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سازمان بنادر و دریانوردی



A Preliminary Conceptual of Risk Management and Supply Chain in Seaport

Kasypi Mokhtar
University Malaysia Terengganu
kasypi.mokhtar@gmail.com

Muhammad Zaly Shah
Muhammad Hussein
University Technology Malaysia
drzaly@gmail.com

Othman Che Puan
University Technology Malaysia
ocpuan@yahoo.com.my

Abstract Seaport is a complex system that requires comprehensive studies for the formulation of an effective system's management strategy. One of the elements of seaport management is supply chain. It is a chain process of handling goods and equipments within the terminal. Such a process involves many risks that are related to the operational and management aspects. Risk itself has two aspects which are some loss must be possible and there must be uncertainty that associated with that loss. By that, the processes against uncertainties and losses are related with optimization of performance to achieve terminal maximum output is necessary. Risk management can be a more effective approach to deal with these uncertainties by identifying probability of losses. This preliminary study is to assess the elements of supply chain and its associated risk, to review the risk management in seaport and to analyse the previous study on risk management and supply chain management. These situations are necessary in determining the level of risk management in the supply chain process in seaport terminal.

KEYWORDS: supply chain management, risk management, seaport, conceptual theory

Introduction

In the new era of seaport development, shippers look for ports with high productivity and efficiency. The reason is, by improving port efficiency from 25 to 75 percentile, is able to reduce shipping costs by 12% (Clark et al., 2004) alas with the fuel price rocketing impact the company's running cost. It is vital as nearly 90 percent of the world's international trade by tonnage via seaborne (UNCTAD, 2002). In other words, shippers are looking for ports, which are able to provide optimum services such as efficient custom clearance, less container damage, no untraced container, direct berthing and less turnaround time for vessel.

Correspondence: M. Kasypi Department of Maritime Management, 21030 Universiti Malaysia Terengganu.

There are several parties owned seaport i.e., federal government, state government and private sector. The port systems are very complex and difficult to be analyzed as a whole, as port management involves various parties i.e., government agencies, forwarding agents, shipping agents, and shipping lines. This scenario sometimes compels sharing of facilities (i.e., tug, and pilot) by stakeholders. It also causes bureaucratic red tapism. However, some guidelines are necessary to mitigate this situation. The challenges in maritime industries are not only related to quantity but also quality of the service. Here, continuous progress in globalisation of shipping and trade business results in increasing pressures on seaport terminal to reduce terminal cost and improve operational efficiency. By achieving this standard, port operators are able to compete globally and offer efficient services with competitive charges.

Risk Management

In line with world demand, some terminal operators have expanded their berthing wharves, facilities and skill manpower. The expenses for terminals expansion increased slightly after 9/11 when some countries i.e., United States imposed extra precaution for importer and exporter. The aim is to mitigate the possibility of having uncertainty and loss associated with risk. The impact of 9/11 has been tremendously changed the world where things associated with risk becomes main priority for most targeted countries. Dorofee *et.al.* (1996) define risk as the possibility of suffering loss. This definition includes two key aspects of risk which are some loss be possible and there must be uncertainty associated with that loss and added with additional condition as a choice how to address it. These three conditions from the basic underpinnings of risk and provide a basis for a more in-depth exploration.

DoD (2003) states that risk is a measure of the potential inability to achieve overall programme objectives within defined cost, schedule, and technical constraints and has to components: (1) Probability/likelihood of failing to achieve a particular outcome and (2) the consequences/impacts of failing to achieve that outcome. Dictionary defined risk as the probability of loss or damage to human being or assets, and it is considered as general cases definition. Frank Knight (1921) mentioned risk in the modern world where risk is defined as the probability of incurring a loss. It was popular in 1920s in the economic field.

Risk management is not something new, however for certain industry i.e., seaport this concept recently being discussed especially the case of 9/11. Haimes (1998) stated that risk management must be an integral part of the overall management of a system. The concept of risk management is underpinning in all aspect of activities, particularly vital in management of technological systems. The failure of the system can be caused by the failure of the hardware, software, organisation or the human involved. Focardi and Jonas (1998) said the theoretical framework for risk management is provided primarily by finance theory. However, finance theory only provides modelling aspect on how financial

markets work. Whereby risk management evolves from a control function to a financial optimisation, data analysis, identification and forecast risk factor.

In reality, risk management is not a science but is able to be predicted and mitigate accordingly. The first step in risk management is to identify the different risks involved in the organisation. There is no defined process to manage risk, but there are ways to assess its impact, and proactive management can help minimize its downside impact. Furthermore no single way of perceiving “risk”; different definitions fit different settings. In academic literature, the widely used definition of risk is “the variance of the probability distribution of outcomes (March and Shapira, 1987).”

Supply Chain Management

Supply chain management consists of firms collaborating to leverage strategic positioning and to improve operating efficiency (Bowersox *et.al*, 2003). This relationship reflects strategic choice and the supply chain strategy is a channel arrangement based on acknowledged dependency and relationship management. Furthermore, in operational aspects require managerial process that span across functional areas within individual firms and link trading partners and customer across organisational boundaries.

Brindley and Ritchie (2004) state supply chain operations, managing supply chain, and the incidence or risk are not new phenomena although currently people look at a new level of significance. However, in seaport risk and supply chain are relatively new concept as operators are stringent after 9/11 tragedy especially on terrorism. This new dimension has created a new challenge and extra precautions for seaport operators to mitigate any possibility of these aspects. Seaport has become one of the terrorist targets as a medium of transporting prohibited goods. This could create a chain of tense for intermodality transport as seaport is an interface between several modes of transportation.

There is close relationship between risk and supply chain when supply chain is a set of three or more entities i.e., organization or individuals directly involved in the upstream and downstream flow of products, services, finances, and or information flow from a source to a customer (Blanchard, 2004). When relates with seaport, Bagchi and Paik (2001) said seaports are considered the nuclei of a nation’s supply chain at which vessels can load and unload cargoes and passengers. Indeed without this relationship there is no way of this process is able to proceed. In the seaport process flow, there are probability of having risk and loss to the operators. It is vital to forecast any uncertainty that will translate into loss. The managing of this uncertainty and loss will able to reduce any unexpected and expected probability. Risk itself is the result of uncertainty, and uncertainty is measured using probability concepts. Risk is assessed by using probability not only of an event’s occurrence but also of its consequences. The concept of prioritising that makes risk management more manageable by focusing on the most influenceable problem.

The complexity of supply chain and seaport require comprehensive studies for the formulation of an effective system's management strategy. Bouhia (2004) states by using the state-of-the-art technology i.e., computers led to the application of mathematical models and optimization tools to solve supply chain managements problems. Bardi et al. (2006) state that managing work-in-process inventories is not difficult, but managing finished goods inventories is complex and challenging. By knowing the complexity, the needs to mitigate and solve the problems are necessary to be studied albeit it's time consuming.

Supply Chain Risk Management

Supply chain risk management is a concept of intersection between supply chain and risk management (Paulsson, 2004). Lambert *et al.* (1998) classify supply chain management is the integration of key business processes from end user through original suppliers that provides products, services, and information that add value for customer and other stakeholders. Relatively, supply chain management is a new term when it was introduced by consultant in the early 1980s. It has been established in research area more than a decade rather than risk management longer than supply chain management (Paulsson, 2004).



Figure 1.0: Supply Chain Risk Management as the Intersection of Supply Chain Management and Risk Management

Tang (2006) defines supply chain risk management as the management of supply chain risks through partners so as to ensure profitability and continuity. The definition is derived from the previous researchers, furthermore the supply chain management and supply chain risk management itself can be broaden into two categories: supply chain risk – on the aspect of operational risk or disruption risks and mitigation approach – supply, demand, product or information management.

Operational risks are referred to the inherent uncertainties i.e. uncertain customer demand, uncertain supply, and uncertain cost. Whereas disruption risks are referred to the major disruptions caused by natural and man-made disasters i.e. earthquakes, floods, hurricanes

terrorist attacks, typhoons or economic crises i.e. currency evaluation or strikes. Relatively, the impact of disruption risks is much greater than operational risks. Tzannatos (2004) mentions terrorism in relation to shipping is considered as a complex threat hence maritime security management emerges as a new and intensified challenge for shipping community. Paulsson (2004) studied with different categories are analysed; operational accidents (disturbance and disruption), operational catastrophes (natural disaster), and strategic uncertainty (terrorism and uncertainty).

The second part; mitigation approach is done through the coordination or collaborative mechanism. This can be simplified through figure 1.1.

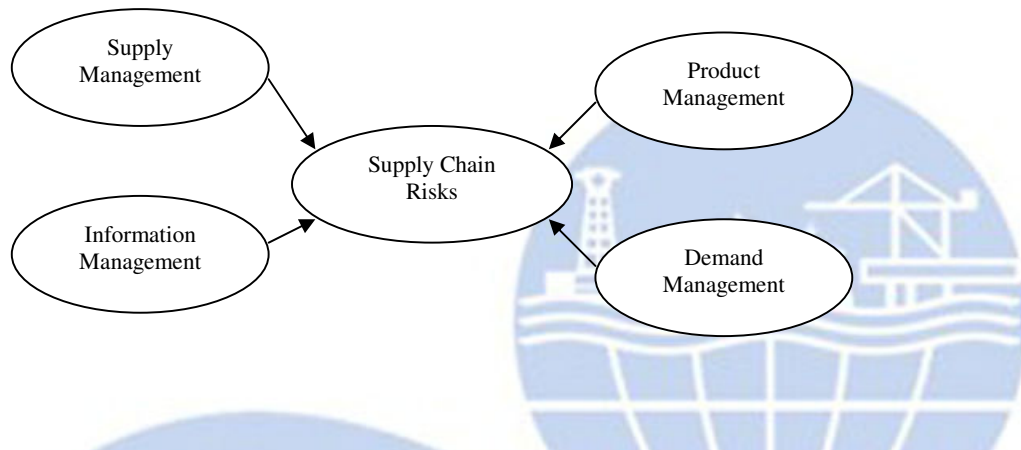


Figure 1.1: Four basic approaches for managing supply chain risks

These four basic approaches can be integrated to improve supply chain operations via coordination and collaboration. By having four steps in dealing with basic approaches the chain process can be done smoothly. The upstream level is vital to ensure the efficiency in supplying materials via the chain. Whereby, downstream is important to influence demand for partners. Furthermore, supply chain partners can modify the product design to make sure that supply materials can meet the demand from downstream users. The last is accessibility to the resources of information where can improve the level of coordination and collaboration to the supply chain users. The integration, coordination and collaboration are able to reduce the supply chain risks during chain process.

Figure 1.2 shows a basic model risk model of transportation chain (Paulsson, 2004). The supply chain is the chain of transport and storage activities from the first supplier to end customer. The risk in supply chain is the focus of interest that will create the possibility such as risk management as applied in the diagram.

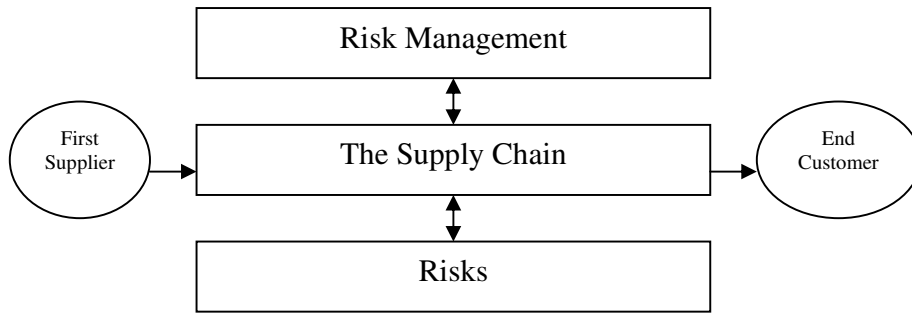


Figure 1.2: A Basic Risk Model

Related Risk Management Model

A risk determination model within business context has been developed by Ritchie and Marshall (1993) as bellows:

$$\text{Aggregate Business Performance} = f(\text{profitability} * \text{Risk})$$

Where

$$\text{Risk} = f(E_r, I_r, O_r, P_r, DM_r)$$

Where

- E_r = Environment variables
- I_r = Industry variables
- O_r = Organisatioanal variables
- P_r = Problem specific variables
- DM_r = Decision-maker related variables

The model has classified into five major characteristics before decision can be made and illustrated as below:

- i. *Environment characteristics:* Changes in the constituent elements of the competitive environment generate risk exposure for all organizations operating with in the environment. Development in generic technologies, economic trade groupings, politics and national cultures may potentially generate heightened risk exposure for the business organization.
- ii. *Industry characteristics:* Changes within a particular industry context will pose risks for the organizations operating within or relating to the industry. These changes may be driven by the industry's response to the wider environmental developments, resulting in new product or service development, changes in competitive strategies or possible new structure arrangements i.e., re-configuration of the supply chain structure and membership.

- iii. *Organizational characteristics*: The organization may potentially change a number of dimensions i.e., structure, culture, operations, systems etc either reacting to changes in the competitive environment taking precipitate actions to address anticipated risks. In either event, the changes and perhaps more importantly the process of implementing such changes risk for organization.
- iv. *Problem specific*: It is difficult to generalize about such factors as they will vary between distinct decisions. Those posing the highest risk exposure are likely to be concerned with the strategic and longer term decision making. Such decisions typically involve not only the highest risk exposure but may also have the most severe consequences.
- v. *Decision Maker*: Increasing attention has given to understand the particular attributes of individuals and groups involved in decision making and how they may be developed to improve their handling capabilities.

Previous studies had shown that modelling approaches are frequently used as methodology to obtain the result for risk management, i.e. decision tree, math programming, neural network, genetic programming simulation, fuzzy logics, analytical hierarchy process, decision support system, multi agent system, genetic algorithm etc. Bish (2003) stated that container terminals also share similarities with Material Handling Systems and Manufacturing Systems, furthermore container terminals also share similarities with rail container transportation systems. However, literature that uses mathematical optimization techniques for rail transportation systems has also been limited until recently (Cordeau, 1998) for a review of optimization techniques for rail transportation.

Alexander (2003) uses statistical model to measure operational loss in financial industry from the Bayesian estimation probabilities equation as below:

$$f(p) \propto p^a(1-p)^b, 0 < p < 1 \quad (1)$$

Reynolds and Syer (2003) use actuarial models for losses equation for operational loss distributions as below:

$$f(z) = \sum_{n=0}^{\infty} h(n)g^{(n)}(z), \quad (1.1)$$

Chan and Wong (2006) said that simulation is indispensable tool in the financial and risk management industry today. As every modern risk management method comprises a significant amount of computations.

In banking sector, the attributes to the effectiveness of using risk techniques have been studied recently to obtain better results for the industry. Table 2.0 shows applicable risk techniques in banking sector that has been applied for the research.

Table 2.0: Risk Techniques in Banking System

Author(s)/ Method	Malhotra & Malhotra (2003)	Lee et al. (2002)	West (2000) ^a	Yobas et al (2000)	Desai et al. (1997)	Henley (1995) ^e	Boyle et al (1992)	Srinivisan and Kim (1987)	Crook et al (2007)	Ong et al. (2005) ^d	Baesens, (2003) ^c
Linear Regression Or LDA	✓ 69.3	✓ 71.4	✓ 79.3	✓ 68.4	✓ 66.5	✓ 43.4	✓ 77.5	✓ 87.5		✓ 80.8	✓ 79.3
Logistic Regression		✓ 73.5	✓ 81.8		✓ 67.3	✓ 43.3		✓ 89.3	✓ 79.3		✓ 79.3
Decision Trees			✓ 77.0	✓ 62.3		✓ 43.8	✓ 75.0	✓ 93.2		✓ 78.4	✓ 77.0
Math Programming							✓ 74.7	✓ 86.1			✓ 79.0
Neural Nets	✓ 72.0	✓ 73.7 (77.0) ^b	✓ 82.6	✓ 62.0	✓ 66.4					✓ 81.7	✓ 79.4
Generic Algorithms				✓ 64.7							
Genetic Programming										✓ 82.8	
K-nearest Neighbors			✓ 76.7								✓ 78.2
Support Vector Machines											✓ 79.7

^a Figs are an average across two data set

^b Hybrid LDA and NN

^c Figs are average across eight data sets. Result are not given for fuzzy extraction rules because benchmark methods had different results compared with those shown in the columns in the table.

^d Figs are averages over two datasets

^e Henley's data had a much higher proportion of defaults than did the other studies.

Norrman and Lindroth (2004) classify three dimensions of supply chain risk management. These dimensions are not directly translated onto container terminal however, the process are in line with as the supply chain process in seaport terminal. The there dimensions are logistics unit of analysis, type of risk or uncertainty and the stage of the risk management process. This can be illustrated into assessing and positioning supply chain risk issues diagram (Figure 2.0). To assess this dimension, analytically needs some adjustment as difference industry portrays difference characteristics, operational, managements and approaches in nature.

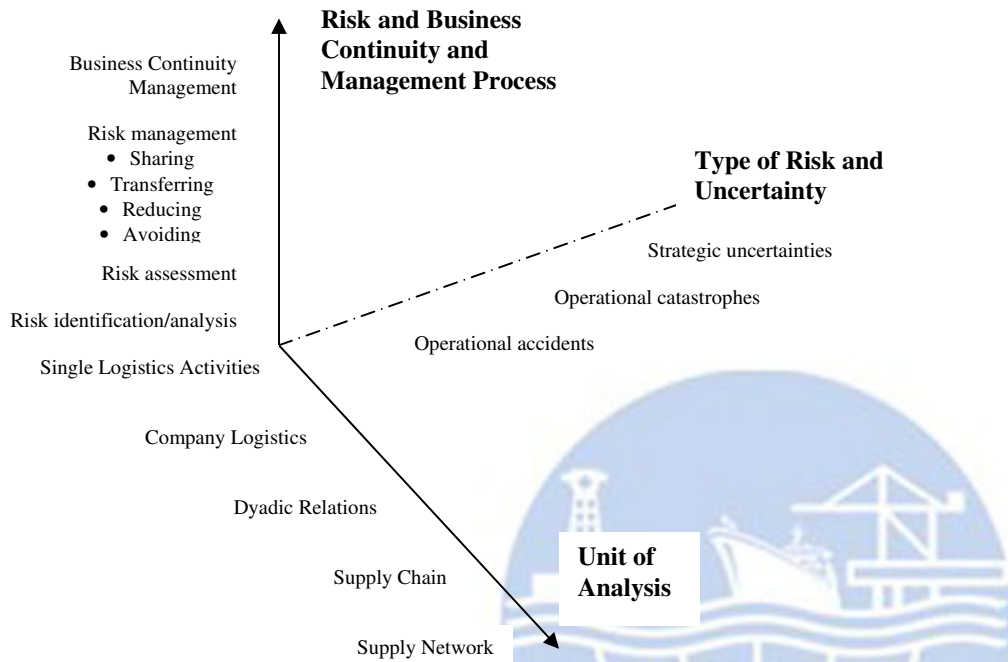


Figure 2.0: A Framework for Assessing and Positioning Supply Chain Risk Issues

In general, supply chain management and risk management intersect in between and called as supply chain risk management Figure 2.0. Researches between risk management and supply chain management have been conducted quiet long time where, risk management is being studied longer than supply chain management. However, adaptation risk management at seaport terminal recently new especially after 9/11 case (Sheffi, 2001; Lee, 2003). The supply chain risk management adaptation enables the seaport operator to focus on the conceptualisation of managing seaport in detail. Adapted Figure 2.1 shows the supply chain risk management has been narrowed in seaport terminal.

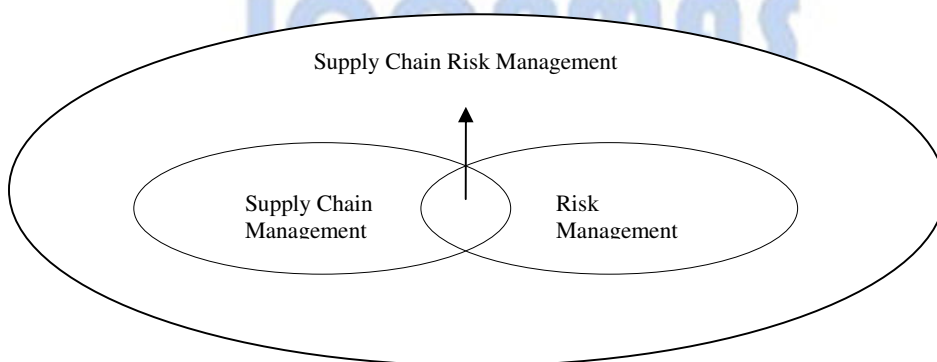


Figure 2.1: Supply Chain Risk Management as the Intersection of Supply Chain Management and Risk Management and Narrowed at Seaport Terminal.

Both Figure 2.0 and Figure 2.1, when it looks deeper can be integrated at seaport terminal as figure 2.2, it also shows that the combination of operational accidents, catastrophes and strategic uncertainty are created the combination of uncertainty, terrorism, natural disasters, disruptions and disturbances of risk. These possibilities of risks are highly needed to look into consideration as seaports are the gateway for sea-locked country for movement of goods.

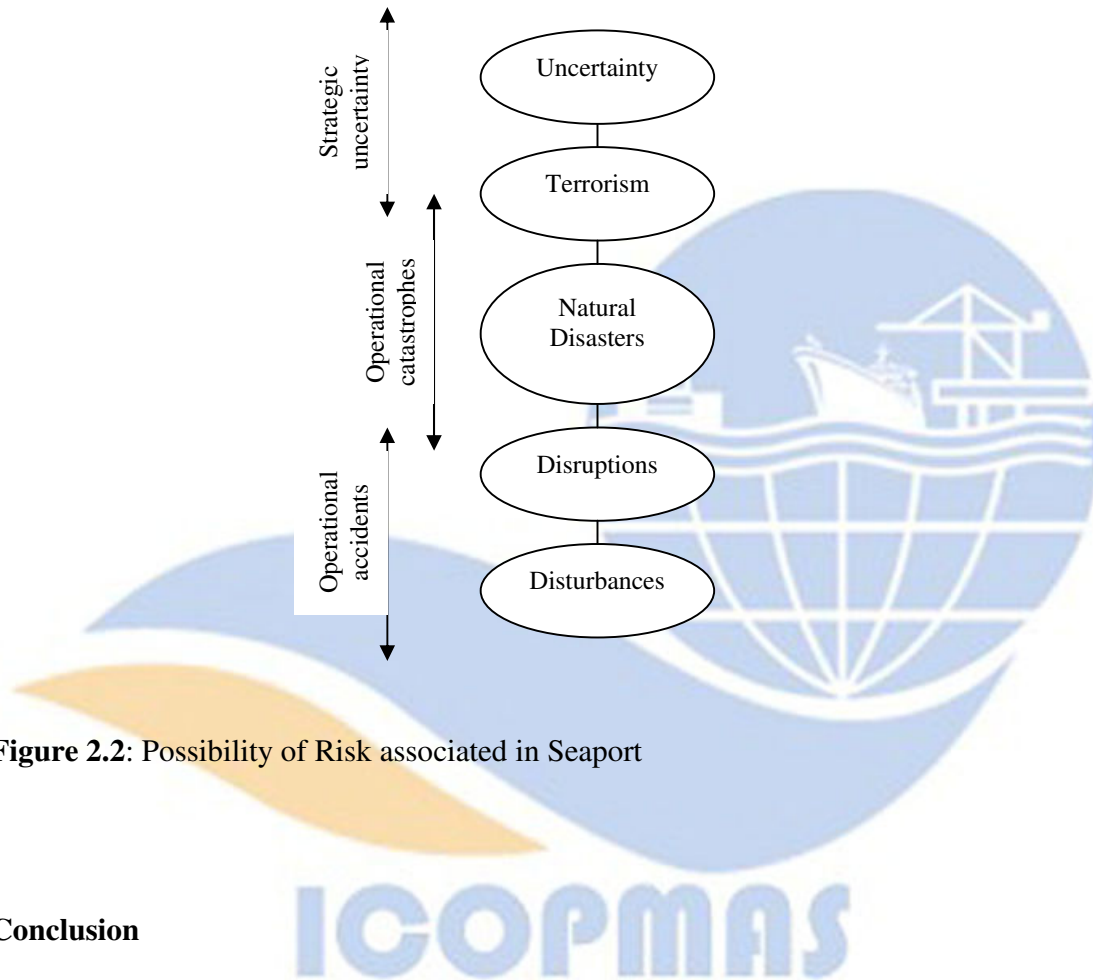


Figure 2.2: Possibility of Risk associated in Seaport

Conclusion

This paper is tried to discuss related work of risk management and supply chain. By having this enable to focus in seaport where seaport is a gateway for sea-locked country. The need to discuss this issue especially in maritime industry is necessary as a main target place to tranship cargo elsewhere. What has been done in this paper is basic assessment where it can be expanded for further research. Besides, this paper is not discussed the suitable method to be used, therefore it is necessary to conduct further research.

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