RISK ASSESSMENT PLAN FOR JOHOR PORT CONTINGENT THREATS

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This dissertation is highly inspired and dedicated
to my lovely dad’s effort,
to ensure his children are fulfilled with comprehensive education,
This dissertation is produced with the full support and blessings
from my mother by continuously providing enormous spirit
in order to fight and ensuring my completion,
This dissertation is produced with the support from my beloved husband,
my young and energetic children, my supportive in laws,
my brothers, sisters and all family members.
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And when Ibrahim said, 'My Lord, make this a place of
safety and provide its inhabitants with fruits all of them who believe in Allah
and the Last Day'. He said, 'I will let anyone who become a disbeliever
enjoy himself a little but then I will drive him to the punishment of the Fire.
What an evil destination!'. (2:126)

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ABSTRACT

The issue of safety and security of marine transportation is a major concern and very critical because it is related with the import and export business in port terminal. As a critical asset that hardly can be substituted by other assets, port terminal requires an effective and comprehensive protection plan to ensure its stability during contingent threats. Risk management process contributes in emergency response protection plan for critical assets during contingent threats. However, there are gaps in risk management process because the critical assets need the resilient elements to retain its original state if threats occur. Thus, the first objective of this research is to investigate and analyse the key risk factors for port terminal. Secondly, to identify and analyse the risk management process for port terminal. Thirdly, to investigate and assess the relationship between resilient indicators in risk management. Fourthly, to develop a structural model of relationship between resilient indicators in risk assessment plan for port resilience emergency plan. The research methodology applied in this research is based on quantitative method with questionnaire survey approach. A preliminary interview with the experts was carried out to validate the questionnaire. Questionnaires are distributed among 75 members from PAGEMA (Pasir Gudang Emergency Mutual Aid). The respondents were chosen among selected group of people that are the vendors for Johor Port representing private and government sectors. The response rate are 72%. The analysis methods used in this research include descriptive analysis, Relative Importance Index (RII) analysis and Structural Equation Model–Partial Least Squares (SEM-PLS). The research findings show the significance level and significance index to each element in risk management process and resilient indicators. Finally, this research have produced a final model of risk assessment plan with six resilience elements and twenty nine indicators. Communication, relationships and planning strategies are the most significant contributors in resilient elements. The combination of significant contributors in resilient elements are an added value to the risk assessment plan. This research also contributes to the methodology in terms of application of risk matrix in investigating and analysing the key risk factors. This research contributes to the emergency response committee in terms of resilient elements justification and their significance in risk management process.

ABSTRAK

Isu keselamatan dan sekuriti di dalam pengangkutan marin merupakan kebimbangan utama dan sangat kritikal kerana ia berkaitan dengan perdagangan import dan eksport di terminal pelabuhan. Sebagai aset kritikal yang sukar ditukar ganti dengan aset yang lain, terminal pelabuhan memerlukan pelan perlindungan yang efektif dan komprehensif bagi memastikan kestabilannya semasa berlaku ancaman kontigensi. Proses pengurusan risiko menyumbang kepada pelan perlindungan dalam tindakbalas kecemasan bagi aset kritikal semasa ancaman kontingensi. Walau bagaimanapun, terdapat jurang dalam proses pengurusan risiko kerana sesebuah aset kritikal memerlukan elemen daya tahan untuk mengekalkan keadaannya yang asal sekiranya berlaku ancaman. Oleh itu, objektif pertama bagi kajian ini adalah untuk menyiasat dan menganalisis faktor risiko yang utama bagi sesebuah pelabuhan. Kedua, untuk mengenal pasti dan menganalisis proses pengurusan risiko bagi sesebuah pelabuhan. Ketiga, untuk menyiasat dan menilai perhubungan di antara indikator daya tahan dalam pengurusan risiko. Keempat, untuk membangunkan struktur model perhubungan di antara indikator daya tahan dalam pelan penilaian risiko bagi pelan kecemasan daya tahan pelabuhan. Kaedah penyelidikan yang digunakan dalam kajian ini berdasarkan kaedah kuantitatif dengan pendekatan kajian soal selidik. Sesi temubual asas bersama pakar telah dijalankan bagi mengesahkan kandungan soal selidik. Seterusnya, borang soal selidik telah diedarkan kepada responden seramai 75 orang yang terdiri daripada ahli PAGEMA (*Pasir Gudang Emergency Mutual Aid*). Responden ini dipilih dari kumpulan yang merupakan pembekal di Pelabuhan Johor yang merangkumi sektor swasta dan awam. Peratusan tindakbalas daripada responden adalah 72%. Analisis yang digunakan di dalam kajian ini terdiri daripada analisis deskriptif, analisis indeks kepentingan relatif (RII) dan kaedah permodelan persamaan struktur (SEM-PLS). Hasil penemuan penyelidikan menunjukkan tahap kepentingan dan indeks kepentingan untuk setiap elemen di dalam proses pengurusan risiko dan indikator daya tahan. Akhirnya, penyelidikan ini menghasilkan model akhir bagi pelan penilaian risiko dengan enam elemen daya tahan dan dua puluh sembilan indikator. Komunikasi, perhubungan dan perancangan strategi adalah indikator utama kepada elemen daya tahan**.** Kombinasi di antara indikator utama kepada elemen daya tahan ini merupakan nilai tambah kepada pelan penilaian risiko. Kajian ini turut menyumbang kepada metodologi dari segi aplikasi matriks risiko dalam menyiasat dan menganalisis faktor risiko yang utama. Kajian ini memberi manfaat kepada jawatan kuasa tindakan kecemasan dari aspek justifikasi elemen daya tahan dan kepentingannya dalam proses pengurusan risiko.

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LIST OF ABBREVIATIONS

WTC	-	World Trade Centre
ISPS	-	International Ship and Port Facility Security Code
IMO	-	International Maritime Organization
USA	-	United States of America
CSI	-	Container Security Initiatives
C-TPAT	-	Custom and Trade Partnership against Terrorism
MTSA	-	Maritime Transportation Security Act
IOT	-	Indian Ocean Tsunami
API	-	American Petroleum Institute
PREP	-	Port Resilience Emergency Plan
JPB	-	Johor Port Berhad
SEM-PLS	-	Structural Equation Modelling- Partial Least Square
CIIP	-	Critical Infrastructure Information Protection
ISM	-	International Safety Management Code
FSA	-	Formal Safety Assessment
TAG	-	Threat Analysis Group
RFRM	-	Risk filtering and ranking management
HHM	-	Hierarchical Holographic Modelling
JKR	-	Department of Public Works
CAPRA	-	Critical Asset and Portfolio Risk Analysis
NPRA	-	National Petrochemical & Refiners Association
NIPP	-	National Infrastructure Protection Plan
RII	-	Relative Important Index
PAGEMA	-	Pasir Gudang Emergency Mutual Aid
MPPG	-	Majlis Perbandaran Pasir Gudang

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Safety and security of the ocean is one of the key challenges of international security in Southeast Asia generally and specifically in Malaysia. As an economic development country, the intra and inter regional trade greatly depends on the seaports operations for import and export activities. Malaysia is strategically located between Celebes Sea and Sulu Sea. Hence, the seaports are exposed to risk of piracy, smuggling and human trafficking. The safety and security issue is a major concern especially on Johor Port as it is a level 1 in critical asset categorisation. Critical asset level 1 means the asset is very critical with no other substitution with other asset in terms of functionality and operation if the assets face contingent threats. Thus, managing the critical assets would be the most challenging job. Other than that, critical asset from the other sector is link to another and it is exposed to various type of risk. The interdependencies of the asset are supported by Trucco et al. (2012) who mentioned that if the functions of the asset or part of it are not work properly then the interdependencies between critical assets will also influence on the other asset.

Hence, this dissertation further elaborates on the risk assessment model for critical asset, specifically seaport as the subject of this research. This chapter elaborates on the research introduction that includes background of the research; the problem statement of the research and follows with the research questions; research objectives; scope of the research; significance of the research; organisation of the chapter; flowchart of the research; research framework and finally chapter summary.

1.2 Background of the Research

The major contingent threat of September 11, 2001 is the main highlight that bring major changes in safety and security issues worldwide (Salter, 2007). The World Trade Centre (WTC) is a large complex with seven buildings. The main twin towers of WTC are the tallest building in the world. However, during the contingent threats, two planes are used as a weapon to attack and strike down the tower. Due to the location of WTC at the heart of the city, then this attack also effected on almost 10 neighbour buildings and towers surrounding the area. Many organisations affected badly and this incident seriously effect on the economy worldwide (Charles et al., 2007). This is a wakeup call for every organisation, every country and every individual to be more alert regarding safety and security issues. The horrific tragedy of 9/11 contingent threats effect the loss of $100Million in airline industry and killed 3000 lives. Timothy (2007), added that this event result in policy changes in most of critical assets especially aviation and maritime sector.

The 9/11 contingent threat reflects on new regulations and enhancement of National Security Council application on marine safety by introducing International Ship and Port Facility Security (ISPS) code, International Maritime Organisation (IMO) and Framework of Standards to Secure and Facilitate Global Trade (Kasypi, 2013). In addition, United States (USA) introduced Container Security Initiatives (CSI) as safety and security prevention step to ensure the contents of container at port are safe and secure. The 24-hour Advance Vessel Manifest Rule (the 24-hour rule), the Custom and Trade Partnership against Terrorism (C-TPAT), the Secure Freight Initiative and Scanning Container is also introduced since the 9/11 event (Barnes and Oloruntoba, 2005).

USA takes further action by developing a port security regulation under the authority of Maritime Transportation Security Act (MTSA) in year 2002. Under this act, all vessels that passing to ports must comply with ISPS code. This is to ensure that any shipment to and from the port past the security screening. The implementation of this regulation is purposely introduced to tighten and ensure the security of the nation.

Besides of terrorist attack issue, the natural disaster contingent threats is another concern. Earthquake and tsunami in Fukushima brings major effect on Daiichi nuclear power plants (Yamamura, 2011; Rittichainuwat, 2012). Infrastructures and buildings are damaged. This technological disaster effect on the society. Besides, Chang (2000) highlighted that the earthquake in Hanshin, Japan effect on Port of Kobe as international container port. This event has cause total loss of 10 Trillion Yen ($US100Billion) and killed 6000 lives. Other than that, Indian Ocean Tsunami (IOT) in Banda Aceh, Indonesia on December 26, 2004 (Leclerc, 2008) heavily damaged all infrastructures in Aceh (Gaillard et al., 2008). However, the waves of tsunami also affected on the neighbour area such as Malaysia, Thailand and Sri Lanka (Srinivas and Nakagawa, 2008). IOT effect on economic losses (Ping and Yi, 2009) and loss of lives (Roy et al., 2007). Although Malaysia is located out of the danger boundary but this events proves that Malaysia should also keep an eye on their safety and risk management (Koh et. al., 2009).

In the case of the City and Port of Oakland, California, Dellums et al. (2009) describes this port as the fifth busiest maritime shipping port but this port face high probability of terrorist attack. Realising the port weaknesses due to the geographical region, The Port of Oakland provide holistic planning to prevent, mitigate and recovery process if harmful event occur. Thus, risk management process is adopted in preparing to face threats and to minimise the impact. However, in the event of heavy fog in November 7, 2007 where the ship hit the San Francisco-Oakland Bay Bridge. Due to the accident, the support tower crashed and caused about 100 – 400 gallons of fuel oil spill. However, when the weather gets better, the local and federal authority inspected the affected area for further assessments. It result in actual fuel oil spill of approximately 58,000 gallons (Dellums et al., 2009). This event effected on fish, birds and marine mammals along the sensitive coastline and wetlands.

Thus, the serious contingent threats as discussed earlier highlight on the types of threats as it can be natural disaster threats, manmade or technological defect (Jones et al., 2013). Once the threat occurred, it seriously impact on the critical assets, economy and loss of lives. The impact due to occurrence of contingent threats is a consequences of the event. In managing risk for critical assets, probability or likelihood of the event to occur is another concern and it is essential to ensure the criticality level of the critical assets. The combination of these three elements of threats; vulnerability and consequences is the main foundation in risk management. Risk as stated by McGill (2008), is a combination of threats, vulnerability and consequences element. Thus, the higher impact of harmful event, the more critical the asset are. Hence, in critical asset protection plan, these three elements are further investigated and identified as very significant in risk management process.

The importance of critical asset protection is also related to emergency management towards disaster. Disaster as defined by National Security Council (2007) is an extreme incident that majorly ruin the social activities, and this includes loss of life, property damage and economic losses. The disruption is out of ordinary ability to recover and need outsources for further recovery process. As in Malaysia, under Section 18 (1), National Security Council Act 2016, the declaration of security area are as follows:

"if any area in Malaysia that is seriously disturbed or threatened by any person and it seriously harm to the people, territories, economy, national key infrastructures of Malaysia or any other interest of Malaysia then the Prime Minister may considers to declare the area as security area."

Based on the quotes from National Security Council Act 2016, national key infrastructures are the main highlight as the critical asset that need to be protected. This is due to any harm on national key infrastructures leads to the declaration of the critical asset area as security area. Thus, Malaysia has set and categorised the critical asset according to the criticality level of either Key Target Level I or Key Target Level II. The listed critical assets are monitored from time to time to ensure the functions of

the critical asset meet the requirement and the critical asset obliged with the regulation and standards set by the Government.

National Security Council defined the critical asset Key Target Level I as an asset with no other option of substitution with other asset if it is ruined and devastated. Hence, it also seriously effect on the national economy, national security and the government functions. While Key Target Level II is an asset that is hardly to substitute if the function is damaged and it effect on the national economy, national society and other government functions. Every Key Target is comply with the Protected Areas and Protected Places Act 1959 in terms of special powers and defensive measures for protected areas and protected places (Protected Areas and Protected Places Act, 1959).

The previous study on risk assessment focus on the specific system components and the likelihood and consequences of control failure. While resilience theory address whole system of behaviour. In identifying critical controls, risk management focuses on the ability to prevent failure and stabilise a certain system state. Resilience focus on the uncontrollable to identify pathways for managing system adaptation to change (Blackmore and Plant, 2008). Based on conceptual analysis of two keys of resilience that are stability landscape and adaptive cycle, this research investigate risk management by including resilience as an overarching measure of sustainability.

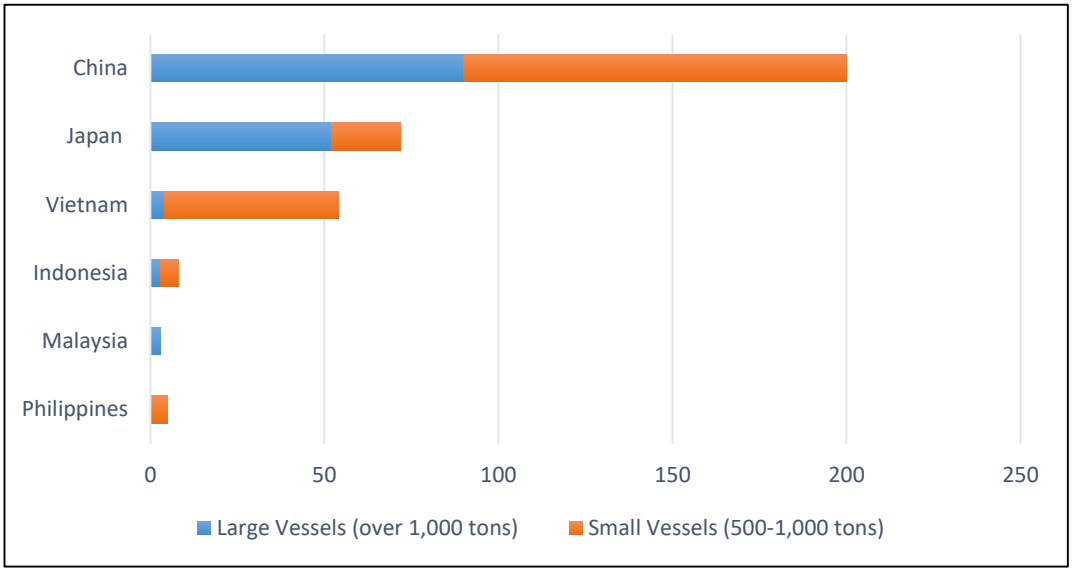
However, this research further investigated on the risk management process with the addition element of resilience as to enhance in minimising impacts and bounce back to come out with other option in facing contingent threats.

1.3 Problem Statement

The process of critical asset management are very crucial and need an enhancement improvement by considering the elements of before, during and after contingent threats. Due to the critical asset functions as national and international trade, it is exposed to risk. Critical assets are specified as assets that is very crucial and its destruction may effect on the economy, health and social generously.

Critical assets are of many sectors and port terminal is one of them. Port terminal is an interface between land and sea. Port functions as a mobility of good intersect between the business of import and export products worldwide (Kasypi, 2013). Since shipping related industry is growing, it contributes to business development of other countries including Singapore as the nearest neighbour country. Being a main contributors to economic development, stern action must be taken to handle any uncertainties especially at the port terminal. Malaysia also rely on sea borne for international trade. Hence, it is essential to understand that any consequences due to threats occurred effect on the port terminal. Due to that, in the process of developing a comprehensive risk management, the probability of risk to occur is analysed. This is because, port terminal are exposed to various risk of incident such as oil spill, wildfire, industrial accident, technological failure, health disease, leaking gas and death.

As in Malaysia, The Straits of Malacca is well known due to its strategic location in the centre of gravity for regional trade besides provides passage from the Indian Ocean into the Pacific Ocean. Since last decades, the issue of security threats beyond this area is a major concern. Due to lack of security conditions within this are, this leads to other problems of piracy, kidnappings, terrorist attacks and criminal activities. US Naval Intelligence (2015) reported that the weak coast guard capabilities of Malaysia, Indonesia and the Philippines and lack of coordination between one another leads to security gaps within this area. The record of law enforcement capabilities is presented in Figure 1.1:



Source: US Naval Intelligence (2015)

Figure 1.1 Maritime Law Enforcement Capabilities in Southeast Asia

Based on this record, the main problem that leads to security threats issues in Malaysia begins with the gaps in law enforcement. Other than that, the coordination in handling security issue within neighbourhood country are very low. Hence, this situation drags the security issues become more serious. Other than that, based on previous actual event occurred on October 2015, six pirates attempt to rob an oil tanker near Tanjung Piai, Pontian. The targeted Liberian registered ship carries 90,000 tonnes of marine fuel oil that worth US$23Million and it is heading to Tanjung Bin (Miranda, 2015). However, the missions to rob the ship failed through Malaysia Maritime Enforcement Agency (MMEA) quick action foiled the attempt and all crew members of the ship are safe.

As a security level 1 critical asset, Johor Port is responsible and must aware of security issue due to its classification as level 1 critical asset. Level 1 refers to the highest level of security protection needed to protect the critical assets from threats. Due to its criticality, ant destruction heavily will affect the asset and it is impossible to substitute the asset with another. As for level 2 critical asset, if any threats occurred then the asset have an option to substitute the current function and operation of the critical asset with other asset.

Realising the importance of critical assets protection then, the awareness on risk management and crisis management arisen. Same goes to the effective risk assessment methodologies for a successful critical asset protection programme (Giannopoulos, 2012). There are various methodologies on risk assessment for critical asset protection. The risk assessment follows from the risk management process in protecting the critical asset. The current records of national critical infrastructure plan summarised by Yusta et al (2011) covers risk assessment as applied in Argentina, Australia, Brazil, Canada, China, Colombia, France, Germany, Netherlands, south Korea, Spain and United Kingdom. Generally the purpose of the critical asset protection plan is to conduct national defence and implement the risk management techniques in order to respond to contingent threats. Further assessment on the possibility of threats, vulnerability and consequences are conducted to assess the level of risk within the critical assets.

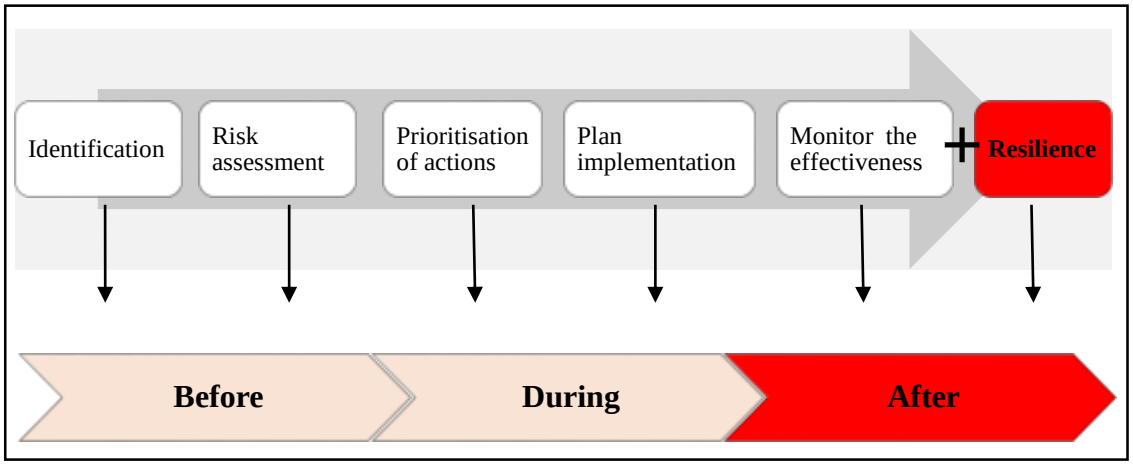
Risk management process includes the process of planning, monitoring and controlling activities based on the information gathered from the risk analysis. Managing risks involve the overall process in analysing and managing the risk (Gerber and Solms, 2005). In managing the risk and maximising the safety and security protection plan for the port terminal, first, this research will identify and analysis the comprehensive risk management process for port terminal. This is to ensure the important process to keep the port terminal secure are well planned and monitor. Risk is related to three elements of threats, vulnerability and consequences. Thus, secondly, all possible threats and consequence will be investigate to prioritise which possible key risk is more important and need further protection.

Critical assets destruction effects on the economy, social and the good name of the country. Sometimes major significances from contingent threats caused dysfunctional of the critical asset with no other options of substantial. Starting from the 9/11 tragedy and since then, the importance of critical assets protection has been realised. Due to previous history of contingent threats then many proactive planned are developed. This includes the development of risk assessment methodologies by considering the details of before, during and after the unwanted event. The need for

risk assessment is highlighted by The American Petroleum Institute (API) (Moore, 2006).

The current research has analysed on the element of risk assessment methodology applied and result in ranking of probability of the assets to expose to risk. Thus, by studying the element of risk management process, this research expands knowledge on resilience indicators which are very significant and functional during contingent threats and effect on minimising the impact.

The literature on previous studies result on five risk management processes that are identification, risk assessment, prioritisation of action, plan implementation and monitor the effectiveness. The identification and risk assessment process are analysed before the contingent threats occurred. This is the first step in risk management process as the criteria, physicality and function of an assets are identified. Further action on risk assessment will analyse the probability of threat occurrence, the probability of vulnerability and level of seriousness might occurred as the consequences of contingent threats. During the contingent threats in the event time framework, prioritisation of action will be taken based on the level of criticality of each asset. This is when the plan is implemented to protect the critical assets. The fifth stage is to monitor the effectiveness of the risk management plan. This includes monitor the consequences after the contingent threats. The formation of risk management process and the resilience element is presented in Figure 1.2:



Source: Van der Vegt et. al. (2015)

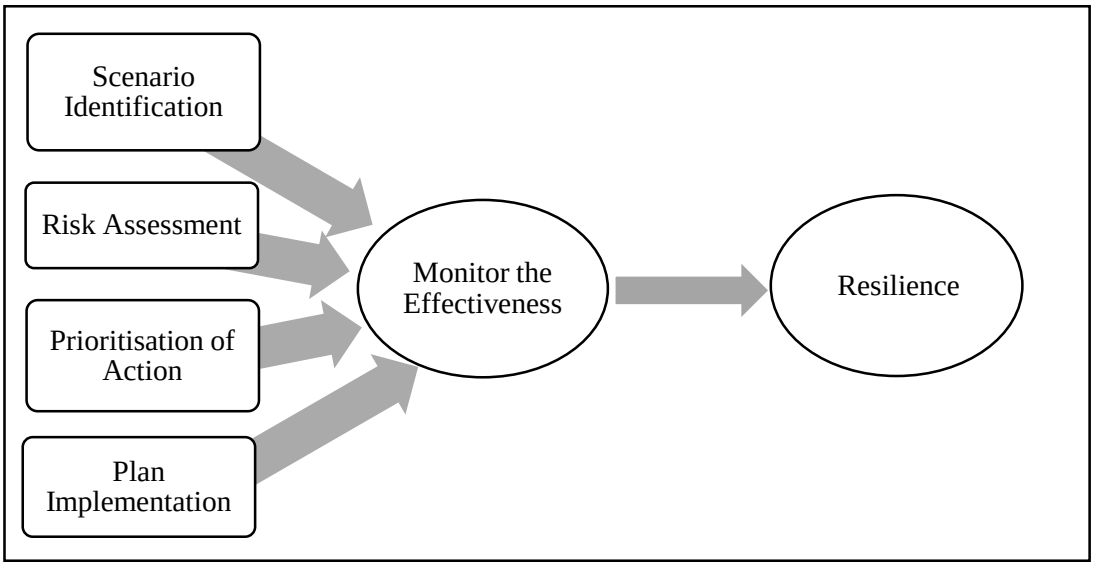
Figure 1.2 The Relationships between Three stages of Contingent Threats Time Frame and the Risk Management Process

Based on Figure 1.2, this research fill the gap by adopting resilience elements in risk management process to minimise the impact if the threats occur. Resilience act upon the harmful event occur. Thus, resilience is another strategy in mitigation plan to transfer the threats and bounce back with the ability of the critical asset to remain stable with its original state of operation and functionality.

Resilience is referring to a condition of systems that absorb stress and able to recover and return back to its original condition (Sapountzaki, 2007). The philosophy inspired by resilience adherent is learning to manage by change. It means that resilience stressed on managing an asset once it face any threats that might harm and disrupt the assets. Van der Vegt et. al. (2015) expressed on the resilience in risk management as a strategy in improving safety and security conditions. The resilience element is more important in current research as it is more explored in the application of risk management (Hollnagel and Woods, 2006). Resilience as in the context of this research refers to connectivity, accessibility and timely emergency response to any threats or contingent threats. Resilience indicators are of emotional competence, social competence, futures oriented, planning, adaptive capacity and minimising the impacts. By implementing the resilience element in risk management process for risk assessment, it will increase the effectiveness of the protection plan and minimise the impact if the threats occur.

The resilience elements are related to individual and organisational readiness towards threats. Other than that, this research fill the gap by coordinating with the expert's opinion regarding Port Resilience Emergency Plan (PREP). This plan is a comprehensive plan that considers the port building structure, fire safety plan, emergency team unit, safety and security system and obstruction.

Thus, this research aims to enhance improvement in risk management process and to minimise the effect if contingent threats occur by highlighting the resilience element in risk management process. Therefore, in cooperating with the risk management for port safety and security, there are issues related to risk management process after contingent threats. The issues are lack of knowledge; outdated emergency prevention tool; lack of awareness for individual; increased maintenance cost; poor relationships with external resources and internal communication system.



Source: Fieldwork Researcher (2016)

Figure 1.3 The Risk Management Process with Resilience Element

Based on Figure 1.3, the risk management process encompass the process of scenario identification, risk assessment, prioritisation of action and plan implementation. Thus, each stage from the risk management process are monitored the effectiveness to ensure the steps taken helps in managing risk. Resilience as to enhance in risk management is a strategy in minimising impacts. The uniqueness of this research is in terms of the resilience element that will be explore more in the after

contingent threats time frame. Realising the lack of focus in after the contingent threats time frame, this research will further investigate on what actions would be taken once the critical assets face threats? How does the critical assets absorb any unwanted changes and able to counter back to remain its assets functions. Thus, the application of new methodology developed from this research that is Port Resilience Emergency Plan (PREP) will be the solution of this problem. PREP is a modified enhancement model that added the resilience elements. Figure 1.4 shows the indicators refers to resilience.

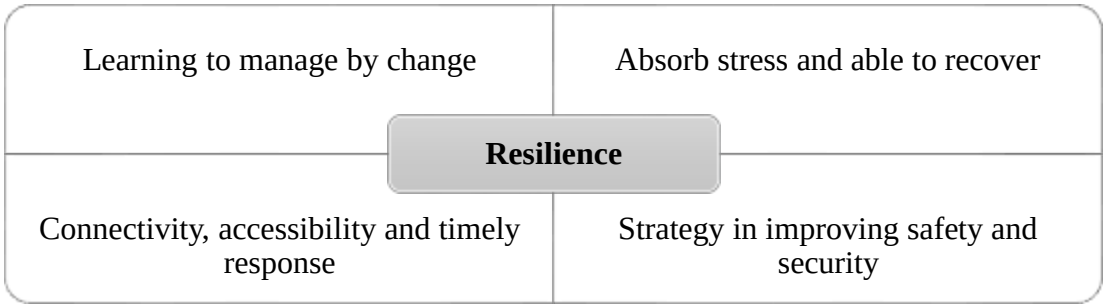


Figure 1.4 Resilience as the Added Element and the Indicators

The upgrade version of new model as an enhancement to the previous model. Thus, it contributes to the growing body of knowledge as the new plan (PREP) is a new idea that enhances improvement on the current plan and will gives benefit to the future. It is also an added value for theories in terms of the resilience as the significant indicators in risk management process and contributes to the commercialisation. Other than that, this research will benefit the stakeholder, the owner and user of the assets.

1.4 Research Questions

This research will answer the following questions:

1) What are the types of risk that faced by port terminal?
2) What is the risk management process for port terminal?
3) What are the relationship of resilience indicators in port risk management?
4) What is the comprehensive and effective risk assessment plan for port resilience emergency plan?

1.5 Objectives of the Research

The objectives of this research were set to answer the research questions. The following are the research objectives:

1) To investigate and analyse the types of risk faced by port terminal.
2) To analyse the risk management process for port terminal.
3) To investigate and assess the relationship of resilience indicators in risk management.
4) To develop a structural model of relationship between resilience indicators in risk assessment plan for port resilience emergency plan

1.6 Scope of the Research

Due to the assets criticality, this research highlighted on the critical asset management specifically instead of asset management. Critical assets consist of various sectors including telecommunications, transportations, water supply and finance. Thus, this research set its limitations to further investigate and analysis on transportation sector. However, the scope of transportation sector is still very wide and consist of air transportation (aviation), maritime, monorail and railway. Each of this transportation division is under its specific regulations and law and enforcement. Hence, to make it clear and precise, this research only focus on maritime transportation sector that is seaport. The operations and main business trade of each port are different depend on the country's main production for import and export dealings. Hence, as the largest oil palm terminal in the world, Johor Port is set as the case study for this research. This is because of its criticality, a comprehensive safety and security protection plan is a must. Thus, Pasir Gudang Emergency Mutual Aid (PAGEMA) members are the selected group of people chosen for questionnaire session to be the respondents. PAGEMA members are chosen because they are aware of safety and security issues within port area. Besides, these respondents are well trained and are acknowledge with the emergency action plan during contingent threats.

In terms of risk management for critical asset, each critical asset specialise and unique for its own strength, benefits and functionality of the asset that hardly to be substitute with other asset. Thus, the scope of this research are narrow down by studying the elements of risk, types of risk and risk management process. In identifying the elements of risk management process, risk assessment is included and contribute in assessing the risk seriousness level. Thus, this research further highlighted on resilience elements as an added elements in risk management process. Resilience is the ability of the critical asset to remain stable with its original state of operation and functionality if contingent threats occur. By considering resilience as an enhance improvement elements in risk management process, this research details the significance of resilience elements to help reduce risk and minimise the impact of contingent threats.

1.7 Significance of the Research

This research contributes to the body of knowledge and to the industry. In terms of the significance of the research to the body of knowledge, this research is an added value to the knowledge in the way to analyse possible threats to occur and the seriousness level of risk to occur. The ability of the stakeholder to analyse the risk probability benefits to the organisation as they can manage and plan for better protection plan and action plan.

Besides, this research is significant due to the justification of the resilience elements and the significant elements in risk management process. Resilience elements consist of emotional competence; social competence; futures oriented; adaptive capacity; planning and minimising impacts. These elements contributes in enhancing proactive risk management in minimising impacts if harmful event occur. The development of risk assessment model benefit to the industry due to resilience in risk management enhance in mitigation action plan and to minimise the impact.

1.8 Organisation of the Chapter

The content of this research will be divided to seven chapters that are introduction; literature review 1; literature review 2; research methodology; case study; data analysis, findings and discussion; and conclusion and recommendations.

Introduction section in Chapter 1 will introduce the content of the research including, the highlight issues in problem statement, the research question and research objective. This chapter detailed on overview for this research. It begins with research background that explains the phenomenon which leads to research problem. Further sections in this chapter will elaborate more on research questions and the aim of achieving the research objectives. The following sections discuss on the limitations of the study and the significance of the study. Align with achieving the objective of this research, the research framework and research methodology explains the organisation

and research flow phase by phase. Finally, chapter summary summarises the content of this chapter.

Chapter 2 is literature review 1 sections that elaborate literally on risk and vulnerability of critical asset. The elements of threat, vulnerability and consequences of contingent threats are discussed. The research focused on port as the critical asset and this chapter further elaborates on risk management for port safety and security. The resilience indicators in risk management process filled the literature review 2 section in Chapter 3. Details of each element that influence the resilience indicator were located in this chapter. Other than that, is the criteria for resilience at post contingent threats are elaborated in this chapter.

Chapter 4 discusses the research methodology for this research. This chapter provides an overview of the research designed in this study. It includes the development of the survey, data collection procedure, criteria in selecting the experts and analyses techniques for each section in the questionnaire. Chapter 5 elaborates on Johor Port, Pasir Gudang as the case study for this research. The standard operating procedure for emergency situations applied in Johor Port is discussed and further explain.

Chapter 6 represents the results of data analysis. The analysis begins with demographic analysis related with the respondents of the research. Next, the data analysis is presented accordingly from objective 1 of the research until objective 4 of the research. In achieving objective 4 of the research, this chapter also represents data analysis using Structural Equation Modelling- Partial Least Square (SEM-PLS). The first phase is to examine the measurement model then followed by assessment of the structural model. This chapter further discuss on the research findings. Chapter 7 ends the dissertation with conclusion summary for each objective of the study and suggestions for research avenue. Based on the chapter outline, the idea concept of this research is compiled into flowchart.

1.9 Flowchart of the Research

The flowchart of the research are illustrated in Figure 1.5. The research are subdivided under three phases namely:

a) Phase I – Research Development
b) Phase II – Data Collection and Analysis
c) Phase III – Findings and Conclusion

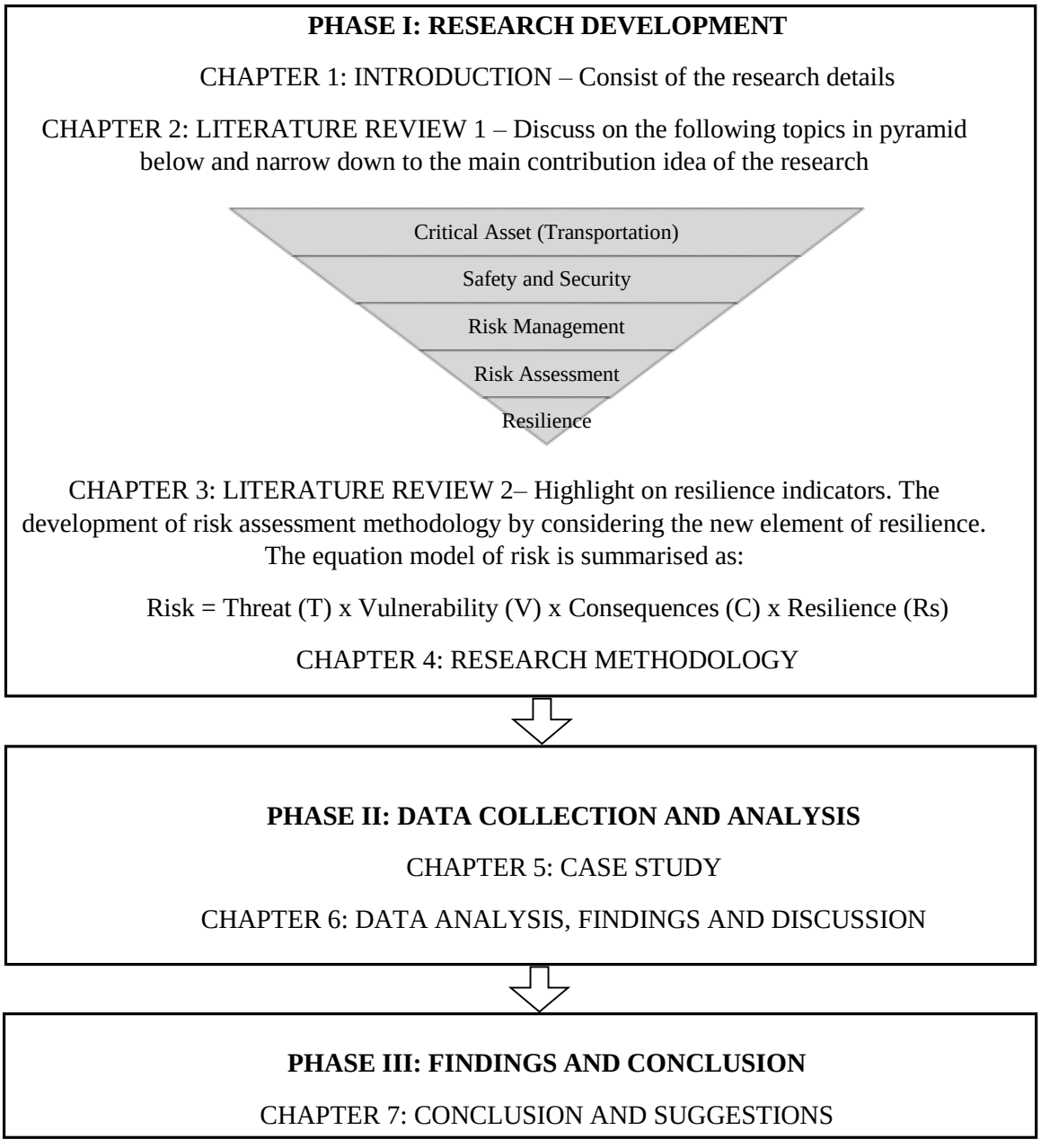


Figure 1.5 Flowchart of the Research

1.10 Research Process

The following Figure 1.6 shows the research process for this research. The elaborations of each research question, following by the objectives, literature review, methods applied, data collection, data analysis and findings for each phase of objectives of the study.

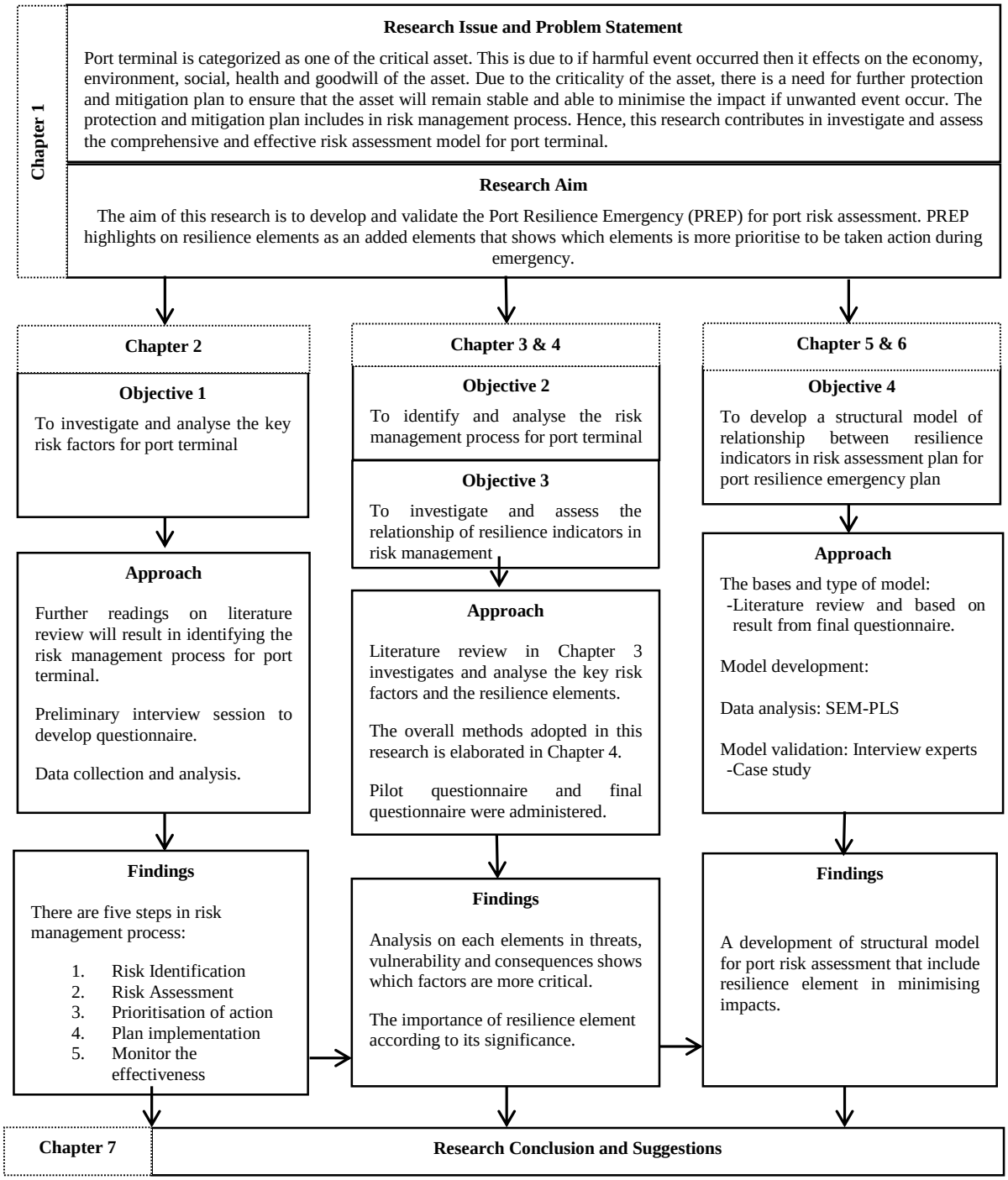


Figure 1.6 Research Process

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