related to performability of disaster relief supply chain. Figure 2 represented the map of impact of a certain risk to an activity in a typical risk breakdown matrix.

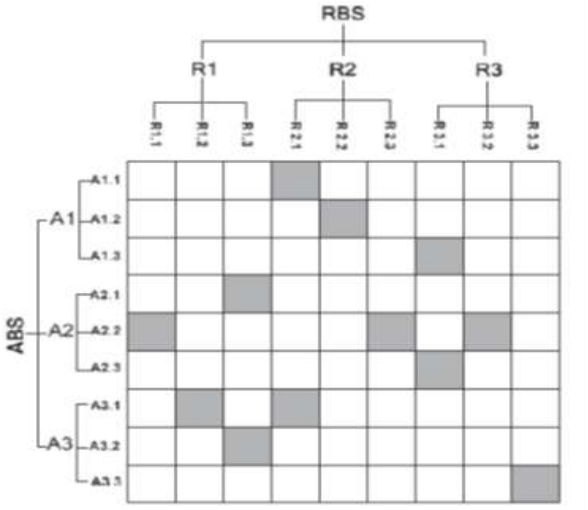

Figure 2. Chart depicting relationship between a risk variable and an activity [9]

IV. QUANTIFYING RISK-BASED PERFORMANCE INDEX

Intended becoming tool to manage performability of disaster response supply chain, determination of an index as basis to estimate criticality of risk variables due to failure in reaping response operation is imperative. In this regard, the basis determination of such index is based on derivation of risk as product of likelihood of the risk variables occurrence and their severity scale. Considering that not all SCOR elements are having equal importance, weightage of SCOR using decision making technique such the AHP (Analytic Hierarchy Process) should

be accomplished. Denote RPI_k as risk-based performance index k,OR_k as occurrence scale of risk variables k, WS_k represents the weight of a certain SCOR attribute and L_k as the estimated loss score because of occurrence risk variables k, then the score of the risk-based performance index of a certain supply chain performance variables is given in equation (1).

$$RPI_k = WS_k OR_k L_k \quad (1)$$

The score of L_k can be estimated using Taguchi Loss Functions. By identifying the threshold of critical risk, decision makers enable to determine appropriate corrective and preventative measures to prevent re-occurrence of critical risk variables.

In this paper, a model depicting integration of SCOR into disaster response supply chain is presented. Using the model enable decision makers to determine relationship among source of risk variables affecting supply chain performance dimensions. Ability to determine critical risk variables affecting performability of disaster response supply chain will become basis to take any measures preventing derailment of humanitarian service operation.

V. CONCLUSION

Driven by the frequent occurrences of natural disaster in Indonesia, endeavor to improve quality of risk assessment in disaster response supply chain is undeniably important to sustain country's development. In this paper, a conceptual model on integrating SCOR into disaster response risk assessment using FMEA framework is presented and followed with derivation on SCOR elements and their corresponding risk variables. Using this framework enables decision makers to anticipate any unintended outcomes of their response's operation thus will improve success operations of disaster alleviation. Opportunities for further investigations are viable in several ways, for example by undertaking empirical observation in testing appropriateness of the model and developing risk metrics of disaster response supply chain using vast array of multi attributes decision making techniques and linked it with performance evaluation techniques.

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REFERENCES

[1] D.C. Whybark, "Co-Creation of Improved Quality in Disaster Response and Recovery," *International Journal of Quality Innovation*, Vol.1, pp.1-10, 2016.

[2] S. Kumar and T. Havey, "Before and After Disaster Strike: A relief Supply Chain Decision Framework," *International Journal of Production Economics*, Vol.145, pp.613-625, 2013.

[3] S. Gupta, M.K. Starr, R.Janjiari and N.Matinrad, " Disaster Management from Production and Operations Management Perspective: Mapping a New Domain," *Production and Operation Management*, Vol.25, pp.1611-1637, 2016.

[4] S. Chabcoub and W.Hachica, " Associating Risk Management with a Performance Measurement System: Case of Academic Libraries," *Proc. Int. Conf. in Advanced Logistics and Transport*, Hammamet, 2014,pp.383-388.

[5] D.Nakandala, H.Lau and L.Zhao, " Development of a Hybrid Fresh Food Supply Chain Risk Assessment Model," *International Journal of Production Research*, Vol.55,pp.4180 – 4195, 2016.

[6] T.C. Weng and F.K. Chan, "AnalyzeQ and Predict the Co-movement Effect of Risks in the Supply Chain Management," *Research in Electronic Commerce Frontiers*, Vol.2, pp. 6- 15, 2014.

[7] J. Liu, F. Liu, H. Zhou and Y. Kong, "An Integrated Method of Supply Chains Vulnerability Assessment," *Scientific Programming*, Vol.2016, pp. 1-10, 2016.

[8] Q. Lu, M. Goh and R.D.Souza, " A SCOR Framework to measure logistics performance of Humanitarian Organizations," *Int. J. Humanitarian*

Logistics and Supply Chain Management, Vol.6, pp. 222-239, 2016.

[9] A.C. Cagliano, A.D. Marco, S.Grimaldi, and C. Rafele, " An Integrated Approach to Supply Chain Risk Analysis," *Journal of Risk Research*, Vol.15, pp.817-890, 2012.