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THE UNITED STATES CONTAINER SECURITY INITIATIVE AND EUROPEAN UNION CONTAINER SEAPORT COMPETITION

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THE UNITED STATES CONTAINER SECURITY INITIATIVE AND EUROPEAN UNION CONTAINER SEAPORT COMPETITION

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Author's Declaration

At no time during the registration for the degree of *Doctor of Philosophy* has the author been registered for any other University award without prior agreement of the Graduate Sub-Committee.

Work submitted for this research degree at the Plymouth University has not formed part of any other degree either at Plymouth University or at another establishment.

Relevant scientific seminars and conferences were regularly attended at which work was often presented.

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Conferences attended**:**

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Abstract

Xufan Zhang

THE UNITED STATES CONTAINER SECURITY INITIATIVE AND EUROPEAN UNION CONTAINER SEAPORT COMPETITION

The increasing volume of container trade poses formidable security challenges. As a result of terrorist attacks, a variety of compulsory and voluntary security measures have been introduced to enhance and secure maritime container trade. The United States (US) Container Security Initiative (CSI) was claimed to impose serious problems in European Union (EU) ports, and in particular it was claimed to affect EU container port competitiveness due to compliance cost and operational inefficiency. This research aimed to analyse the impact of the CSI on EU container seaport competition.

Following an abductive approach, a conceptual model was developed based on the literature review. This directed the design of a Delphi study, which was used to test the opinions of academic, industrial and administrative experts. The Delphi results showed the necessity of implementing maritime security measures integrated into the entire supply chain. The negativity effects of additional costs and operational obstructions are insignificant compared to the overall benefits from a secure supply chain. The CSI is a successful and appropriate maritime security measure. With regard to its effects on the EU container seaport competition, the CSI has not distorted port competition and small ports have not lost market share. It helps the member ports to create new revenue streams and attract more container traffic, hence enhancing their competitiveness. Moreover, it facilitates global trade by reducing total transit time.

A model which contains four factors was built to interpret the results of the Delphi research. This model helps to analyse how a maritime security policy will affect the EU port industry. This research also reveals two major issues under the current supply chain security framework, which are the substantial liability problem and unbalanced bilateral relations. A proposal for developing a comprehensive multilateral regime that is fully integrated into the entire supply chain is recommended as a sustainable solution.

Key words: Maritime security, port security, EU port competition, Delphi technique.

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List of abbreviations

ACI	Advanced Cargo Information
AEO	Authorized Economic Operator
AIS	Automatic Identification System
AMS	Automated Manifest System
ANOA	Advance Notice of Arrival
APEC	Asia-Pacific Economic Cooperation
APMO	Average Percent of Majority Opinions
ASEAN	Association of Southeast Asian Nations
ATS	Automated Targeting System
BASC	Business Anti-Smuggling Coalition
CBP	US Customs and Border Protection
CBPIA	Customs and Border Protection Office of International Affairs
CSCL	China Shipping Container Line
CSI	Container Security Initiative
C-TPAT	Customer-Trade Partnership Against Terrorism
DEA	Data Envelopment Analysis
DHS	US Department of Homeland Security
EC	European Committee
EDI	Electronic data interchange
EESC	European Economic and Social Committee
ERP	Enterprise Resource Planning
EU	European Union
FAST	Free and Secure Trade
FBI	Federal Bureau of Investigation
FREC	Faculty Research Ethics Committee
GAO	US Government Accountability Office
GIS	Geographic information system
GMPH	Gantry moves per hour

HLH	Hamburg-Le Havre
ILO	International Labour Organisation
IMO	International Maritime Organisation
IQR	Interquartile Range
ISO	International Organisation for Standardisation
ISO/PAS	International Standards Organisation Publicly Available Specifications
ISO28000	International security program originated from ISO Technical Committee
ISPS	The International Ship and Port Facility Security
LTTE	Liberation Tigers of Tamil Eelam
MARSEC	Maritime Security
MTSA	Maritime Transportation Security Act
NII	Non-Intrusive Inspection
NISAC	National Infrastructure Simulation and Analysis Centre
NTC-C	National Targeting Centre-Cargo
OCS	Outer Continental Shelf
OECD	Organisation for Economic Co-operation and Development
OSC	Operation Safe Commerce
PIP	Partnership in Protection
ROPMIS	Resources, outcomes, process, management, image, social responsibility
RPM	Radiation portal monitor
SAFE	Framework of Standards to Secure and facilitate Global Trade
SCS	Supply Chain Security
SD	System Dynamics
SEP	Secured Export Partnership
SFI	Secure Freight Initiative

SIP	Secured Export Partnership
SOLAS	Convention on the Safety of Life at Sea
SST	Smart and Secure Trade-lanes
STAR	Secure Trade in the APEC Region
TAPA	Transport Asset Protection Association
TEU	Twenty-foot Equivalent Unit
THC	Terminal handling cost
UNCTAD	United Nations Conference on Trade and Development
USCG	US Coast Guard
VTS	Vessel traffic system
WCO	World Customs Organisation
WMD	Weapon of Mass Destruction
WSC	World Shipping Council
WTO	World Trade Organisation

Chapter 1. Introduction

The primary purpose of this chapter is to introduce the research background, aim and objectives and briefly outline the research methods of this thesis. Additionally, this chapter outlines the research process and thesis structure.

1.1 Research background

The 9/11 events in 2001 caused the worldwide to concern about global safety and security. World commerce depends heavily on maritime transport, so the security of maritime transport has drawn great attention (UNCTAD, 2004). Several major international organisations reacted swiftly to enhance maritime transport safety with strengthening security measures. They produced both voluntary and compulsory rules and programmes, which have been implemented internationally.

In the academic field, there has been a large amount of research on maritime safety and security. Roach (2004) studied security management of terrorism threats in shipping companies. Håvold (2005) discussed safety climate and culture in shipping industry and revealed 11 risk factors through questionnaires. Thai (2007) examined the effects of security improvements in maritime transport with an empirical study of Vietnam. Lun *et al*. (2008) discussed how technology could enhance container transportation security.

Most non-bulk cargoes are transported within standardised containers. The container shipping system is efficient and economical, but also vulnerable to illegal intrusion and misuse. Weapons of mass destruction (WMD), illegal goods and human trafficking can be concealed within containers by terrorists and criminals. Vessels themselves can be used as a weapon in a terrorist attack. In addition, terrorists can operate vessels to finance and support their logistics operations (OECD, 2003).

The Container Security Initiative (CSI) was established in 2002 by US Customs and Border Protection (CBP) to cope with *"the threat to border security and global trade posed by the potential terrorist using a maritime container"* (Donner and Kruk, 2009, p.27). Participating states cooperate with the US CBP to ensure all high-risk containers are identified and inspected before loading onto vessels destined for US ports (Donner and Kruk, 2009). Currently, the CSI has been operated in 58 ports worldwide. It is labelled as voluntary since the regulations are not mandated by a law or international convention.

1.2 Outline research gap

Despite the positive implications of conducting security initiatives for global trade safety and security, arguments arise from the potential issues caused by compliance with the CSI. Additional costs and operational inefficiency are the two major issues raised by many studies (OECD, 2003; Dekker and Stevens, 2007; Bennett and Chin, 2008; Bichou and Evans, 2007; UNCTAD, 2007; Kruk and Donner, 2008; Bichou, 2011). A major part of the cost burden comes from the container scanning required by the new security regime. In order to comply with the regime, initialisation costs occur for purchasing, installation, initial training and civil engineering works. Moreover, there are operational costs for operating the container scanning equipment. The cost estimation varies but the results of past research conclude that the additional cost could cause problems for both low-volume container ports and high-volume container ports (OECD, 2003; Miller, 2007; Bichou and Evans, 2007; UNCTAD, 2007; Dekker and Stevens, 2007). In addition, stakeholders argued that procedural requirements act against operational and logistical efficiency. Both the direct functional redundancies and the indirect supply chain disruptions that arise out of the longer lead times could lead to less reliable demand and supply scenarios (Bichou, 2011).

On the other hand, advocators of maritime security measures argue that the total cost and time of cargo inspection can be lower than conventional random physical inspections since *"detailed data recording, electronic reporting and other procedural requirements"* by the new security regulations make pre-screening and targeting the suspicious containers possible (Bichou, 2008a, p.30). A shipment through a CSI port will undergo zero inspections upon arrival except for an occasional random examination (Bichou, 2011). Productivity of the entire supply chain can be improved because of better procedural arrangements. Moreover, security regime compliance is commercially rewarding. Much research focuses on positive impacts regarding logistical efficiency (Crutch, 2006; Gutiérrez *et al*., 2007; Thai, 2007). Positive impacts include reduced transit time and improvements of lead-time predictability (Thai, 2007; Bichou, 2011), a reduction in stowaways (Timlen, 2007), improved manpower utilisation (Thai, 2007), better document processing and cargo handling (Thai, 2007), and improved customers satisfaction and enhanced branding (Gutiérrez *et al*., 2007; Thai, 2007; Bichou, 2011).

Nonetheless, to date, there is little data and empirical analysis to support either the positive or negative operational and financial impacts of maritime security regime compliance. There are some studies that examine the existence of these impacts, based on conceptual work, economic situation or anecdotal evidence (Babione *et al*., 2003; Lee and Whang, 2005; Thai, 2007; Rabadi *et al*., 2007; Gutiérrez *et al*., 2007; Bennett and Chin, 2008; Yang, 2010; Urciuoli *et al*., 2010; Voss *et al*., 2009; Talas and Menachof, 2009).

Dekker and Stevens (2007) conducted an explorative empirical study of maritime security-related costs and financing in European Union (EU) states. In addition, Dekker and Stevens (2007, p.499) suggested three topics for further study on maritime security costs and financing and associated regulations comprise: (i) "*assessment of a harmonised (legal) system of best practice*", (ii) "*long-term analysis on the effects of security measures on the competitive positions of seaports*"; and (iii) "*provision of empirical evidence for the answer on the question whether security measures should be more (port) administration-based than industry-based"*.

It is revealed in the literature review that there is rarely a qualitative analysis to explore how the maritime security measures affect port competitive position. On the other hand, previous research used very limited and abstracted input factors for their quantitative approaches to investigate port competitiveness (Yeo, 2007). Therefore, a qualitative approach will be suitable for this research and help to fill the knowledge gap.

Therefore, this research will offer a confirmatory and qualitative research project which will not only be useful for ports, but also for governments in terms of developing a better policy.

1.3 Research aim and objectives

There are a number of benefits from complying with the CSI, mainly focused on trade facilitation. However, some effects still remain controversial. According to the discussion in Section 1.2, two major debates over the CSI are compliance cost and operational inefficiency. Moreover, CSI has been introduced as a voluntary bilateral arrangement between US Customs and container export ports overseas; therefore, a concern of port competition distortion was expressed by some stakeholders.

Theoretically, trade and transport operators can still operate with or without participating in those programmes (Donner and Kruk, 2009). However, implications in terms of port competition distortion have emerged. First of all, financial problems have become a major concern since the CSI was introduced, such as the financial cost for carrying out both the non-intrusive inspections (NII) and physical inspections. The CSI member ports could ultimately transfer these extra costs to the US importers as their cost-recovery measures; however, these costs may be significant enough to cause importers to consider cheaper alternatives (Parliament of Australia, 2003). Although not joining the CSI does not cease a country's container movement to the US, the shipment processing from non-CSI ports may be less efficient than CSI-affiliated countries (Parliament of Australia, 2003). Longer processing time from a non-CSI port may affect the export port's efficiency, which will influence the customer decision towards port choice.

Port competition is becoming increasingly complex and is affected by various factors within the whole logistics (Haezendonck and Notteboom, 2002). The competitive position of a container port is affected by *"its competitive offering to the host of shippers and shipping lines for specific trade routes, geographical regions and other ports to which the container port is connected" (*Notteboom and Yap, 2012, p.551). Parola *et al.* (2007, p.117) defined competitiveness as *"the skill or talent resulting from acquired knowledge, able to generate and* *sustain a superior performance as well as face competitive dynamics"*. Port competitiveness is decided by the competitive advantages created or acquired by a port (Haezendonck and Notteboom, 2002). Much port competitiveness analysis highlighted port selection criteria (Pearson, 1980; Willingale, 1981; Brooks, 1984; Slack, 1985; Brooks, 1985; Murphy *et al*., 1988; Murphy *et al.*,1989; Peters, 1990; Murphy *et al.,*1991, Murphy *et al*., 1992; UNCTAD, 1992; Jeon *et al*., 1993; McCalla, 1994; Malchow and Kanafani, 2001; Haezendonck and Notteboom, 2002; Malchow and Kanafani, 2004; Lirn *et al*., 2003; Bichou and Gray, 2005). Yeo (2007) summarised 38 port competitiveness determinants based on existing research. Port efficiency and charges remain the most significant factors for port competitiveness. Port service is another factor that differentiates a port from its competitors (Bennathan and Walters, 1979). Apart from factors mentioned above, issues such as port policy and port management are also related to port competitiveness.

Port competition varies in different regions and places depending on how the port competition forces affect the port environment. Therefore, factors that influence EU container seaport competition will be identified in this research and used to analyse how the CSI affects the EU container port market.

This project aims to analyse the impacts of the Container Security Initiative (CSI) programme on EU container seaport competition. In order to achieve the research aim, the following research objectives are:

> O1: To review literature on maritime security and EU container seaport competition.

O2: To review the various port security regulations of the US, focusing on the CSI programme and the existing debates over its implications.

O3: To identify the determinants of EU container port competitiveness.

O4: To investigate the effects of the CSI on EU container seaport competition.

O5: To propose a sustainable solution to existing issues discovered on maritime security.

1.4 Research methodology

This research used a qualitative approach in order to address the research gap identified above. The Delphi technique was chosen to gather and analyse the primary qualitative data required to assess the conceptual model. The Delphi was chosen because it can stimulate participant discussion without the necessity of gathering subjects into one place and without the risk of 'group think' (De Meyrick, 2003; Rowe *et al*., 2005; Iqbal and Pipon-Young, 2009). It provides rich qualitative information (Clayton, 1997 Hsu and Sandford, 2007; Cottam, 2012).

Regarding this research, the term 'security' refers to terrorism since the research is designed to investigate measures against terrorism. Therefore, maritime security is related to maritime terrorism. A literature review on various maritime security initiatives, including the CSI and their impacts on port competition was carried out. Following the literature review, a conceptual model that included five conceptual assumptions was developed. From each of these conceptual assumptions a set of statements was derived, which formed the basis for the Delphi study.

The Delphi survey consisted of three rounds and the Delphi statements were formed based on the conceptual assumptions. Three groups of experts comprised the Delphi panel: (i) academics who have the opinions and expertise of scholars researching maritime security and container port competition; (ii) industry-users, having the opinions and industry experience of EU container port management and the CSI implementation; (iii) administrators, occupying the positions and experience of major organisations involved in maritime security regulation and maritime governance on international, supranational and national levels. All participants remained anonymous to protect their identity and the integrity of the companies and organisations involved. The Average Percent of Majority Opinions (APMO) Cut-off Rate was used to as a consensus measure.

1.5 Research limitations

Although the research has achieved its aim, there were some limitations beyond the researcher's control. Firstly, due to the nature of the research topic and time factor, the primary data were collected based on a small panel size. Keeping participants' momentum and interests in the survey is also very difficult. Therefore, a larger panel size would be better for data collection. The second limitation caused by the nature of the Delphi technique. As one of the survey methods, the results showed inconsistency among participants (Bichou, 2008a). Three groups of experts with different backgrounds were included in the Delphi and their understandings of statements were influenced by their backgrounds. Lastly, due to the varying port competition environments in different regions, this research focused on EU port region rather than the globe. In order to obtain a more comprehensive understanding of how the CSI affects the port industry, other port regions such as Asia and the Americas should be considered for future research.

1.6 Thesis structure

This thesis consists of the following ten chapters:

Chapter 1 Introduction: An overview of this research including the research background, aim and objectives and research methods is explained in this section. It also provides an outline of the thesis structure.

Chapter 2 Literature review: Maritime security measures and the Container Security Initiative (CSI): This chapter presents and discusses issues regarding maritime security and the relevant framework, including major compulsory and voluntary measures. The CSI and its controversial implications are included as well.

Chapter 3 Port competition: In order to fulfill the research aim and objectives, port competition and competitiveness determinants are discussed in this chapter. Theories on political economics are introduced additionally as the foundation of this abductive research.

Chapter 4 Conceptual model and assumptions: This chapter demonstrates a conceptual model by developing five conceptual assumptions. These conceptual assumptions form the basis of this research.

Chapter 5 Research methodology: This chapter describes and explains the research philosophy, strategy and approach, data collection method, Delphi design, and data analysis techniques.

Chapter 6 The Delphi research process: This chapter presents the process of the Delphi survey. It begins with a discussion of the panel selection process, followed by the description and presentation of the pilot study. The chapter then outlines the process of each round of Delphi. The results of the three rounds, including the response rate and consensus level are presented.

Chapter 7 The Delphi research results: This chapter presents discussions of statements that reached the consensus each round. The conceptual assumptions of the model developed in Chapter 4 are revised as well.

Chapter 8 Discussion of the Delphi research: This chapter starts with a discussion of quality criteria of this Delphi search and critically analyses the Delphi implementation. The rest of this chapter discusses and analyses the primary data and secondary data collected from the Delphi study and the literature review, based on the conceptual model and assumptions developed in Chapter 4.

Chapter 9 Maritime governance, security measures and port competition in the EU: A new model is developed in this chapter to provide explanations of the research gap revealed in Chapter 2 and results of the Delphi. Since this research is shaped within an abductive approach, this research attempts to explain the incomplete observation specified in Chapter 2. The model built in this chapter provides an insight to the current maritime security initiatives and how they have affected EU container seaport operations and competition.

Chapter 10 Conclusion: This chapter provides a summary of the realisation of the research aim and objectives, research contribution and research limitations.

It also gives suggestions to the issues discovered from this research and recommendations for further study based on the research limitation.

Chapter 2. Literature review: Maritime security measures and the Container Security Initiative (CSI)

This chapter begins by introducing the background of implementation of maritime security regimes. Various risk factors and the potential vulnerability posed in global supply chains are identified and discussed. With the growing concern about seaborne trade safety and security, compulsory and voluntary frameworks have been introduced at international, supranational, national and regional level. These frameworks and measures are in relation to the relevant regulatory body. This research aims to investigate the CSI; therefore, Chapter 2 provides a comprehensive description of the CSI, including its background, regulatory body, strategic goals and elements, criteria for joining, and implementations during different phases. Its controversial benefits and negativity are discussed critically, particularly focusing on the aspects of financing, operational efficiency and trade facilitation.

2.1 Development of maritime security

2.1.1 Background

The world economy depends on global trade. Seaborne trade carries over 90% of global commerce by economic value, mainly via containerised cargo (ICS, 2015). Great efforts have been made to develop and improve this system in order to boost the global economy. Nevertheless, the vulnerability of maritime transport has posed a variety of risks. One significant risk arises from terrorist groups and in particular containerised shipping. "*The stakes are extremely high, as any important breakdown in the maritime transport system would fundamentally cripple the world economy*" (OECD, 2003, p.2).

The events of September 11th, 2001 have caused international concerns in terms of safety and security. Worldwide governments and relevant authorities started assessing their vulnerabilities to highly organised terrorist groups right after the devastating attack, and evidence has shown that the threat of terrorism is growing (Sandler, 2014). Based on statistics from RAND (2012), in the 2000s, there were 23,000 terrorism cases growing from around 4,700 in the 1990s, and 3,400 in the 1980s. Based on the threat imposed by seaborne trade, a series of actions have been set in place to enhance the maritime trade security and minimise the threat of terrorism.

Several major international organisations such as World Customs Organisation (WCO), International Maritime Organisation (IMO), International Organisation for Standardisation (ISO) and International Labour Organisation (ILO) immediately reacted to the need to enhance the safety and security in maritime sector. A wide variety of rules and measures have been introduced and implemented at the level of international, supranational, national and regional (Bichou, 2008a). They can also be categorised as mandatory regulations and voluntary initiatives. In 2009, the World Bank and DFID jointly produced the Supply Chain Security Guide to address topics of supply chain security (Donner and Kruk, 2009). The Guide included a brief overview of the current compulsory and voluntary Supply Chain Security (SCS) (Table 2.1 and Table 2.2). However, many requirements by these regulations have overlaps and inconsistency that have caused confusion for both the shipping industry and relevant authorities (Chang and Thai, 2016). Chang and Thai (2016) noted that this issue has been argued by Thibault *et al.* (2006), Sarathy (2006), Hintsa *et al*. (2009) and Yang (2010) and Sadovaya and Thai (2012). For instance, the International Ship and

Port Facility Security (ISPS) Code, the Regulation No 725/2004 of the EU, Advance Notice of Arrival (ANOA) of the US, and Singapore regulations all require vessels to submit ship security information before entering the port (Chang and Thai, 2016). According to Chang and Thai (2016, p.722), Sadovaya and Thai (2012) classified maritime security requirements for carriers and ports into four categories, namely, "*security onboard a ship and/or in port facility, personnel-related security, cooperation with authorities regarding security issues, and security of overall company management*".

Name /Year implement	Originate Country /Institute	Regul. Body	Route Covered	Mode	Participation /Status	Category	Goal
US24 Hour Rule, 2003	US	Customs	From any Country to US Import	Sea	US ports	Govt. Mand.	Advanced information
ISPS Part A, 2004	IMO	IMO	Global	Ship/Port	167 member states	International /Mand.	Standardisation and consistency framework for evaluating risk
Pre-arrival&Pre-departure EU,2009-11	EC	Member state Customs	With EU, and any country to EU	Sea	All EU member states	EU-will become Mand. on 1-1-2011	Advanced information
Japan ACI, 2007	Japan	Customs	From any country to Japan	Sea /air	Japan ports and airports	Govt. Mand.	Advanced information
Mexico 24-hour rule, 2007	Mexico Customs	Customs	From any country to Mexico	Sea	Mexico ports	Govt. Mand.	Advanced information
US10+2, 2009	US	CBP	From any country to US	All	US ports	Govt. Mand.	Advanced information
China 24hour advanced Manifest Rule,2009	China	Customs	From any country to China	Sea	China ports, except for Hong Kong and Macau	Govt. Mand.	Advanced information
100% scanning, 2012 (delayed)	US	CBP	Global to US	Ship/Ports	Pilot phase, 5 ports operating	International Mand. in 2012	Comprehensive SCS
ISPS= The International Ship and Port Facility Security ACI=Advance Cargo Information IMO= International Maritime Organisation EC=European Committee Mand. =Mandatory Govt.=Government							

Table 2.1 Summary of main compulsory SCS programmes
Source: the author 2014 adapted from Donner and Kruk (2009, p.25)

Name/Year implemented	Originate Country/Institute	Regul. Body	Route Covered	Mode	Participation Status	Category	Goal
TAPA,1997	US	Body	Only truck transport routes in US, ME, AF and Asia	Truck	207 members	Private voluntary	Crime incident reporting/identify solutions/share information
C-TPAT	US	CBP	From any country to US	All	6375 certified and 3916 validated companies	Govt. voluntary	SCS
CSI, 2002	US	CBP	Applied to US imports	Sea	58 ports	Govt. Voluntary	SCS
WCO SAFE FoS, 2005	WCO	WCO	Worldwide	All	156 member states	Intl.-Voluntary	Standards for SCS and trade facilitation
ISO28000 Series,2005	ISO Technical Committee	ISO	All	All	157member states	Intl.-Voluntary	Improve SCS
EU-AEO,2008	European Commission	EC Directorate General Taxation and Customs Union	Any country to EU (Imp. & Exp.)	All	192 companies	Govt. voluntary	Trade facilitation and SCS

TAPA=Transport Asset Protection Association
WCO SAFE= World Customs Organisation
CBP=US Customs and Border Protection
ISO= International Organisation for Standardization
C-TPAT= Customs-Trade Partnership Against Terrorism
SAFE Framework of Standards
ME=Middle East AF=Africa
EU-AEO=EU Authorized Economic Operator

Table 2.2 Summary of major voluntary SCS programmes
Source: the author 2014 adapted from Donner and Kruk (2009, p.31)

2.1.2 Maritime security

It is difficult to provide a comprehensive definition of maritime security. Bueger (2014, p.159) critically reviewed various existing maritime security definitions and he concluded that "*no international consensus over the definition of maritime security has emerged*". Nevertheless, Bueger (2014) explained the discussions of maritime security are frequently related to various threats which could jeopardise seaborne trade. These threats are "*maritime inter-state disputes, maritime terrorism, piracy, trafficking of narcotics, people and illicit goods, arms proliferation, illegal fishing, environmental crimes, or maritime accidents and disasters*" (Bueger, 2014, p.159). The concept of marine safety differs from maritime security. Bueger (2014) indicated that 'marine safety' emphasises vessel safety, protection of seafarers and marine environment. To be more specific, marine safety implies regulations of, *inter alia*, vessel construction, maritime installations, safety procedures and maritime professionals education (Bueger, 2014). Despite the differences, safety is the core of maritime security and maritime security and marine safety are increasingly linked since the vessel herself, carriers, and seafarers could be the targets or perpetrators of terrorist and other crimes (Bueger, 2014). Therefore, in order to be inclusive, this research adopts the concept of 'maritime safety and security' which combines maritime security (terrorist acts, illicit cargo) and marine safety (vessel safety and seafarer protection). In a similar vein, port safety and security is also an umbrella term that consists of two aspects: port safety issues (safety and health of persons, safety of vessel and environmental aspects) (Kristiansen, 2005); and port security issues. Council Directive 2005/65/EC (2005) defined security incidents as resulting from terrorism activities. Therefore, in this research, port security refers to measures and actions against terrorist acts. The term 'security' standalone refers to terrorism in this research since the research is designed to investigate measures against terrorism.

2.1.2.1 Terrorism threats

According to the definition given by the US Federal Bureau of Investigation (FBI) (2013), terrorism can be categorised as international terrorism and domestic terrorism. International terrorism is defined by the FBI (2013, n.p.) with three characteristics:

- *Involve violent acts or acts dangerous to human life that violate federal or state law.*

- *Appear to be intended (i) to intimidate or coerce a civilian population; (ii) to influence the policy of a government by intimidation or coercion; or (iii) to affect the conduct of a government by mass destruction, assassination, or kidnapping.*
- *Occur primarily outside the territorial jurisdiction of the US, or transcend national boundaries in terms of the means by which they are accomplished, the persons they appear intended to intimidate or coerce, or the locale in which their perpetrators operate or seek asylum.*

Transportation is critical to terrorism. Various transportation modes have been used by terrorists to transport weapons. The terrorists of 9/11 used an airplane to conduct the attack, while the 'Madrid train bombings' in 2004 occurred on a commuter train. In addition, transportation systems have become a target because of their vulnerabilities which could lead to economic damage and human casualties. The significance of cost to the local economy caused by a terrorist attack have been estimated. For example, GAO (2003, p.8) referred to a work by O'Hanlon (2002) that a US port closure due to a detonated Weapon of Mass Destruction (WMD) could amount to US$1 trillion. Gerencser *et al.* (2003) noted that discovering an undetonated WMD at a US seaport could cause a 12-day closure, which would cost about US$58 billion. Hall (2004, p.354) stated that "*a 10-day shutdown of port facilities would cost the U.S. economy $1.94 billion a day*". Saywell and Borsuk (2002) estimated this disruption would cause a loss as much as 1.1% of the combined GDP of Hong Kong, Singapore and Malaysia.

Maritime transport is exposed to security challenges because it is a complex international transportation network (OECD, 2003). One of the challenges is the multiplicity of terrorist risk factors related to shipping (OECD, 2003). Objects for terrorism attacks include logistics infrastructure such as ports and operational aspects of transport and cargo. According to Parfomak and Frittelli (2007), maritime terrorism contains varying potential attack scenarios. They argued that although individual scenarios could be distinctive from each other, they may be characterised with five common dimensions: perpetrators, objectives, locations, targets and tactics. The Organisation for Economic Co-operation and Development (OECD) also identified a variety of risk factors within the maritime sector in terms of terrorism, which are cargo, vessels, people, finance and logistics support (OECD, 2003) (Figure 2.1).

2.1.2.2 Risk factors

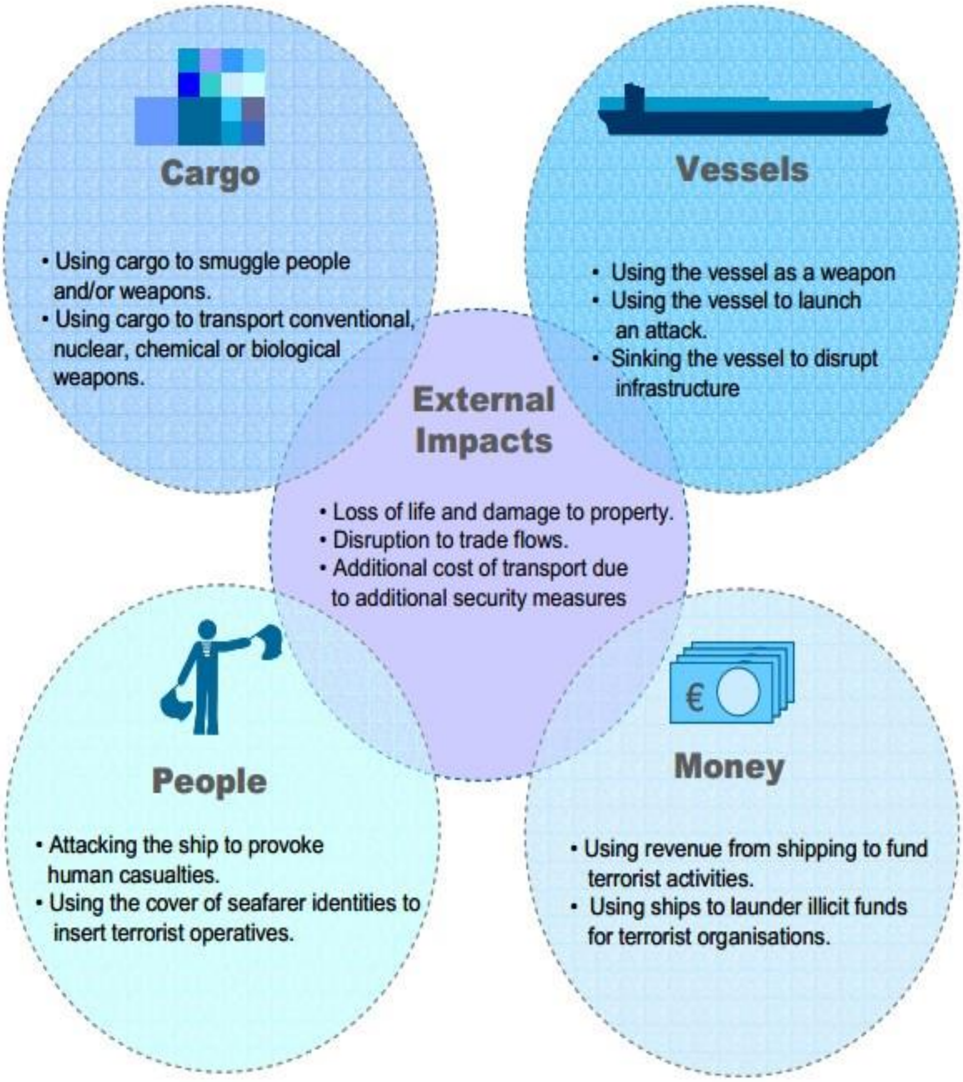


Figure 2.1 Terrorist risk factors in shipping
Source: OECD (2003, p.7)

Container Cargo

Containerised shipping transports most of the world's non-bulk cargoes. These standardised boxes have gained great development since their first introduction in the 1950's (OECD, 2003). According to Rodrigue *et al.* (2009*)*, the early stage of container shipping development can be divided into two phases: introduction (1958-1970) and adoption (1970-1990). During the period of growth which was from 1990 to 2008, containerisation began to significantly influence global trade patterns and manufacturing strategies, particularly with China's entry in the global economy. It has been playing an increasingly significant role in the process, largely due to its numerous economic and technical advantages. According to Drewry (2015), the share of container trade in the total cargo trade volume has steadily increased from 11% in 2000 (236.6 million TEU) to 14% in 2010 (541.8 million TEU). According to the United Nations Conference on Trade and Development (UNCTAD) (2014), the full origin-destination container trade volume reached 160 thousand TEUs in 2013, up from 140 thousand TEUs in 2010. The key drivers behind this global container trade volume growth were the "*sustained global trade growth, increased global sourcing and manufacturing, a shift from transporting cargo in bulk to transporting cargo in containers and growth in transhipment volumes*" (Drewry, 2015, p.98).

In order to lower the cost and achieve economies of scale, container vessel size has increased after 1956, when the first container ship with a capacity of 58 containers started her first voyage. In 2006, the 14,770 TEU *Emma Maersk* with the dimension of 397 meters long, and draught equal to 15.5m, started her first voyage (Maersk Line, 2011). In 2011, Maersk Line put eight PS-class vessels, sized like *Emma Maersk* into services in the world. Maersk's *Triple-E* which is

400 metres long, 59 metres wide and 73 metres high, are deployed on the Asia to Europe trade (Maersk Line, 2013). China Shipping Container Lines (CSCL) launched its *CSCL* Globe ship with a maximum capacity of 19,000 TEU in 2014 (OECD, 2015). Both the maximum and average size of container ships have grown over the recent years. Many shipping lines that had no container ships of over 18,000TEU capacity have ordered new ships. In April 2015, the orderbook including 52 ships with capacity larger than 18,000 TEU was 52 (OECD, 2015). With the current record in terms of TEU capacity, Samsung Heavy Industries OOCL's new ordered vessel with 21,000 TEU would break new capacity records when it would be delivered in 2017 (OECD, 2015).

In 2002 it was claimed that an average cargo ship can carry 6,000 Twenty Foot Equivalent (TEU) containers (The Economist, 2002). One container may involve as many as 25 different parties and 30-40 documents since a container can carry goods from different customers (The Economist, 2002). Therefore, it has been estimated that even by 2002 an average container ship voyage involved up to 40,000 documents such as bills of lading and container manifests, and by 2006 the estimate was 98,000 such documents (Allen 2006).

There are serious security challenges caused by the sheer volume of container movements as well as the uniformity of containers and their relatively high speed of movement (OECD, 2003). First of all, the containerised system is porous so that it can be used for illegitimate purpose. Terrorists could use containers to deliver Weapons of Mass Destruction (WMD) (OECD, 2003). One worst case could be a terrorist organisation smuggles a global positioning satellite-enabled WMD into a container and then sends it into the international transport network in a legitimate way, and remotely detonates the weapon when it arrives the population centre (OECD, 2003). Besides terrorism, drugs and illegal goods can be concealed within containers by criminals. From 1996 to 1998, 950 seizures of narcotic drugs in commercial ocean cargo shipments were reported, accounting for 223,502 kilos of drugs (OECD, 2003). When comparing the figures to other transport modes, it is obvious that the maritime transportation is the preferred option for drug smugglers. Container is also the target of high-value cargo theft. Containers pose threats when carry legitimate cargos that can be used by terrorists for evil aims (OECD, 2003).

Various hazardous cargos, such as explosive compounds, munitions and dangerous chemicals are shipped by containers (OECD, 2003). The explosion that occurred on *Hanjin Pennsylvania* in 2002 near Sri Lanka was caused by improperly stored fireworks and calcium hypochlorite containers (Smeele, 2010). Another explosion and fires happened on a container vessel include the *Sea-Land Mariner* near Crete in April, 1998 and the *Zim Haifa* in 2007 (Ellis, 2010). Since the event of 9/11, two separate terrorism cases that used containers to enter another country occurred in Italy and in Israel (Allen, 2006). Ten civilians were killed in the latter case (Coleman and Levin, 2006). All of these examples have shown the potential risks posed by container shipping.

Vessels

Vessels can be used as a weapon in a terrorist attack against a population area which located near a port or shipping channel to damage port facilities or the vessels and cause access block to a port facility (UNCTAD, 2004). According to OECD (2003), previous terrorism attacks involving vessels have tended to target the ships instead of using them. For example, the boarding of the cruise vessel *Achille Lauro* in 1985, the oil tanker *Limburg* in 2000 and the suicide attacks against the *USS Cole* in 2000 all reveal the vulnerability of marine vessels (Parfomak and Frittelli, 2007).

It appears that a boat laden with explosives rammed the *MV Limburg* causing 90,000 barrels of oil to be spilled in 2002 (GlobalSecurity.org, no date). As a result, ships were diverted from Yemeni ports such as Aden and insurance premiums for those still calling at ports in the Yemen tripled (Richardson, 2004). Ships could also be the facilitator of other attacks. The terrorist group named the Liberation Tigers of Tamil Eelam (LTTE) developed its own forwarders and seaborne transport network (OECD, 2003). LTTE funded ships to carry weapons for a possible war against the Sri Lankan government (OECD, 2003). In addition, there are many cases with the cargo itself being targeted as the object, such as in the case of *Hanjin Pennsylvania* (Smeele, 2010). Most container cargoes and the ship were seriously damaged.

People

Seafarers are often directly targeted and indirectly suffer from terrorist attacks on vessels, such as the case of the Limburg. Another risk factor identified by OECD (2003) is that some seafarers could actually work for terrorist groups. The latter should be especially notable, considering that seafarers normally travel around with the ships, which could bring significant difficulties on detecting terrorism activities (OECD, 2003).

Financing and logistics support

OECD (2003) explained that terrorist groups can operate vessels to generate funds, furthermore, to support their logistics operations. The aforementioned case of LTTE is extensively documented. The LTTE have developed freight forwarders and shipping lines since the mid-1980s (OECD, 2003). Their legitimate operations carry cargoes such as wood and tea, and the vessels operate openly in the world seaborne market. They also carry weapons and ammunition for other terrorist groups for money (OECD, 2003). The funds generated from their operations are used to support their on-going fight against the Sri Lankan government (OECD, 2003).

2.1.3 Overview of maritime security programmes at various level

With the growing concern about international shipping security of goods and passengers, several compulsory and voluntary frameworks have been introduced at international, supranational, national and regional level in order to enhance maritime security and safety. These programmes could help to form a multi-layer regulatory system to fill the potential security gaps (Willis and Ortiz, 2004). A model (Figure 2.2) illustrating the hierarchy of current regulatory programmes by level of security and supply chain converge was illustrated in Bichou (2008a).

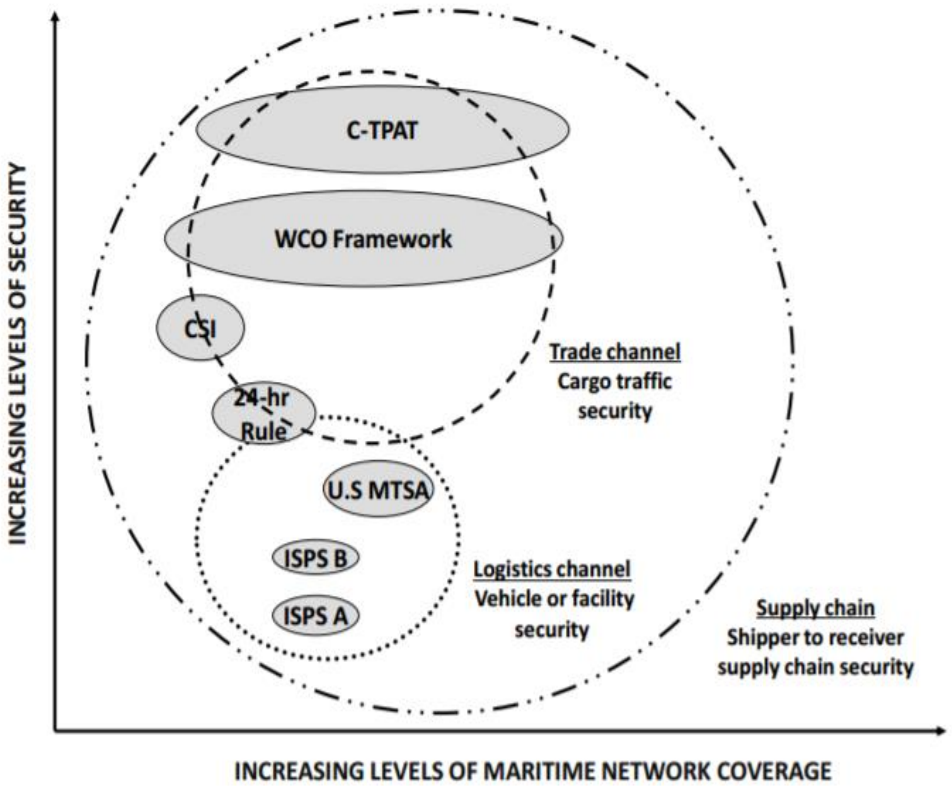


Figure 2.2 Hierarchy of security measures by level of security and network coverage
Source: Bichou (2008a, p.21)

International regulatory measures that have been implemented and endorsed are the ISPS code, the IMO/ ILO code of practice on security in ports, and the WCO 'Framework of Standards to Secure and facilitate Global Trade' ('SAFE Framework') (WCO, 2007; OECD, 2009). The ISPS code drafted and developed by the IMO is the most important and influential security initiative that affects more than the international shipping industry (Bichou, 2004). The ISPS code contains Part A (see Table 2.1) and Part B. As Table 2.1 (see Section 2.1.1) shows that Part A is mandatory, while Part B guidelines are voluntary, but some countries have incorporated them in their national security regulations as mandatory requirements (Bichou, 2011). As to various national levels, the US has developed many significant initiatives. Bichou (2008a) listed several US-led initiatives: (1) the Maritime Transportation Security Act (MTSA) of 2002 that includes both mandatory and voluntary ISPS provisions; (2) a range of security programmes targeting specific maritime operations, including the Container Security Initiative (CSI), the 24-hour Advanced Manifest Rule (the 24-hour rule), the Customs and Trade Partnership against Terrorism (C-TPAT), the Operation Safe Commerce (OSC), the mega-port initiative, and the Secure Freight Initiative (SFI). These programmes, except the 24-hour rule, have been codified into the US Security and Accountability For Every Port Act of 2006 (Bichou, 2008a). There are also other national programmes, including Canada's and Mexico's own 24-hour rules and the Swedish Stair-sec programme (Bichou, 2008a).

Various initiatives are set and implemented at supranational level. Bichou (2008a, 2011) gave a comprehensive and detailed review of supply chain and maritime security measures. For instance, the Council Regulation (EC) No 725/2004 (2004) was on enhancing ship and port facility security. Commission Regulation (EC) No 884/2005 (2005) laid down procedures for carrying out Commission inspections in maritime security, however, it ended validity at 29 April, 2008. Commission Regulation (EC) No 324/2008 (2008) laying down revised procedures for conducting Commission inspections in the field of maritime security repealed Commission Regulation (EC) No 884/2005. Council Directive 2005/65/EC (2005) was on enhancing port security. The Authorised Economic Operator (AEO) which was part of the EU Custom Security Programme came into force on 1st January 2008 can be seen as the EU response to the US C-TAPAT programme (Bichou, 2008a). Bichou (2008a) also mentioned several regional initiatives such as the US-Canada-Mexico Free and

Secure Trade (FAST) initiative, the Association of Southeast Asian Nations (ASEAN)/Japan Maritime Transport Security, the Secure Trade in the APEC Region (STAR) for Asia Pacific and the Secured Export Partnership (SIP).

Last but not least, Bichou (2008a, p.3) stated that there is a set of industrial led and voluntary security programmes worth mentioned, including *“Secured Export Partnership (SEP) programme, the ISO/PAS 28000:2005 standard (Specification for security management systems for the supply chain), the Business Anti-Smuggling Coalition (BASC) scheme, the Technology Asset Protection Association (TAPA) initiative, and a series of Partnership in Protection (PIP) arrangements”*. The ISO/PAS 28000:2005 was applicable to all sizes of organisations in a supply chain and was revised by ISO 28000:2007 (International Organisation for Standardisation, 2007). Bichou (2008a) believed that these measures would form a more effective framework and a higher level of security assurance across the shipping network. However, voluntary programmes are not imposed by a law or international code like compulsory programmes (Donner and Kruk, 2009). Theoretically, trader and transport operators could operate although possibly at a competitive disadvantage- without joining in one of those programmes (Donner and Kruk, 2009).

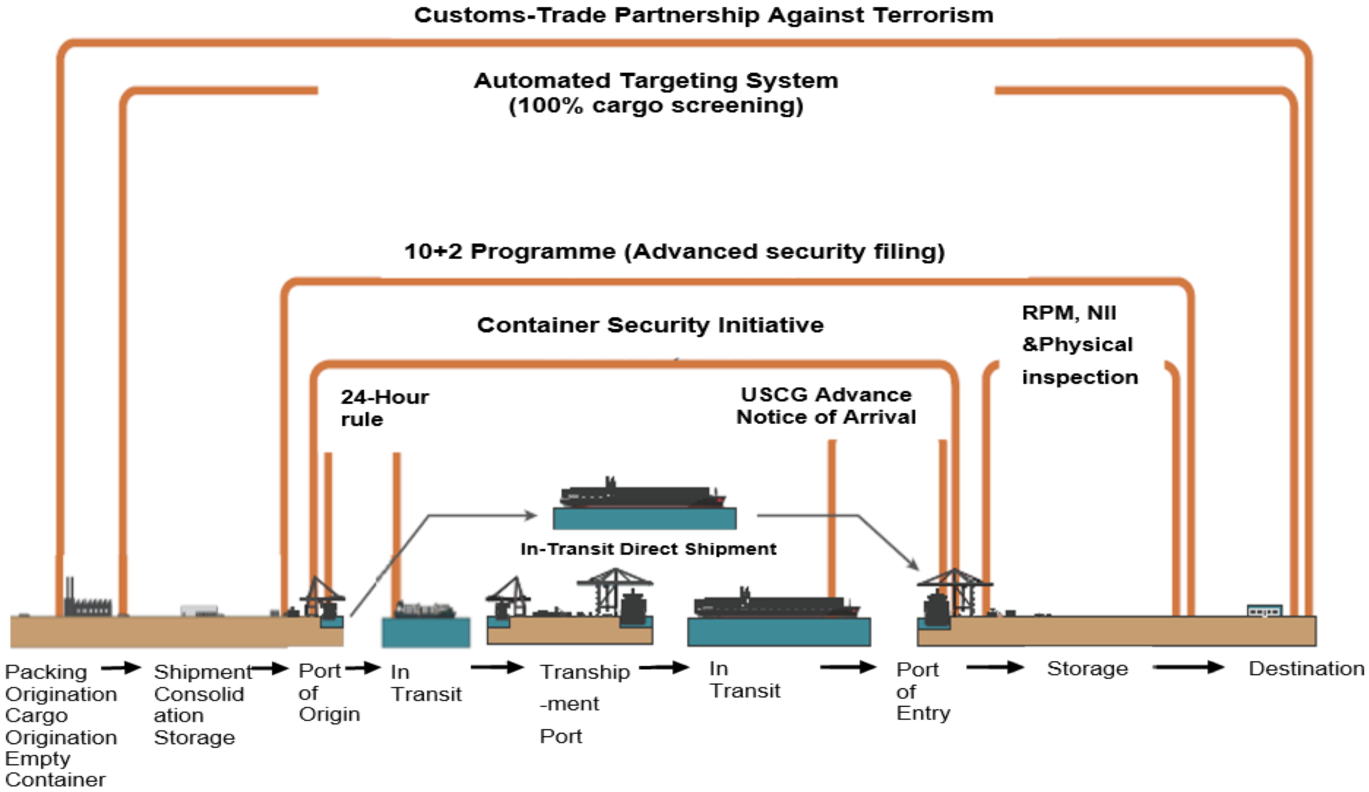
2.2 The introduction of the CSI

2.2.1 US Customs and Border Protection (CBP)

The vision of the Department of Homeland Security’s (DHS) is to "*ensure a homeland that is safe, secure, and resilient against terrorism and other hazards*" (DHS, 2016, n.p.). It has 16 operational and support components (DHS, 2016). The US Coast Guard (USCG) is one of the five armed forces of the US and the only military department of the DHS to protect the maritime economy and the environment. The CBP is one of the DHS's largest and most complex components (DHS, 2016). Its priority mission is to keep terrorists and their weapons out of the US (DHS, 2016). The CBP has made great progress to ensure the US-bound supply chains are more secure against potential terrorist acts and keep away from the delivery of weapons of mass effect (DHS, 2009). The CBP is using a multi-layered approach to ensure the completion of the supply chain from the point of loading through arrival at a US port of entry (Figure 2.3). The DHS (2009, n.p.) explained the multi-layered approach includes:

- *Advanced information under the 24 Hour Rule and Trade Act of 2002 (supplemented now by Imported Security Filing requirements).*
- *Screening the information through the Automated Targeting System (ATS), the 10+2 Program and National Targeting Centre-Cargo (NTC-C).*
- *Partnerships with industry and the private sector such as the C-TPAT.*
- *Partnerships with foreign governments, such as the CSI and the Secure Freight Initiative (SFI).*
- *Use of Non-Intrusive Inspection (NII) technology and mandatory examinations for all high-risk shipments.*
- *Radiation portal monitoring and Secondary radiation monitoring systems.*

The figure illustrates the container delivery system from cargo origin, through packing and loading onto a container ship, and through arrival at a US port and delivery to the final customer.



NII=Non-intrusive imaging RPM=Radiation portal monitor USCG= US Coast Guard

Figure 2.3 US CBP Layered defence strategy
Source: the author 2016 adapted from Congressional Budget Office (2016, p.10)

The layered approach helps the CBP to receive, process, and act swiftly upon commercial information to target the suspect shipments without interfering with the cargo movements through ports (DHS, 2009). Various inspection equipment and technologies are utilised during this process to ensure the safety and security of container movement (Table 2.3 on p.52). The NII system is the most common inspection system to give a quite accurate image of the container's contents. It has two types of imaging systems: large-scale (portal gamma-ray, mobile truck gamma-ray, rail, etc.) and small-scale (Figure 2.4 on p.53) (DHS, 2014). It inspects and screens conveyances or cars, trucks, railcars, containers, and personal luggage, packages through either gamma-ray imaging systems (Figure 2.5 on p.53) or x-ray (Figure 2.6 on p.54). The total time for inspection is about 2-5 minutes per object (DHS, 2014). The Radiation Portal Monitors (RPMs) serve a similar goal as the NII, using gamma-ray and neutron detection. It is considered to be the first measure to prevent the illicit trafficking of radioactive and nuclear materials (Congressional Budget Office, 2016). In addition to scanning systems, different technologies are used to prevent the container from interception and being tampered with. Technical specifications on secure containers and sealing have been set out (Table 2.3).

System/Technology	**Description**
Non-Intrusive Inspection (NII)	Imaging system consists of various technologies (gamma-ray, X-ray) with different capabilities (large-scale, small-scale) to identify specific materials with different kinds of equipment (mobile, crane mounted, hand-held).
Radiation Portal Monitors (RPMs)	Passive radiation detection for screening. It detects traces of radiation emitted from an object passing through a RPM. Gamma radiation is detected, and in some cases complemented by neutron detection when sensitivity for nuclear material is desired.
Mechanical seals: Indicative seals	The seals are affixed either on the handle mechanism directly or to the door superstructure. It indicates when unauthorised entry into the container has occurred.
Mechanical seals: Security seals	Similar to indicative seals but it is only to indicate whether the seal has been compromised. It has a unique identification number and is marked by the seal owner's stamp.
Mechanical seals: High-security seals	In addition to the same functions of the above two seals, it also serves to physically prevent or delay entry into the container. It has stronger materials and more strategic locations. The most common forms are the bolt seal and cable seal.
'Smart' seals: Electronic seals	It integrated physical security and information management capabilities. It has a physical sealing device with a data chip and a mechanism for information reading.

Table 2.3 A list of major scanning systems and container sealing technologies
Source: the author 2014 adapted from European Conference of Ministers of Transport (2005), Donner and Kruk (2009), and DHS (2014)

Figure 2.4 Small-Scale NII technology
Source: DHS (2014, p.25)

Figure 2.5 Gamma-ray systems
Source: DHS (2014, p.23)

Figure 2.6 High energy fixed X-ray systems
Source: DHS (2014, p.24)

2.2.2 The establishment of the CSI

The CSI was established in 2002 to cope with the threat to border security and global trade caused by potential terrorists using of a sea container to deliver a weapon (Donner and Kruk, 2009). The main aim of the CSI, as Donner and Kruk (2009, p.27) quoted from the words of the CBP was "*to extend the zone of security outward so that American borders are the last line of defence, not the first*".

The CSI was proposed to ensure all containers that pose potential risks for terrorism were screened and inspected at foreign ports before they were loaded on vessels imported to the US (CBP, 2011). Over 80% of all waterborne cargo shipping to the US is subject to pre-screening (CBP, 2011). A foreign member port agrees to inspect the US-bound containers thoroughly at its own ports.

According to the report given by the CBP (2011), the CSI was firstly conducted in ports which have the highest volume of container shipments to the US. Currently, the programme has been implemented in 58 ports around the world, including North Central, and South America, the Caribbean, Europe, Africa, the Middle East, and throughout Asia (Figure 2.7).

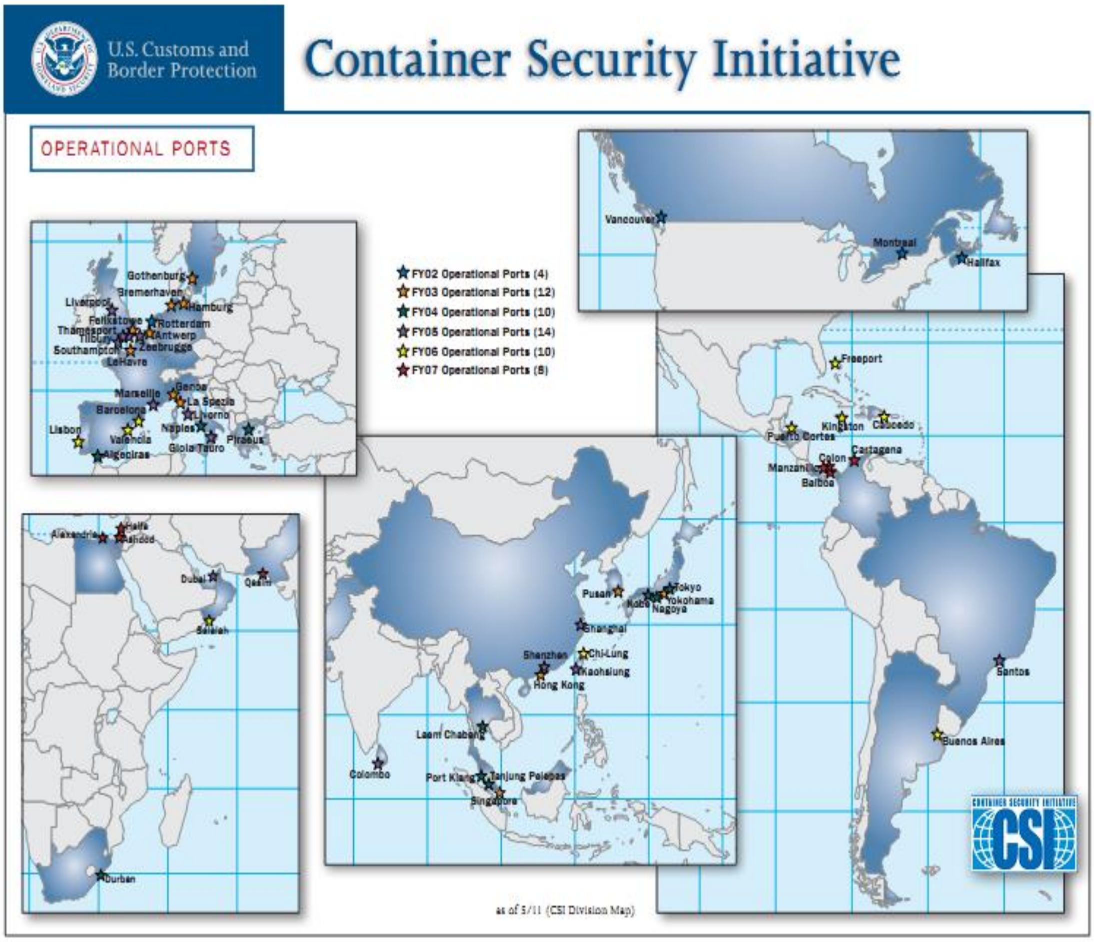


Figure 2.7 CSI current operation ports
Source : CBP (2011, p.5)

Before the introduction of the CSI, less than 5% of the 17,000 containers entering the US each day were examined, accounting for approximately US$1.3 billion worth of goods (Lenain *et al.,* 2002; Allen, 2006). These container cargos were inspected with drive-by imaging equipment and the vast majority of that activity occurred at the port of entry in the US (Koch, 2002). In the fiscal year 2010, more than 10.1 million maritime shipments were screened at CSI ports before leaving for US ports, an average of 27,600 a day (CBP, 2011). In 2013, on average, 27,600 import containers arrived at US seaports every day and ports handled 18 million TEUs of cargo (American Shipper, 2014). Selection for inspections is mostly triggered by data mining shipping information and intelligence to identify suspicious container contents (American Shipper, 2014). In fiscal year 2013, the DHS's fiscal year 2015 budget request to Congress revealed that CSI teams reviewed more than 11.2 million bills of lading prior to container loading and conducted 104,000 examinations of high-risk shipments in cooperation with host country CSI teams (American Shipper, 2014). About 94% of examination requests are granted by foreign authorities, which left 6% of cases further scrutiny is denied, according to the CBP (American Shipper, 2014).

2.2.3 The CSI strategic goals and core elements

The CSI itself has adopted a multi-layered approach in a similar way to the US overall, which consists of three strategic goals and their associated objectives (Table 2.4).

Strategic Goal 1	Secure US Borders	**Objective 1.1**: Enhance the process for identifying high-risk cargo by receiving and making full use of advance trade data.
		Objective 1.2: Improve the process of screening and examining containers by developing and fully utilizing state-of-art technology.
		Objective 1.3: Promote parity through increased examinations of high-risk containers prior to entering the United States.
Strategic Goal 2	Build a Robust CSI Cargo Security System	**Objective 2.1**: Advance Security of all world nations by promoting an international framework of standards covering data elements, host country examinations, risk management and detection technology.
		Objective 2.2: Enhance cargo security and trade facilitation by strategically identifying the optimal trade lanes and ports for inclusion into CSI.
		Objective 2.3: Expedite the movement of low-risk shipments through the global supply chain.
		Objective 2.4: Continue to work with other agencies on maritime contingency and recovery plans and efforts.
Strategic Goal 3	Protect and Facilitate Trade	**Objective 3.1**: Increase the effectiveness of CSI by negotiating with host countries to review and request examination of all-risk shipments identified by CBP through the Automated Targeting System (ATS).
		Objective 3.2: Ensure effective coordination with host countries by conducting periodic risk evaluations of ports to assess the level of staffing and other resource needs.
		Objective 3.3: Encourage interagency cooperation by developing a capacity to collect and share information and trade data gathered from CSI ports.
		Objective 3.4: Present CSI standards and promote greater participation by international governments, international organisations, trade communities and other organisations engaged in maritime security.
		Objective 3.5: Improve CSI operations by evaluating the feasibility of regionalizing management of CSI teams.

Table 2.4 CSI three strategic goals
Source: the author 2014 adapted from CBP (2006)

Holmes (2004) stated that the CSI is the umbrella term for security initiatives that include C-TPAT, the 24-hour rule, and the CSI itself. The CSI discussed in this project includes the proper specific port-to-port shipping element and the 24-hour rule which is a primary aspect of the CSI. Table 2.5 gives an outline of the CSI and the 24-hour rule. According to the CBP (2006, n.p.), the CSI has three core elements:

- *Using intelligence and automated advance targeting information to identify and target containers that pose a risk for terrorism.*
- *Pre-screening those containers that pose a risk at the port of departure before they arrive at the port of entry.*
- *Using state-of-the-art detection technology to scan containers that pose a risk.*

	Arrangement	Targets /participants	Requirements &responsibility	Inspection &certification	Observation
CSI	Bilateral agreement/ partnership between the United States and foreign-trade country/port partners	Foreign ports (US ports under reciprocity) with substantial and direct waterborne container traffic to the United States	Establish security procedures to identify high-risk container cargo. Work with deployed CBP officers to target containers at risk. Provide NII equipment for container screening and inspection	Validation process and risk assessment mechanism (updated regularly)	CBP offers CSI reciprocity (As of April 2005, Canada and Japan customs personnel are already deployed in US ports)
24-hour rule	Compulsory regulation, not applicable to bulk cargo	Ocean carriers or their agents. Licensed or registered NVOCCs	Electronic reporting to CBP, via AMS and 24 hours before loading at foreign ports, of complete manifest information for all cargo on board ships calling in US ports, even if the cargo is being transhipped or continues on the ship to a third country after it departs the US	CBP identification/clearance of transmitted information Non-issuance or delay of permits to unload suspected cargo, or cargo with incomplete/late advance manifest. Penalties may also apply	Exception may be made for break-bulk cargo shipments. Importers may request confidentiality of their identity and the identity of their shippers Generic descriptions are not accepted

Table 2.5 Outline of the CSI and the 24-hour rule
Source: Bichou (2011)

2.2.4 Joining the CSI

Three main criteria, that are trade volume, terrorism connections and geographical interest, are set up for participation in the CSI. Certain steps need to be implemented once a port has been selected. The steps include "*negotiating and executing a Declaration of Principles document with the host country; conducting an operational assessment of the proposed port; determining CSI facility possibilities and conducting surveys and estimates of requirements to establish a CSI office; staffing the CSI office; and building-out all facilities, support and IT infrastructure necessary for the CSI team to be operational*" (CBP, 2006, n.p.). In addition, Allen (2006, p. 440) listed four basic requirements for CSI candidates: *"(1) determine criteria for establishing if a container represents as a 'high risk'; (2) have local customs officials work with US Customs agents, who are posted at these ports, to identify 'high risk' containers; (3) pre-screen these containers before they are loaded onto US bound ships with non-intrusive inspection (NII) equipment (including gamma or X-ray imaging capabilities) and radiation detection equipment; (4) the port must implement the use of 'smart' or tamper proof container-seals in order to secure the containers once they are en route to the US"*. Additionally, the host port authorities need to *"implement an 'automated risk management system' and share intelligence on potential security threats from within the country with U.S. Customs agents, and identify and resolve security breaches in the port area"* (Allen, 2006, p.440). The minimum standards for the candidate countries are listed in the following Table 2.6.

1	The availability of NII equipment and radiation detection equipment in order to meet the objective of quickly screening containers without disrupting the flow of legitimate trade. The ability to inspect cargo originating, transiting, exiting, or being transhipped through a country.
2	The seaport must have regular, direct, and substantial container traffic to ports in the United States.
3	Commit to establishing a risk management system to identify potentially high-risk containers, and automating that system. This system should include a mechanism for validating threat assessments and targeting decisions and identifying best practices.
4	Commit to sharing critical data, intelligence, and risk management information with the US CBP in order to do collaborative targeting, and developing an automated mechanism for these exchanges.
5	Conduct a thorough port assessment to ascertain vulnerable links in a port's infrastructure and commit to resolving those vulnerabilities.
6	Commit to maintaining integrity programs to prevent lapses in employee integrity and to identify and combat breaches in integrity.

Table 2.6 Minimum standard for CSI candidate ports
Source: the author 2014 adapted from CBP (2006)

According to the US Government Accountability Office (GAO) (2003, p.10), the bilateral agreement of the CSI stated that the US Customs *"sends an assessment team to the CSI port to collect information about the port's physical, informational infrastructure and the host country's customs operations"*. Then a CSI team of Customs personnel will assist the host country's customs officials to identify high-risk containers departing from a CSI port (GAO, 2003). A typical CSI team is made up of four to five team members. This team is structured as: *"two to three inspectors from Customs' Office of Field Operations, one intelligence research analyst, and one agent as a CSI team leader representing the Office of Investigations"* (GAO, 2003, p.11). The team utilises Customs' Automated Targeting System to screen containers that poses risks for inspection (GAO, 2003). To improve its screening capabilities, the team further analyses these containers by using data provided by the host nation's customs administration. Then host countries' customs inspect containers identified by both US and host customs as high risk (GAO, 2003). One key tenet of the CSI is that the US Customs inspectors are able to *“observe and verify the inspections”* (GAO, 2003, p.10).

CSI three phases implementation

There are three phases for a global implementation of the CSI. During the first year of the CSI, US Customs quickly achieved active participation among the nations respectively, which it applied to enrol in the CSI (GAO, 2003). Phase I included international 'megaports' and strategic ports (CBP, 2003a). Firstly, Canada agreed to place US Customs officials at three seaports under the Smart Border Declaration that preceded the announcement of the CSI (GAO, 2003). Between January 2002 and January 2003, bilateral agreements with 12 governments were concluded, including the 18 of the 20 'megaports' which have the highest shipment volume of containers to the US, as well as two other governments representing three strategic ports (GAO, 2003) (Table 2.7). US Customs soon deployed CSI teams to 5 of these ports.

Phase I ports		
Hong Kong, China	Shanghai, China,	Singapore, Singapore
Kaohsiung, Taiwan, China	Rotterdam, The Netherlands	Pusan, Korea
Bremerhaven, Germany	Tokyo, Japan	Genoa, Italy
Shenzhen, China	Antwerp, Belgium	Nagoya, Japan
Le Havre, France	Hamburg, Germany	La Spezia, Italy
Felixstowe, United Kingdom	Algeciras, Spain	Kobe, Japan
Yokohama, Japan	Laem Chabang, Thailand	Montreal, Canada
Vancouver, Canada	Halifax, Canada	

Table 2.7 Phase I CSI ports
Source: the author 2014 adapted from Allen (2006)

These initial ports were chosen based on the criteria of "*regular, direct and substantial container traffic, originating, transiting, exiting or being trans-shipped through their facilities to the US*" (Allen, 2006, p.440). Approximately 70% of all goods entering US ports depart from these 'megaports' (Allen, 2006). As the CSI progressed, Customs adjusted its provisions as it met challenges. For instance, the first CSI team in Europe found that manifest data which was required from the host customs was not readily available (GAO, 2003). Consequently, the CSI team was not able to thoroughly screen containers overseas. To resolve this issue, Customs implemented the 24-hour Rule requiring carriers to submit key information directly to Customs (GAO, 2003). Additionally, to develop an adequate survey instrument, Customs embedded additional expertise into the teams and developed comprehensive and standardised port surveys (GAO, 2003). US Customs claimed that the CSI teams conducted manifest data screening for more than 606,000 containers and identified 2,091 containers in total which were considered as high risk between the time of initial deployments for the first five CSI ports (Halifax, Montreal, Vancouver, Le Havre, Rotterdam) and May 2003 (26 CSI ports in total including two China's ports) (GAO, 2003). These containers then were inspected by host customs administrations (GAO, 2003). However, at the early stage of the programme, *"Customs has not taken adequate steps to incorporate factors crucial to the programme's long-term success and accountability"* (GAO, 2003, p.4). GAO (2003) noted that a systematic human capital recruitment plan, train and assign relevant programme staff was still in absence after 1 year of the implementation. Customs also lacked *"performance measures that demonstrate programme achievements and establish accountability"*, although they were tracking number of countries participated in the CSI (GAO, 2003, p.4). Without indicators that measures programme outcomes, Customs could not accurately assess the programme's success or establish an oversight basis.

The US Customs only focused on short-term operational planning to quickly roll out the programme without considering its long-term success (GAO, 2003).

During Phase II, the CSI was extended to ports in 'middle-income' developing countries: Argentina, Brazil, Panama, Sri Lanka, Malaysia and South Africa (Allen, 2006). None of the least developed countries were included in Phase II since most of these regions are landlocked and rely on exporting unprocessed and raw commodities which are transported by bulk carriers rather than containers (Allen, 2006). During Phase II, the strategic importance of the port and if it has expressed willingness to meet the CSI requirements were considered as eligible standards (CBPIA, 2002). There were 23 ports in this phase, including Marseilles, Naples, Barcelona, Valencia, Southampton, Thamesport, Lisbon, Buenos Aires, Santos and Colon (Table 2.8).

Phase II ports		
Port Klang, Malaysia	Tanjung Pelepas, Malaysia	Gothenburg, Sweden
Marseilles/Fos, France	Livorno, Italy	Gioia Tauro, Italy
Naples, Italy	Barcelona, Spain	Valencia, Spain
Southampton, UK	Thamesport, UK	Zeebrugge, Belgium
Osaka, Japan	Piraeus, Greece	Lisbon, Portugal
Buenos Aires, Argentina	Santos, Brazil	Colon, Panama
Balboa, Panama	Durban, South Africa	Colombo, Sri Lanka
Izmir, Turkey	Dubai, UAE	

Table 2.8 Phase II CSI ports
Source: the author 2014 adapted from Allen (2006)

According to the last published official information of the CBP (2014), the CSI is in Phase III at the moment. There are 58 ports that have joined the programme (Table 2.9). It targets ports which did not qualify under Phase I and Phase II. Table 2.9 present the 58 foreign ports participating in the CSI, which account for 85% of container traffic destined for the US (CBP, 2014).

In the Americas and Caribbean	
Montreal, Vancouver and Halifax, Canada	Kingston, Jamaica
Santos, Brazil	Freeport, The Bahamas
Buenos Aires, Argentina	Balboa, Colon and Manzanillo, Panama
Puerto Cortes, Honduras	Cartagena, Colombia
Caucedo, Dominican Republic	
In Europe	
Rotterdam, The Netherlands	La Spezia, Genoa, Naples, Gioia Tauro, and Livorno, Italy
Bremerhaven and Hamburg, Germany	Felixstowe, Liverpool, Thamsport, Tilbury, and Southampton, United Kingdom (UK)
Antwerp and Zeebrugge, Belgium	Piraeus, Greece
Le Harve and Marseille, France	Algeciras, Barcelona, and Valencia, Spain
Gothenburg, Sweden	Lisbon, Portugal
In Asia and the East	
Singapore, Singapore	Shenzhen and Shanghai, China
Yokohama, Tokyo, Nagoya and Kobe, Japan	Kaohsiung and Chi-Lung, Taiwan, China
Hong Kong, China	Colombo, Sri Lanka
Pusan, South Korea	Port Salalah, Oman
Port Kiang and Tanjung Pelepas, Malaysia	Port Oasim, Pakistan
Laem Chabang, Thailand	Port of Ashdod, Israel
Dubai, United Arab Emirates(UAE)	Port in Haifa, Israel
In Africa	
Durban, South Africa	Alexandra, Egypt

Table 2.9 Current CSI operation ports
Source: CBP (2014)

Phase III included more ports in 'middle income' developed countries. Pakistan is considered as a high-risk nation for potential terrorist tampering of containers (American Shipper, 2014). Hence, port Qasim is the only port in the world that inspects every US-bound container prior to loading (American Shipper, 2014). The agency reached an arrangement with Pakistan Customs to go through all sea containers with x-ray imaging equipment and radiation portal monitors (American Shipper, 2014). The scanning results are uploaded in real-time to a secure website for CBP analysts to observe (American Shipper, 2014). Pakistani authorities will open to inspect any containers that identified as suspicious and CBP can supervise the process by video. During 2013, more than 44,700 containers were scanned at port Qasim (DHS, 2014). This programme was named as the Secure Freight Initiative (SFI) by the CBP and conducted as a pilot programme at six ports to test the idea of 100% container scanning prior to vessel loading. However, the rest of the pilot ceased after proving too difficult to replicate. The reason why the programme is made possible in Qasim is its low container volume from Qasim to the US, limiting logistical challenges, and strong Pakistani government support in order to maintain trade with the largest consumer market in the world (American Shipper, 2014). Moreover, the region is considered too dangerous for US personnel work at site overseas. Therefore, the process is done remotely (American Shipper, 2014). The long-term goal of the US Customs is to screen all US bound containers 100% and if necessary, scan them at the port of origin (CBP, 2014).

2.2.5 The CSI positive implications for seaborne trade

Trade facilitation

There are a number of benefits of the CSI programme that have been highlighted by the CBP, mainly focused on trade facilitation. The WTO (2017, n.p.) defined trade facilitation as "*removing obstacles to the movement of goods across borders (e.g. simplification of customs procedures)*". It is about the simplification, modernisation and harmonisation of international trade procedure (WTO, 2017). Trade procedures means *"activities, practices and formalities involved in collecting, presenting, communicating and processing data required for the movement of goods in international trade"* (WTO, 2017, n.p.). Trade facilitation involves activities related to financing, insurance, import/export procedures and the actual movement of goods (Allen, 2006).

First of all, the CSI could increase the level of awareness for securing global trade (CBP, 2014). The programme contributes to the development of world supply chain security standard. International organisations, such as the WCO, World Bank, the IMO as well as other domestic outreach forums, allows the CSI to be an integral part of the supply chain security system (CBP, 2006). It adds protection to the primary system of international trade on which the worldwide economy depends. Besides the intended benefits arising from improved security, there have been discussions that the seaborne trade could be facilitated indirectly or directly by the CSI implementation (Allen, 2006).

The international collaboration between Customs could improve the capabilities and the overall effectiveness of the targeting process (CBP, 2006). The CSI offers opportunities to expand and take advantage of technological resources, and the use of additional cargo information from the trade community could improve the opportunities to obtain advance information on potential threats and identify high-risk containers (CBP, 2006). Carriers could also benefit from the kind of investment required to meet the US container screening requirements. Overall supply chain performance will be enhanced quicker clearance of containers and more efficient and effective administrative tools (Allen, 2006). From this perspective, the supply chain performance can be improved in the medium term (Allen, 2006). Furthermore, Allen (2006) pointed out that the CSI compliance required customs modernisation, port facilities investment and the streamlining of regulations to remove technical barriers and these measures could potentially increase the competitiveness of developing country exporters.

To fulfil Objective 2.3 (see Table 2.4 on p.57), CSI participating countries, sea carriers and the importing and exporting parties must commit to effectively using the cargo loading time at a foreign port (CBP, 2006). The CSI transfers the container examinations from unloading ports in the US to the loading ports overseas, utilising the normal downtime for a container awaiting loading to fasten customs clearance at US ports of entry. However, the cargo movement at the export ports could be interfered with. In order to identify high-risk containers, CBP officers cooperate with host customs administrations to set up security criteria (CBP, 2006). NII technology and other methods like radiation checks are used at the leaving port (CBP, 2011). High security Mechanical Seals (see Table 2.3 on p.52) and Tamper Evident Tape are applied after container examination to maintain the integrity of the container during the transit to the US (Donner and Kruk, 2009). All the checks are carried out in the host countries and the host countries bear the equipment cost for such checks. Costs caused by this examination transfer to foreign ports may have more significant effects on less developed country exporters competitiveness than developed countries (Allen, 2006). Based on the Allen (2006), apart from cost aspect, there are other obstacles at the participation ports. These issues include *"the frequency of reloading of goods, congestion at ports, complex customs-clearance regulations, non-transparent requirements, documentation costs due to lack of automation, and the uncertainty about whether bills of lading or letters of credit are enforceable"* (Allen, 2006, p.444). Notwithstanding the possible disruption at export ports, the cooperation between Customs authorities helps to increase the communication between terminal operators and carriers, reduce delays in vessel departure, and mitigate corruptions in ports (Donner and Kruk, 2009). Additionally, foreign customs officials physically presenting themselves could help to diminish certain obstacles (Allen, 2006).

Establishment of a collaborative network

The CSI programme is voluntary and aims at fostering *"a collaborative working relationship with the participating foreign governments, promoting, among other things, the sharing of intelligence, local trends, and best practices"* (Donner and Kruk, 2009, p.27). This collaborative work plays a crucial role when there is increased risk, height threat levels, and re-establishing the flow of commerce in the event of a terrorist attack (Donner and Kruk, 2009). The CSI ports could get special continuity considerations and their cargo could enjoy facilitated handling at ports of entry in the US during the recovery process after a domestic or international terrorist attack (Donner and Kruk, 2009). The CBP claimed the most important benefits brought by this CSI collaborative work is cooperation enhancement and intelligence sharing. Nevertheless, the establishment of this collaborative work around the world has triggered certain concerns.

Firstly, the European Commission (EC) started legal proceedings against those EU states which have individually reached the bilateral agreements with the US (Parliament of Australia, 2003). The EC expressed their concern that European ports would "*become divided into those which are approved by US Customs and those which are not, resulting in the erosion of fair and genuine competition between ports*" (Parliament of Australia, 2003, n.p.). In response to the legal action by the EC, US Customs claimed that the CSI builds on certain existing WCO concepts and have gained some endorsements from the WCO and the G-8 group. Dallimore (2008, p.192) stated that the CSI contravenes *"the freedom of transit because it makes a distinction between cargo containers (including* *those in transit) based on the port of departure"*. It could create discrimination against cargo departing from a non-CSI port. Although it is claimed that non-CSI ports would still be able to transport containers to the US under normal circumstances, the processing may be less efficient than the affiliated ports (CBP, 2006). On one hand, shippers and carriers may be forced to route through a CSI port to avoid cargo delay at US ports of arrival, therefore, preventing them from choosing more efficient routes through non-CSI ports. The CBP could disrupt the most efficient transit route available because of *"the competitive distortion that expedited clearance creates between seaports"* (Dallimore, 2008, p.192). On the other hand, smaller ports may not be qualified to join the programme and reduce their US-inbound business since they cannot bear the compliance requirements (UNCTAD, 2003). In a terrorist event, the US have the right to refuse ships from non-CSI ports altogether. Larger ports may gain new business from non-CSI ports.

Secondly, the CSI sets up a reciprocal system of arrangements between the US coast guard and a foreign country port (CBP, 2011). Under this system, there could be sensitive information exchange, which may be considered necessary to ensure safety and security of any ports involved (CBP, 2011). This bilateral system of information exchange requires a host country to execute security checks on US-bound containers. In return, the host country can send its officers to any US port to inspect ocean container shipments being shipped to their country (CBP, 2011). Under the CSI framework, US Customs officials present themselves to 'observe' screening of cargo shipped to the US, participation in the CSI could be counted as 'supervision' of the foreign nation practices in foreign port by US authorities (Parliament of Australia, 2003). It has been pointed out that there could be potentially significant sovereignty issues under the CSI system (Parliament of Australia, 2003; Metaparti, 2010). Moreover, in a fully CSI compliant cooperative network, the substantial liability issue under the CSI in the event of a terrorist attack utilising shipping or sea containers remained unaddressed (Parliament of Australia, 2003).

2.3 Maritime security measure's implications for maritime sector

Many maritime security studies have stressed the importance of the security measures like the ISPS code, the 24-hour Rule and their impacts on assessment (Stasinopoulos, 2003; Bichou *et al.*, 2007; Park, 2013). The ISPS code has two parts: Part A introduces mandatory provisions to establish the new international framework to enhance maritime security (Bichou, 2004); Part B involves voluntary guidance, consisting of detailed procedures to be implemented to comply with the provisions of chapterXI-2 of the SOLAS convention and of Part A of the code (Bichou, 2004). Although Part B is non-mandatory, the US is already implementing it on a mandatory basis. Based on the argument of Goulielmos and Anastasakos (2005), measures such as the ISPS should be viewed as policies which facilitate international trade instead of hindering the cargo movements in the global supply chain. Thibault *et al*. (2006) reported on how companies involved in US containerised trade have responded to the new maritime container security programmes through interviewing senior container line executives, port officers, and marine terminal security officers. They found out that the most significant benefit is the cooperative security relationship between industry and government formed under the new initiatives. Thai (2007) conducted an empirical study of Vietnam with a group of shipping, port and freight forwarding companies. He found that security improvements resulting from maritime security requirements could enhance service quality as a result of the increased reliability of service, social responsibility awareness, and operation and management efficiency improvement, hence enhance the market image.

Park (2013) mentioned a survey undertaken by the Korea Maritime Institution in 2008, both port group and port users agreed that balancing port security and efficiency is a critical factor of port security. To obtain the minimum required compliance level, ports and shipping companies need to undertake technical and organisational measures that would cause additional costs to shipping industries (Dekker and Stevens, 2007). Dekker and Stevens (2007) conducted an explorative empirical study on maritime security-related costs and their financing in EU states. They suggested three topics for further study: (i) *"assessment of a harmonised (legal) system of best practice", (ii) "long-term analysis on the effects of security measures on the competitive positions of seaports"; and (iii) "provision of empirical evidence for the answer on the question whether security measures should be more (port)administration-based than industry-based"* (Dekker and Stevens, 2007, p. 499).

2.3.1 Financing and cost associated with maritime security measures

In order to comply with the new security regime, maritime operators are frequently required to invest in security equipment, procedures and human capital recruitment and training (Bichou, 2008a; Bichou, 2011). Additionally, Bichou (2008a, p.22) mentioned extra costs are generated to cover *"provisions for detailed reporting, further inspections and other operational requirements"*. Regarding non-ISPS initiatives, Bichou (2008a) referred the DNV Consulting

(2005) that voluntary security programmes would cost port and terminal operators in the EU around €5 million only for auditing. Bichou (2008a) mentioned there are two major kinds of maritime security costs: compliance costs, and procedural and operational costs.

Ex-ante costs assessment

Various studies have assessed the compliance cost of port security at a very early stage of new security regulations. The data and methods used for these ex-ante assessments mostly from national regulatory risk assessment models (Bichou, 2008a). These models are ad-hoc programmes conducted by governmental agencies for new initiatives costs and benefits assessment (Bichou, 2008a). Bichou (2008a) provided a summary of aggregate ex-ante estimates for ISPS compliance cost (Table 2.10).

Source of estimates	Cost items	Scope	Initial Costs	Annual Costs	10 years total cost (2003-2013) @7% DFC
US Coast Guard (USCG)	Total ISPS US ports	226 port authorities, of which 5000 facilities are computed (ISPS Parts A & B MARSEC Level 1)	1125	656	5399
	Total ISPS US-SOLAS and non-SOLAS vessels subject to the regulation	3500 US-flag vessels, as well as domestic and foreign non-SOLAS vessels (operating in US waters) (ISPS Parts A & B MARSEC Level 1)	218	176	1368
	Automated Identification System(AIS)		30	1	50
	Maritime Area (contracting government)	47 Captain of the Port US zones	120	46	477
	Outer Continental Shelf facility(OCS) (offshore installations	40 US OCS Facilities under US jurisdiction	3	5	37
	US cost for ISPS implementation	ISPS parts A and B	115	884	7331
	Aggregate Cost of elevating MARSEC level from 1 to 2	Based on a twice Maritime Security Level (MARSEC level) 2 per annum, each for 21 days	16 per day		
UK	Total ISPS UK port facilities	430 facilities (ISPS Part A MARSEC Level 1)	26	2.5	
	Total ISPS UK-flagged ships and company related costs	620 UK-flag vessels (ISPS Parts A, MARSEC Level 1) (Assumed UK£1=1.6 USD)	7.4	5.2	
OECD	AIS	Based on 43,291 international commercial fleet of more than 1,000 GT (excluding passenger and cruise vessels), MARESC Level 1, ISPS Part A only	649.3	Undetermined(UD)	
	Other vessel measures		115.11	14.6	
	Ship operating companies		1163.89	715.4	
	Total ships & shipping companies		1279	730	
	Port Facility Security Assessment, Port Facility Security Officer, Port Facility Security Plan	2,180 port authorities worldwide, of which 6,500 facilities are computed (from Fairplay) (ISPS Part A only MARSEC Level 1)	390.8	336.6	
	Total ISPS ports		UD		
	Global cost for ISPS implementation	MARESC level 1, ISPS part A only	UD		
Australian Government	Total costs for Australia	70 Australian flag ships and 70 ports, of which 300 port facilities	240AUD	74AUD	UD
Shipowners association	Total costs for vessels	47 Australian vessels	29655AUD		UD

All cost figures are expressed in 2003 US $ million, except for Australia where costs are expressed in 2002 AUD $ million

Table 2.10 A summary of ISPS ex-ante cost estimations by various regulatory risk assessment impacts

Source: the author 2014 adapted from Bichou (2008a, p.24)

Table 2.10 illustrates that the US Coast Guard (USCG) estimated the initial costs of ISPS compliance for the US ports could reach US$1.1 billion and the annual cost would be US$656 million thereafter up to 2012 (DHS, 2003). Bichou and Evans (2007) included data on ex-ante estimates of port security in the UK and Australia. Within the UK, the initial cost for ISPS Code compliance for 430 port facilities was US$26 million and the annual cost was US$2.5 million, while in Australia the cost of the ISPS compliance for 300 port facilities was US$240 million initially with an annual cost at US$74 million. The OECD (2003) reported comprehensively on the global economic influence of maritime security measures. They estimated the ISPS implementation costs for ports were around US$2 billion for the initial investment and US$1 billion for annual expenditure for developing country ports alone (OECD, 2003).

Ex-post costs assessment

Following the new measures entering into force, researchers adopted varying methods ranging from surveys and economic impact research to financial assessment and insurance risk modelling for ex-post compliance cost assessment (Bichou, 2008a). The survey of UNCTAD (2007) suggested that the average cost for ISPS compliance would be US$0.08 for each ton handled and US$3.6 for each TEU handled, of which US$0.03 and US$2 for recurrent costs respectively. A World Bank survey conducted by Kruk and Donner (2008) pointed out that the average ISPS compliance costs amounted to US$0.22 per ton and US$4.95 per TEU handled. Bichou (2004, 2008a) and Bosk (2006) explained that such contradictory findings may be explained by two reasons: the diverse approaches used to calculate the ISPS costs; and different interpretations of the Code across ports and terminals worldwide. As to economic impact studies, Damas (2001) estimated the cost of the new security measures introduced in response to the 9/11 event would be US$151 billion annually for the US, of which US$65 billion only accounts for logistical changes to supply chains. The other encountered costs were for workplace security, IT security and contingency operations, insurance and liability, and employee absenteeism (Russell and Saldanha, 2003). The International Monetary Fund (IMF) estimated the monetary costs owing to higher security amounted to about US$1.6 billion annually, with an extra financing burden of maintaining 10% higher inventories at US$7.5 billion per year (IMF, 2001). Dekker and Stevens (2007) undertook another exploratory empirical study on maritime security-related cost and their financing in European member states. A survey which covered the EU 27 and the European Economic Area (EEA) countries with a cross-section of 30 'top seaports' was conducted. The chosen seaports were located at Northern Europe, Central Europe and Southern Europe. According to the results, the port facilities had to make a relatively limited effort to achieve 100% compliance. The results also revealed that 44% of the investment costs were on 'landside-accesses and entrances', accounted for the largest share in the total investment. The second and third largest part were electronic systems (34%) and seaside access (14%) (Dekker and Stevens, 2007). The categories 'landside-railways and roads', and 'inspections and insurances' have the percentage of 4% and 3%, respectively (Dekker and Stevens, 2007). The category 'personnel' accounted for only 1% of the investment costs. In terms of the running costs, personnel costs accounted for 57% of the total running costs. Inspections and insurance account for 2% of the total running costs (Dekker and Stevens, 2007).

The implications of CSI compliance cost for different stakeholders

Every stakeholder involved in the global supply chain would be affected by the compliance costs of the CSI (Allen, 2006). These stakeholders are identified by Allen (2006, p.441) as *"exporters, port authorities, carriers, US manufactures who rely on foreign inputs, retailers who sell goods with imported components, and finally US consumers"*. Moreover, these entities must recognise the monetary costs are necessary and could be offset by the more cost-effective facilitated cargo processing and increased security (CBP, 2006). The initial costs would fall on ports for investing in required capital. They would likely charge carriers who then recover this cost by charging exporters (Allen, 2006; Bichou, 2008a). Allen (2006) focused on port authorities, carriers and exporters who would experience the most observable CSI related cost increase.

Port authorities

Based on the aforementioned information, in order to maximise the cargo security shipping into the US ports and ensure the safety of the global supply chain, cargoes need to be scanned before coming into US ports. Ports authorities are responsible for investing in new security equipment and technologies such as the NII and RPMs (see Table 2.3 on p.52), developing relevant security plans, implementing formal security procedures, recruiting security personnel, and carrying out regular training and security drills (Bichou, 2011).

As to the compliance cost of the CSI, DHS (2009) pointed out that few additional costs are incurred. However, much research implies a different story. Various cost assessments on ISPS compliance were discussed in Section 2.3.1, the CSI cost estimation mainly focused on infrastructure-related investment and running costs. Miller (2007) highlighted several port concerns in an article in the Wall Street Journal. According to Miller (2007), analysts believed that each port would have to purchase 1 to10 scanners. Allen (2006) stated that purchasing or upgrading container-scanning devices would cost between US$1-5million per device and this figure varies considerably. The expenditure for a container scanner for the port of Rotterdam was EUR€14 million, while the Singapore Ministry of Trade spent US$1.9 million on purchasing the scanners (Allen, 2006). The port authority of Buenos Aires approved a US$33 million budget for equipping the port with four container scanners, reserving US$20 million for device acquisition, and the rest for upgrading existing infrastructure (Ceriotto, 2004). Besides the investment in purchasing scanners, the other compliance costs such as developing IT systems and personnel training are too high to be overlooked. It would cost as much as two to three times the initial investment for device upgrading in the actual scanner (Allen, 2006). Yet these costs are set by the divergent labour costs in different countries and different infrastructure investment requirements (Allen, 2006).

The CSI related costs are not limited to initial investments for ports upgrading. It would be difficult and costly for some countries to meet the advance notification requirements of both the CSI and the 24-hour rule since their customs officials may not have the required skills (Allen, 2006). The EU estimated the average initialisation cost for one port to be about US$100 million, and there would be billions of Euros in extra spending (Miller, 2007). Some smaller ports from which only very few containers are shipped to the US may find this cost is too large to be justifiable, and they lack resources for purchasing NII scanning devices

(Allen, 2006). Small ports still face other problems such as space constraints, even if they are capable of purchasing the scanners.

Depending on the port nature and ownership, the capital and human resource investments would be borne either by the public/private port management, the state customs, or commercial terminal operators (OECD, 2003). Therefore, how these costs are covered will depend on the body that is responsible for the initial capital cost. This will directly influence how the fees are passed onto shippers, carriers and final consumers (Allen, 2006).

Carriers

Carriers initially bear the costs of 24-hour rule compliance cost stemmed from new IT systems investment, personnel training and working-hours (UNCTAD, 2003). Thibault *et al.* (2006) found that small shipping companies generally bear lesser initial compliance costs but higher running costs due to the complexity of spreading fixed costs across a small business base. Moreover, ports would also pass security compliance costs onto carriers. The Port Klang authority in Malaysia had announced that it would start charging carriers the 'extra movement charges' between US$30-150 for containers picked for scanning (The Star, 2004). However, the Singapore Port Authority declared that carriers would not be charged any extra fees for CSI-related infrastructure expenses, not for scanning (Allen, 2006). Anyhow, these costs would most likely be passed onto the exporters as documentation fees charged by carriers (Allen, 2006). Based on Allen (2006), most carriers had started to charge between US$25 and US$35 per bill of lading for administrative expenses recovery. For small container lines, they normally bear less initial compliance cost but higher running costs because of their small business base (Thibault *et al.,* 2006)

Exporters

According to Allen (2006), exporters would be most likely to bear the cost passed by the CSI ports and involved carriers, under the category of documentation fees, or specific fees on containers picked for screening. Nevertheless, these extra charges do not appear excessive when compared to overall costs of moving a container throughout the supply chain. According to Felixstowe Port Authority (2004), supposing the cost of shipping a container is US$1,000, a US$20 movement fee only accounts for 2% of total transport costs. These containers can also benefit from US 'green lanes' to avoid costs associated with delays. For shipments from non-CSI ports, the CBP may delay cargo release or deny the carrier's preliminary entry-permit to unload at the US port (Dallimore, 2008). This would take a considerable amount of time due to required container physical inspections. By routing through a CSI port, this situation could be avoided.

Allen (2006) also believed that exporters located near a CSI port would bear the least costs amongst all possible exporters, whilst exporters located further away from a CSI port would bear a considerably higher cost regardless of their adopted strategy. Normally, these exporters located in a non-CSI port may choose not to reroute their containers through a CSI port and bear the risks of cargo delay when entering the US (Allen, 2006). Based on Machalaba (2001), in some cases, containers are delayed up to two weeks at US ports because of security screening and average delays represent between 3 to 4 days. Spending one extra day in Customs adds almost 1% to the total transport costs (Allen, 2006). Exporters could choose to alter their direct route to the US through a CSI port; however, this would lead to an increase in both the length of the haul and the associated cost by affecting *"supply and demand of a particular route, freight insurance, the value and commodity category of the goods shipped, and the distance of the route"* (Allen, 2006, p.442). Furthermore, the cost of shipping the containers is extremely different in different regions. These charges account for 3% of the market price in the US but 12% in Africa (Allen, 2006; Limao and Venables, 2001). Limao and Venables (2001) argued that transportation costs may be more critical to many developing countries than developed countries. For companies in Bangladesh who export finished clothing to the US, the most significant cost factor is the transportation cost of the final merchandise to the buyer rather than the labour or capital cost (Bradsher, 2004). Therefore, the increase in transportation costs can cause heavy losses in the developing countries (Allen, 2006). Allen (2006) referred to a work by Walkenhorst and Dihel (2002) and noted every 1% increase in transport cost would cause sub-Saharan African countries suffer a decrease of 0.3% in their GDP, while South Asian countries would experience a reduction of approximately 0.6%. A fall of 10% in transport costs could increase trade by 25% in some African areas (Limao and Venables, 2001). To remain competitive in the export-oriented sector, developing country exporters may have to lower wages or lay off employees, leading to higher unemployment and lower welfare (Allen, 2006). Therefore, the decision whether an exporter chooses to reroute through a CSI port largely determined by how much risk they are willing to take and is much more critical for developing country exporters (Allen, 2006).

2.3.2 Operational and logistical efficiency

Although cargo scanning can maximise the supply chain security, Bennett and Chin (2008, p.28) used the quotation from Zin (2007, p.13) "*it slows down cargo* *and causes a gridlock at ports*". The opponents of the 100% scanning measures quoted a cost-benefit analysis conducted by Martonosi *et al*. (2005) to express their concerns of cargo delay and congestion. According to the study of Martonosi *et al*. (2005), the estimated delay would increase from 0.5 hours per TEU under current operations to 5.5 hours per TEU under the 100% scanning measures. World Shipping Council (WSC) (2007) estimated that the 100% scanning requirement would influence US$500 billion of commerce. The WSC (2007) also mentioned the possibility of ceasing US imports to minimise costs. Asian port operations were predicted to suffer the largest impact of a range of US supply chain security initiatives, since over 50% of US imports are loaded in China (WSC, 2007).

According to Bichou (2011), there were two major debates over port efficiency due to security initiatives implementation. While port security measures enhance port security, many argued that procedural requirements of the new security measures would lower operational and logistical efficiency (Lenain *et al.,* 2002; Bichou, 2008a; Thai, 2009). Supply chain disruption could arise as an indirect result of the additional lengthy procedure (Bichou, 2011).

The implementation of the security regulations could potentially bring negative and /or positive impacts on extra costs, delaying cargo transit times, and port efficiency (Yeo *et al.*, 2013). Bichou (2011) found that under the 24-hour rule, the vessel waiting time can be extended to three days or even more for carriers due to their failure in electronically connecting to the US CBP Automated Manifest System (AMS). As a result, shippers and receivers would have to make adjustments to their production plan, distribution and inventory management (Bichou, 2008a). Additionally, ports are affected by the documentation requirement which could lead to congestion and possible delays in both ships' departures and arrivals (Bichou, 2008a). Shippers also need to spend extra time and resources for carriers to complete documentation procedures (Bichou, 2008a). Although higher security quality is gained from the stricter security procedures, port efficiency and timeliness may be jeopardised (Chang and Thai, 2016). Shipping companies have already begun passing the direct and indirect cost impacts of the 24-hour rule to shippers and cargo owners (Bichou, 2008a).

Some literature advocates that security initiatives bring positive effects on port efficiency and performance owing to better procedural arrangements (Banomyong, 2005; Bichou, 2008a). Donner and Kruk (2009) stated that the 24-hour rule has improved the self-discipline of both the export shipping and maritime logistics industry, which in turn improves the efficiency of port operation. Bichou (2011) explained that measures such as the CSI and the 24-hour rule are prevention-oriented that would be more cost-effective and less time-consuming than traditional random physical inspections. Clark *et al.* (2004) and Yeo *et al.* (2013) argued that having an appropriate level of regulation at port can improve port efficiency. Proponents of the new security regime argued that its implementation is also commercially rewarding (Bichou, 2011). Moreover, compliant participants would gain commercial benefits from *"access certification and fast-lane treatment", "reduced insurance costs, penalties and risk exposure"* (Bichou, 2008a, pp.30-31). The conventional security screening at the unloading port could lead to containers being delayed for up to two weeks at US ports (Machalaba, 2001). In addition, new security regimes also bring benefits such as *"support of legitimate commerce, reduced risk of cargo theft* *and pilferage, stronger protection against illegal drugs and human trafficking, and improved lead-time predictability and supply chain visibility"* (Bichou, 2011, p.6).

However, Bichou (2008a) stated that there is little empirical analysis to support both arguments. Bichou (2008a) reviewed available research of the impacts of maritime security measures on ports and noted much of it is based on mathematical modelling, conceptual work, economic situation or anecdotal evidence. Erera *et al.* (2003) included the mathematical modelling in their heuristic method to estimate the delays caused by container scanning. Babione *et al.* (2003) used simulation to analyse the impacts of post 9/11 security initiatives on the container traffic flow in Seattle Port. Lee and Whang (2005) used a simple quantitative model to assess how supply chain security could be assured with a total quality management approach. Bennett and Chin (2008) used port statistics, filed study data and industry insights and adopted Monte-Carlo simulation and queuing models to quantify the financial and operational implications of 100% scanning export US-bound container scanning. There are also simulators specifically designed for *"pre-defined disruption scenarios and predict their impacts on port efficiency"* (Bichou, 2008a, p.31), such as the NISAC's two port simulators (NISAC, 2005). Talas and Menachof (2009) developed a conceptual model to calculate a port facility's remaining security risk after the risk treatment implementation decisions (such as regulatory measures).

2.4 Summary

This chapter started by introducing the background of current maritime security challenges and vulnerabilities in container shipping. Various maritime security measures were explained. The CSI was described and discussed including its strategic goals, arrangements and current implementation. The benefits and the negativities of implementing the maritime security measures, especially the CSI, were critically reviewed to form a completed literature synthesis. Objective 1 and Objective 2 have been partially achieved in this chapter.

Chapter 3. Port competition

In this chapter, port competition and various competitiveness determinants will be presented and discussed, including port selection, port efficiency, port service and other related issues. Moreover, maritime transportation is fundamental to global trade which is influenced by political activities. Shipping industry is closely affected by political economy. Therefore, theories on political economics will be introduced in this chapter to lay a foundation for this abductive research and research result interpretation.

3.1 Definition of Port competition

The phenomena of globalisation and liberalisation have had a positive effect on international trade. Demand for freight transport is a derived demand. Port basic activity is maritime trade, which is in turn driven by international commerce and economic activity (Estache and Trujillo, 2009). The position and function of a port has become a crucial node in the logistics chain which connects the origin and the destination of goods (Meersman *et al.*, 2010). Various stakeholders with conflicting interests are involved in this logistics process, which leads to the difficulty in giving an unequivocal definition of port competition (Van de Voorde and Winkelmans, 2002). Many different parties are involved in global supply chains and therefore the competitive position of a seaport is determined by many other factors than its own infrastructure and organisation (Meersman *et al.*, 2010). According to Van de Voorde and Winkelmans (2002), defining port competition takes every aspect relevant to ports and competition into consideration. As a result, the following definition is provided:

"Sea port competition refers to competition between port undertakings, or as the case may be, terminal operators in relation to specific transactions. Each operator is driven by the objective to achieve maximum growth in relation to

goods handling, in terms of value added or otherwise. Port competition is influenced by (1) specific demand from consumers, (2) specific factors of production, (3) supporting industries connected with each operator, and (4) the specific competencies of each operator and their rivals. Finally, port competition is also affected by port authorities and other public bodies ". (Van de Voorde and Winkelmans, 2002, pp.11)

Heaver (1995) argued that competitive strategy mainly focuses on terminals rather than ports. Notteboom and Yap (2012) explained that the nature and characteristics of port competition depend upon the type of port and the commodity. Haezendonck and Notteboom (2002) argued that port competition is affected by a combination of factors within the whole logistics chain. Merkel (2017) also believed that port competition is affected by not only the port itself but also by modes of traffic within a logistics chain. Notteboom and Yap (2012, p.549) explained port competition as:

"Essentially involves a competition for trades, with terminals as the competing physical units transport concerns and/or industrial enterprises as the chain managers and representatives of the respective trades, and port authorities and port policy makers as representatives and defenders of the port sector at a higher level, engaged in offering good working conditions (e.g. infrastructure) to this sector".

3.2 Container port competition and port competitiveness

There has been an increasing attention on the container port industry in recent years as containerised transportation evolves (Cullinane *et al*., 2005). Notteboom and Yap (2012) suggested container port competition includes three levels, namely intra-port competition, inter-port competition at the national and regional levels, and inter-port competition between terminal operators in different port ranges.

The length of Europe’s coast line is 100,000km and more than 1,200 ports are located along it (OECD, 2011). In addition, there are several hundred ports lay along its 36,000 km of inland waterways (OECD, 2011). These ports handle 90% of Europe's international trade by volume, acting as the key points of modal transfer (OECD, 2011). According to Notteboom (2012), the total European port throughput was 4.26 billion tons in 2008, 3.76 billion tons in 2009 and 4.04 billion tons in 2010. There are about 130 container seaports in Europe and 40 of them provide intercontinental container services (Notteboom, 2012). Container throughput was 900 million tons in 2010 (Notteboom, 2012). With total sea container volumes handled by the world's top 100 container ports amounting to 545.6 million TEUs in 2015, the European container port system is one of the busiest worldwide. It features established large ports and medium-sized to smaller ports each with specific features in hinterland markets and geographic locations (Lloyd's List, 2016). Smaller ports contribute to Europe's economy because they are fundamental to short sea shipping and inland waterways traffic. They also provide ferry services that freely move people and goods within the EU.

The contemporary containerised transportation and container port industries play vital roles in the world economy, and the container port industry market structure has changed greatly over recent years (Cullinane *et al.*, 2006). Cullinane *et al.* (2006, p.355) highlighted two main challenges for the contemporary container port industry:

(1) *"the complicated nature of its operations; this is a consequence of the number of different agents involved in importing and exporting containers and the complex operational interactions between the different service processes taking place at a port"*;
(2) "*the increasingly competitive commercial environment that has arisen in recent years"*.

Many container ports have lost their monopoly control over cargo from their hinterland (Cullinane *et al.*, 2006). Competition within certain regions is becoming more intensive (Yap and Lam, 2006a). Ports not only compete with their neighbours within a hinterland, but also compete with other ports located in the wider region (Notteboom and Yap, 2012). Wan and Zhang (2013) investigated the relations between port competition and urban road congestion and noted that port competition has changed to competition between alternate intermodal systems. Ishii *et al.* (2013) used game-theory approach to analyse the inter-port competition and the incentives for ports to engage in competitive behaviour. According to Marcadon (1999), ports started extending their hinterland into areas which were neglected before to cope with rising competition. In terms of policy level, Cui and Notteboom (2017) mentioned that many governments consider privatising public ports as an option to increase port competitiveness.

With the development of advanced infrastructure and equipment, container ports are concerned if they can successfully compete for cargoes from within their hinterlands, as well as their capacity to physically handle cargoes (Cullinane *et al*., 2006). This is because liner companies have more than one port choice when design their cargo movement routes (Cullinane *et al.*, 2006). Therefore, in such a competitive environment, a port has to obtain the economic scale to cement their customer base because economies of scale are always chosen by customers (Cullinane *et al*., 2006). Various strategies have been introduced to make them more profitable and attractive. It was pointed out by Perez-Labajos and Blanco (2004) that commercial seaports are faced with the loss in customer loyalty and need to establish new strategies to secure container traffic. They suggested two factor groups for strategy development: (1) a commercial factor group that includes *"develop their infrastructure, integrate themselves in the transport networks, increase their offer of logistics services, encourage improvement in the operators, regulate services and offer something different as regards price and/or quality"* (Perez-Labajos and Blanco, 2004, p.554); and (2) a technological factor group, including electronic data interchange (EDI), vessel traffic system (VTS) and geographic information system (GIS) (Perez-Labajos and Blanco, 2004).

Veldman and Buckmann (2003) adopted two major factors (cost and quality of service) to analyse port competition and choice. The cost factors "*the costs of transporting a container between the stack in a seaport and the centre of a hinterland region by road, rail or barge*" (Veldman and Buckmann, 2003, p.10). The service factors included the frequency of service, quality of service and probability of choosing a route (Veldman and Buckmann, 2003). They suggested that the competition in the Antwerp-Hamburg range is intense since there are many alternative routings from the customer can choose and there are great overlaps between hinterlands of seaports. Cost and service quality were also cited by Ohashia *et al*. (2005) in the study of airport competition. However, they detailed cost and service quality based on airline service which was slightly different from Veldman and Buckmann (2003). Cost factors include port charges and cargo transport cost (Ohashia *et al*., 2005). Service quality factors include *"cruising/flight time, loading/unloading time, and customs clearance time, and waiting time caused by schedule delay"* and waiting time for the next available flight (Ohashia *et al*., 2005, p.151).

According to Yeo (2007), multi-dimensional factors were used by varying scholars for evaluating port competition. Various researchers also used a single or simple measure for calculating the competition phenomenon (Yeo, 2007). Rimmer (1998) concluded that port competitive position was affected by the port's location and throughput to a great extent. Heaver *et al*. (2001) also proposed port location as one of the two critical factors for port competitive position. The other influential factor was network strategies and "*initially, such new competitors may not pose much of a threat, but some gain a critical mass of traffic and establish effective hinterland connections. Monitoring the effectiveness of new ports requires careful attention to the success of their network strategies, even at the level of agencies and forwarding firms* " (Heaver *et al*., 2001, p.300). Figueiredo *et al.* (2015) noted that ports have integrated inland transportation into their services to address the rapid development in the shipping industry. A better access to intermodal facilities can attract more traffic for a port from its neighbouring port (Figueiredo *et al.*, 2015).

Robinson (1998) added the number of port calls by shipping companies as an evaluation factor of port competition. McCalla (1999) believed that concentration of port service was the most effective way to maintain and increase port traffic. Chang (2000) claimed that transhipment and intermodal cargo were closely related to improving of port competitive position. As an important node of an intermodal system, a port in a smooth intermodal system can attract more containers than a congested one (Wan and Zhang, 2013). The Port of Hong Kong and the port of Singapore were analysed as examples to illustrate that transhipment cargoes could make container ports increasingly larger. The importance of transhipment cargo was also mentioned and related to the success of port of Singapore and port of Hong Kong by Fung (2001).

The concept of port competition was given by Van de Voorde and Winkelmans (2002) and Notteboom and Yap (2012) (on pp.85-86). Port competitiveness is different from port competition. Parola *et al.* (2017, p.117) gave the definition of competitiveness as "*the skill or talent resulting from acquired knowledge, able to generate and sustain a superior performance as well as face competitive dynamics*", based on their interpretation of Porter (1990). Notteboom and Yap (2012, p.551) explained that the competitive position of a container port depends upon "*its competitive offering to the host of shippers and shipping lines for specific trade routes, geographical regions and other ports to which the container port is connected*". Parola *et al.* (2017) considered port competitiveness as a multidimensional concept which stems from the ability of port authorities and operators to execute value-added activities. Broadly speaking, port competitiveness is decided by the competitive advantages created or acquired by a port (Haezendonck and Notteboom, 2002). Notteboom and Yap (2012) listed factors that could bring port competitive advantages and they explained the complexity and difficulties in defining competitiveness. Two major areas were addressed by varying scholars, namely: identification of port competitiveness drivers; and identification of port competitiveness measurements (Parola *et al.*, 2017). Yeo (2007) reviewed and summarised six categories of aspects regarding port competitiveness (Figure 3.1).

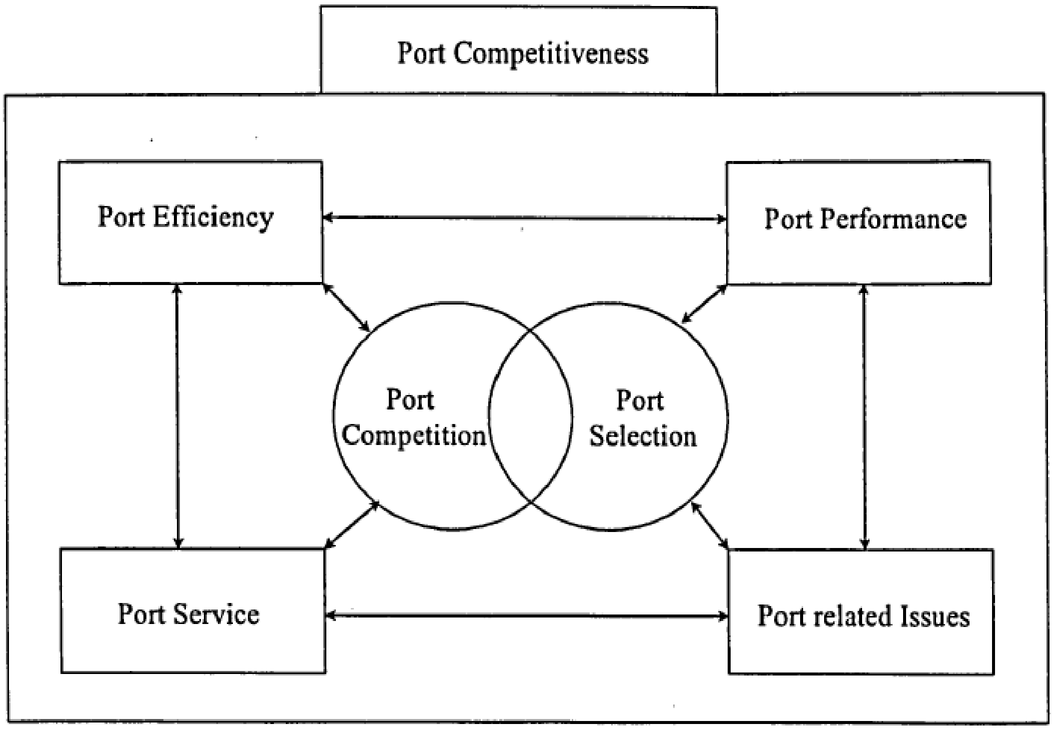


Figure 3.1 Conceptual diagram for port competitiveness
Source: Yeo (2007, p.69)

In terms of research methods, various studies that categorised into quantitative research and descriptive research were conducted to ascertain the characteristics of container port competitiveness. Notteboom and Yap (2012) summarised studies utilised quantitative techniques (Table 3.1) and studies that are descriptive in nature (Table 3.2).

Quantitative method	Studies
Integer linear programming	Aversa, Batter, Haralambides and Yoshizaki, 2005
Dynamic programming	Zeng and Yang, 2002
Analytical hierarchy process	Guy and Urli, 2006; Lirn, Thanopoulou, Beynon and Beresford, 2004
Stochastic frontier analysis	Notteboom, Coeck and Van den Broeck, 2000; Tongzon and Heng, 2005
Data envelopment analysis	Garcia Alonso and Martin-Bofarull, 2007; Trujillo and Tovar, 2007
The logit model	Veldman, Bickmann and Saitua, 2005
Structural equation model	Bichou and Bell, 2007
Cointegration test and error correction model	Yap and Lam, 2006a
Transport cost model	Jara-Diaz, Cortes and Ponce, 2001
Transport demand model	Luo and Grigalunas, 2003
Cluster analysis	De Langen, 2002
Shipping networks	Yap, Lam and Notteboom, 2006
Oligopolistic model	Yap and Lam, 2006b

Table 3.1 Port competitiveness quantitative research
Source: the author 2014 adapted from Notteboom and Yap (2012, p.552)

Areas discussed	Studies
Container port development	Cullinane, Wang and Cullinane, 2004; Notteboom and Rodrigue, 2005; Slack and Fremont 2005
Container port competition	Notteboom, 2002; Robinson, 2002; Van de Voorde and Winkelmans, 2002; Yap and Lam, 2004
Container shipping lines	Heaver, Meersman, Moglia and Van de Voorde, 2000; Slack, Comtois and Mccalla, 2002
The supply chain	Notteboom and Winkelmans, 2001

Table 3.2 Port competitiveness descriptive research
Source: the author 2014 adapted from Notteboom and Yap (2012, p.553)

3.3 Port selection

Port selection criteria have been highlighted by many port competitiveness studies (Parola *et al.*, 2017). Various research of port criteria since the 1980s were investigated and summarised in the paper of Yeo *et al.* (2008). The key port competitiveness components Yeo *et al.* (2008) summarised included geographical factors, port facilities, port tariffs, frequency of port callings, port reputation, port services, safety handling of cargoes. Malchow and Kanafani (2004) conducted research on major US ports and they identified port location as the most significant port characteristic. As to container ports, Yap and Lam (2006a, p.37) noted the influential factors as *“hinterland accessibility, productivity, quality, cargo generating effect, reputation and reliability”.*

Ha (2003) evaluated the service quality factors of 15 ports that handle containers worldwide. Ha (2003, p.134) categorised these factors into seven groups: *"ready Information availability of port-related activities, port location, port turnaround time, facilities available, port management, port costs and customer convenience"*. The importance of these factors was ranked by respondents (shipping lines) and service quality was evaluated through scoring. The survey suggested that besides monetary factors and efficiency, many ports should improve their service quality by improving *"the quantity and quality of information flows and data availability"* (Ha, 2003, p.137). Lirn *et al*. (2003) studied the criteria and sub-criteria for transhipment ports. Forty-seven relevant criteria were identified through interviews. Using Delphi method, they grouped these criteria into four main service criteria and 16 sub-criteria. The four major factors were *"port basic physical characteristics, port geographical location, port management perspective, carriers' cost perspective"* (Lirn *et al.,* 2003, p.237). Lirn *et al*. (2004) conducted another round of Delphi and reduced the criteria from 16 to 12. Using the AHP method, they suggested the most importance factors were container handling cost, proximity to main navigation routes, proximity to import/export areas, basic infrastructure condition and existing feeder networks (Lirn *et al*., 2004).

3.3.1 Port competition and port selection at regional level

Tongzon and Heng (2005) argued that port competition has generally become more intense and the port competition environment varies between regions and places. Port-regional relationship topic has been overlooked after 1990s (Ng, 2013) and few systematic studies on the implications of regional transformation on port's competitiveness are available (Homosombat *et al*., 2016). Regional research on the competition among ports has been undertaken by several researchers, particularly in Asia (Hoshino, 2010). Yeo (2007) noted the work by Kim (1993) that investigated port choice by Korean shippers, consignees and shipping companies in Korea. In descending order of significance, the selection criteria of export ports Kim (1993) identified were *"distance between origin and destination, annual cargo handling volume, loading hours, average detention hours at port, goods value per tonne and inland trucking cost per kilometre affected"* (Yeo, 2007, p.71). Import port selection depends on *"sea transportation distance, number of liners calling-in, annual volume imported and inland transportation charges per unit distance"* (Yeo, 2007, p.71). Yeo *et al.* (2008, p.916) referred to the work by Jeon *et al*. (1993), noting that port selection depends on *"navigation facilities and equipment holding status, port productivity, price competition, and port service quality"*. Nir *et al*. (2003, p.168) analysed shippers' port choice behaviour in Taiwan, using four variables that are *"travel time, travel cost, route and frequency"* in a linear multiple port selection model. They found that travel time and cost were the most significant attributes. Tiwari *et al*. (2003), using China as case study, used conventional transport mode choice models to assess how shippers select liner companies and ports. They concluded that the most influential factors were distance of the shipper from port, distance to destination (for exports) and distance from origin (for imports), port congestion and vessel size (Tiwari *et al*., 2003). Huybrechts *et al.* (2002) used a survey to investigate the attractiveness of the port of Antwerp, based on respondents' perspective on port choice determinants. They found out that port accessibility mainly due to the restrictions of River Scheldt prevented Antwerp from becoming a market leader within North Europe.

Tongzon and Sawant (2007) investigated the port choice determinants from the perspective of the shipping lines from Southeast Asia, using a survey questionnaire. In descending order of significance, efficiency, port charges and connectivity, location, infrastructure, wide range of port services and cargo size were identified as the 'stated preference' of the shipping lines (Tongzon and Sawant, 2007). However, the 'revealed preference' approach adopted by Tongzon and Sawant (2007) showed that port charges and wide range of port service were the only significant factors in shipping lines' port choice.

Regarding regional port competitiveness research, Cullinane *et al*. (2004) analysed the container terminal development process in China and its impact on the competitiveness of Hong Kong and other neighbouring ports. Cullinane and Song (2007) focused on Northern Asian ports and applied a variety of models to assess factors relevant to port competitiveness. Song and Yeo (2004) identified cargo volume, port facilities, port location, service level and port expenses as the five most influential criteria for the competitiveness of Asian ports. Fleming and Baird (1999) focused on the UK, the US and North-Western Europe and found that six sets of key factors were affecting port competitiveness. Valentine (2002, p.8) concluded them as *"port tradition and organisation, port accessibility, by land and sea, state aid and their influence on port costs, port productivity, port selection preferences of carriers and shippers, and comparative locational advantage"*. In the study by Malchow and Kanafani (2004) mentioned above (on p.93), they tried to find criteria for port selection in the US by using the discrete choice model. They found out that in addition to port location, efficiency could increase port competitiveness.

3.3.2 Determinants of Port competitiveness

Aronietis *et al.* (2010) stated that it is essential to identify the criteria that determine the port competitiveness so that the strengths and weaknesses of the ports can be evaluated. In this research, the criteria and factors that determine a port competitiveness are referred as ‘port competitiveness determinants’. Haezendonck and Notteboom (2002) categorised these criteria into quantitative ones (hinterland accessibility, productivity, cargo generating) and qualitative ones (quality, reputation and reliability). Yeo (2007) summarised 38 port competitiveness determinants after eliminating overlaps of previous research. He concluded cost was considered as a very important port competitiveness determinant. Port geographic location and service factor were other vital attributes. Parola *et al.* (2017) conducted a critical review of academic literature of 170 papers to explore the nature of ‘port competitiveness’, covering 32-year period (1983-2014). The key drivers of port competitiveness they found were in hierarchical order. Port cost is the most-cited driver. Besides port costs, in the order of ranking, other drivers are hinterland proximity, hinterland connectivity, port geographical location and port infrastructure (Parola *et al.,* 2017). Operational efficiency and service quality are two other notable determinants. De Martino and Morvillo (2008) categorised port competitiveness components as hardware and software. Hardware components are related to infrastructure and links to the transport system (De Martino and Morvillo, 2008). They include port location, infrastructure and supra-structures and equipment, and inland logistics (De Martino and Morvillo, 2008; Parlola *et al.,* 2016). Software components are related to port service quality (De Martino and Morvillo, 2008). They include efficiency factors, service factors, IT systems, safety and security that are vital to maintain customer loyalty (Bichou and Gray, 2004). Huybrechts *et al.* (2002) and De Martino and Morvillo (2008) believed software component is the most significant determining factor in port competitiveness. Parola *et al.* (2017) also grouped port competitiveness components into three categories, supporting the views of Notteboom (2008), namely hinterland-related, maritime-related and endogenous factors. Endogenous factors are *“constituted by a number of attributes that strictly originate from the port itself”* and *“have been traditionally considered as the main drivers of port competitiveness”*. (Parola *et al.*, 2017, p.125). The components of port competitiveness that Yeo (2007) selected are presented in Table 3.3 based on three categories from Parola *et al.* (2017). The components include port location, port facilities including superstructure (berth, depth, channel length), terminal efficiency, hinterland networks, value added logistics; and port services, safety handling of cargoes, confidence in port schedules, operational efficiency, electronic data interchange, IT, integration, simplification of procedures, incentives, operational transparency, and port labor and skills.

Component Categories	**Components**
Hinterland-related: attributes affect the capacity of the port to expand its commercial influence on-shore, e.g. inland transportation.	• Deviation from main trunk routes • Efficient inland logistics network • Inland transportation cost • Inter-modal link • Land distance and connectivity to major shippers • Size and activity of Free Trade Zone (FTZ) in port hinterland • Size of contiguous city's economy
Maritime-related: dimensions regarding maritime cargo demand and shipping service connectivity	• Cargo proportion of transhipment cargo • Frequency of cargo loss and damage • Frequency of ship's calling and diversify of ship's route • Frequency of large container ship's calling • Level of ship's entrance and departure navigation aids system • Number of direct calling of ocean-going vessel • Port congestion • Volume of inducing cargoes by your company • Volume of total container cargoes
Endogenous: attributes that strictly originate from the port itself.	• Cost for cargo handling, transfer and storage • Cost related vessel and cargo entering • Government, local autonomous entity, private sectors • Level of service for fresh water, bunkering and ship's products • Promptness of issue document handling • Professionals and skilled labours in port operation • Prompt response • Port sales: port promotion • Port's safety and security • Real working time • Recognition and reputation of port • Reliability of schedules in port • Service capacity for ship's size • Sophistication level of port information and its application scope • Free dwell time on the terminal • Availability of vessel berth on arrival in port • Stability of port's labour • Terminal productivity • Water depth in approach channel and at berth • Zero waiting time service • 24h a day, seven days a week service • Port accessibility

Table 3.3 Summarised port competitiveness components
Source: the author 2017 adapted from Yeo (2007, p.72) and Parola *et al.* (2017, p.125)

Based on Table 3.3, the endogenous factors, including cost factor (price), efficiency factor and service factor, together with safety and security (component of software drivers) are chosen for this research to be discussed and tested for port competitiveness in the EU.

3.3.3 Port efficiency

Port efficiency is one of the important elements of port competitiveness (Clark *et al*., 2001). A variety of research projects on port competitiveness looked into port efficiency factors (Figueiredo *et al.,* 2015).

Figueiredo *et al.* (2015) undertook the Data Envelopment Analysis (DEA) to investigate the role played by the inter-port competition. Cullinane *et al.* (2006) concluded that the container port industry is characterised with intense competition. Cullinane *et al.* (2006) also suggested that the intense competition has stimulated container ports to have an overt interest in resource utilisation efficiency. Therefore, the port industrial players must undertake the container port or terminal performance analysis to survive and compete (Cullinane *et al.*, 2006). Such analysis "*not only provides a powerful management tool for port operators, but also constitutes an important variable for informing regional and national transport/port planning and operations*" (Cullinane *et al.*, 2006, p.355)

Cullinane *et al.* (2006) conducted a critical review of port competitiveness studies from 1970s up to 2002 and concluded that a great number of studies sought to evaluate the performance of ports and optimise cargo handling operational productivity. Nevertheless, among the studies they reviewed, Cullinane *et al.* (2006) found that only a few studies tried to derive a summary evaluation of port productivity. For example, at the early stage, De Monie (1987) tried to measure single factor productivity and in 1998, Talley compared actual with optimum throughput over a specific time period. Research on the measurement of productivity activities efficiency has gained significant progress over the years (Cullinane *et al.*, 2006). Blonigen and Wilson (2006) stated survey is one common method to measure port efficiency. Gonzalez and Trujillo

(2009) conducted a systematic analysis of the existing parametric and non-parametric approaches to economic efficiency and productivity analysis as applied to the port sector. Cullinane and Wang (2010) mentioned non-parametric frontier methods have been developed for transport productivity and efficiency measurement. Cullinane *et al.* (2006), Cullinane and Wang (2010) and Nguyen *et al.* (2016) suggested Data Envelopment Analysis (DEA) and Stochastic Frontier Analysis (SFA) as more holistic and complex methods to measure port performance. Estache *et al.* (2002) used the econometric estimation of production/cost functions for ports as an alternative. Blonigen and Wilson (2006) adopted a simple econometric-based method using US Census data on imports into US ports to measure port efficiency.

With the development of logistics and supply chain management, the port has become a vital node in the overall trading chain and port privatisation has been one of the most obvious industry phenomena (Tongzon and Heng, 2005). Port competitive position and operations efficiency are vital for a nation to gain competitive position in world trade (Tongzon, 1989; Chin and Tongzon, 1998). Therefore, it is essential to identify the relationship between the port efficiency and port ownership (Tongzon and Heng, 2005).

Port ownership structure on port efficiency

Tongzon and Heng (2005) reviewed early empirical research and suggested that much research seems to show there is a lack of clear-cut relationships between ownership and port efficiency. For example, based on the observation of output and inputs for 28 UK ports, Liu (1995) used SFA for assessing port ownership structure on inter-port efficiency. However, the results of Liu (1995) did not show that port ownership significantly influence port performance.

Notteboom *et al*. (2000) studied the efficiency of a sample of 36 European container terminals and four Asian container ports, using the Bayesian Stochastic Frontier Model. No relationship was discovered between the type of ownership and the efficiency level. On the contrary to these studies, some studies argued and demonstrated that port ownership affected port efficiency. Estache *et al.* (2002) analysed how the Mexico's 1993 Port Reform affected port efficiency through analysing 44 observations from 11 independent Port Administrations panel data. The study showed that the reform of decentralisation and privatisation undertaken at Mexico ports stimulated significant improvements in the average port performance in the short term. Cullinane *et al.* (2002) applied a 'port function matrix' to Asian major container ports for analysing port ownership structure and its impacts on port efficiency. The results suggested that privatisation improves port economic efficiency. Song (2003) studied the administrative and ownership structure of ports and he found out that the Hutchison Port Holding Group invested largely in both port of Hong Kong and port of Shenzhen. These two ports are rivals of each other. He concluded that competition and co-operation could exist in the same region at the same time. Hence, a strategy called co-opetition is needed by terminal operators to deal with both situations (Song, 2003). Cullinane and Song (2003) applied SFA to the selected Korean container ports and analysed the effects of privatisation on port efficiency, using both the cross-sectional and panel data versions of the stochastic frontier model. The results suggested some evidence for supporting the opinion that privatisation and deregulation improve port productive efficiency. Barros and Athanassiou (2004) used DEA to estimate the efficiency of Portuguese and Greek seaports and the results indicated that privatisation helps to improve efficiency. Baird (2000) applied the 'port privatisation matrix' and studied the UK port privatisation. He argued that since the primary objective of a port is to facilitate trades, hence seaport property rights transfer would not definitely improve the operational efficiency, or may even be counter-productive (Baird, 2000). Tongzon and Heng (2005) looked at the relationship between port ownership structure and port efficiency as well as port competitiveness determinants from a quantitative angle. They found that the participation of private sector in the port industry can improve port operation efficiency. Cui and Notteboom (2017) argued that port privatisation can positively affect cost effectiveness and technical efficiency. However, full port privatisation is not an effective way to increase port operation efficiency, which indicates that it is not a linear relationship (Tongzon and Heng, 2005).

Port size on port efficiency

Apart from research on ownership, some empirical research also examined the relationship between port size and port efficiency. Liu (1995) found that port efficiency could be explained by port size to a small degree. Martinez-Budrı´a *et al*. (1999) illustrated the results of the Data Envelopment Analysis (DEA) on the relative efficiency of 26 Spanish Port Authorities during 1993-1997. The results showed that ports with larger size were more efficient than the smaller ones. The work of Barros and Athanassiou (2004) also indicated that the scale of port operation could improve port efficiency level. In the study of Notteboom *et al*. (2000), a positive relation was found between port size and port efficiency level. The results of the 'port function matrix' analysis conducted by Cullinane *et al*. (2002) indicated that port/terminals with larger scale have certain efficiency advantages over smaller rivals. Nevertheless, Coto-Millan *et al*. (2000) adopted

SFA to investigate the efficiency level of Spanish ports, using panel data of 27 Spanish ports during 1985-1989. The results suggested that relatively larger ports tend to be less efficient. Tongzon (2001) also applied the DEA to compare four ports' efficiency levels in Australia and 12 other international container ports, showing that there is no clear relationship between a port's efficiency and its size and its function (hub or feeder).

3.3.4 Port service

In addition to port efficiency, port managers also need to differentiate their services from competitors (Bennathan and Walters, 1979). McCalla (1999) mentioned that many ports were facing "*global issues and the local responses*" in terms of port service. The global issues included world shipping alliances and the increasing vessel size and local responses were services from port towards customer's needs, i.e., increasing draught, terminal capacity, port cost and labour productivity (McCalla, 1999). The study of Foster (1978) determined that the priority of the service quality was over the monetary factor, from the shipper's perspective. Foster (1979) conducted the second research that targeted shippers. However, based on the collected data, he argued that service cost and port charges were still the most important determinants. Haralambides (2002) argued that port charges, including port dues and cargo handling charges, was one of the most important port service factors. In the survey of Ha (2003) mentioned in Section 3.3, the questionnaire method was adopted to investigate the service quality offered to look at the criteria and sub-criteria in broad terms. *"Ready information availability of port-related activities (operation and quality of customs clearance, EDI system, provisions of online port-related information, provision of cargo tracing system), location, port* *turnaround time (ship congestion in port, free dwell time for containers, on-dock container handling), available facilities, port management (labour performance, safety rules, authority marketing activities, worker's foreign language skills), monetary cost (charges, terminal charges, pilotage, towage) and customers' convenience (ready procedure for port use, reflection on port user's opinions and requirements, settlement of accident claims in port, benefits to the regular shipping operators, immediate handling of container port users' dissatisfaction)"*, were identified as the major factors (Ha, 2003, pp.131-137). The survey collected viewpoints of ship operators and logistics managers. They were asked to give scores to these service quality factors. Ha (2003) found that, in addition to monetary costs and time efficiency, ports need to improve their service quality, especially by improving the quantity and quality of information flows and data availability. Moreover, perceptive factors like available information (from various sources like experience and port marketing) and the port's reputation could be equally important to monetary cost (Ng, 2006). Chang and Thai (2016) suggested that corporate quality, interactive quality, physical quality, and port security are the elements of port service quality. Thai (2008) proposed the 'resources, outcomes, process, management, image, social responsibility' (ROPMIS) model to measure service quality in maritime transport. Thai (2015) proposed that ROPMIS model could be used to measure maritime transport services and specific sub-sectors, such as ports. Pallis and Vaggelas (2005) argued that a port should have more than two providers to ensure better port service. Port service was categorised as *"techno-navigational services regarding: (a) pilotage, (b) towage, and (c) mooring"* and *"cargo-handling services including: (a) stevedoring, stowage, transhipment and other intra-*

terminal transport, (b) storage, depot, and warehousing, depending on cargo categories, and (c) cargo consolidation", and *"passenger services, including embarkation and disembarkation"* (Pallis and Vaggelas, 2005, p.4).

3.3.5 Other issues

As Figure 3.1 (p.92) shows, apart from port efficiency, port service, port selection and port performance discussed above, Yeo (2007) also mentioned issues such as port policy, construction of container terminals and port functions are related to port competitiveness.

Clark *et al*. (2004) mentioned that in the case of transport cost, the determinants of port efficiency not only consisted of infrastructure variables, but also of policy variables and management. Their research also suggested that the effect of having regulations on port efficiency is an inverted U-shaped effect. Some level of regulations can increase port efficiency, however, an excess of it would reverse these gains (Clark *et al.,* 2004).

As Pallis and Vaggelas (2005) suggested that each port should have at least two service providers so that port users would have choice. The EC heavily promoted common competitive standards across ports in the EU as an indispensable move to achieve a European market for port service (Roe, 2009). The port policy attempted to enforce a competitive regime in large ports in the EU, which required a port to have at least two providers of services. Although the EC believed this regime would intensify competition, improve quality of services and reduce costs, it has experienced protracted attempts (Roe, 2009). Wang *et al.* (2004) looked at China's port governance and analysed port of Shenzhen and Shanghai as two sub models. The port of Shenzhen was managed by port authority according to the concept of commercial operation.

Wang *et al*. (2004) called this governance as 'hands-off' policy, while the port of Shanghai was managed by central government. The latter model is more common in the older major ports in China that mainly rely on institutional resources (Yeo, 2007). Wang *et al*. (2004) suggested the former 'hand-off' model as a better policy. Wang and Slack (2000) stated that port policy was one of the most important factors that influenced port competitiveness in the Pearl River Delta in China. The other factors included the impact of globalisation, container standardisation, multimodal accessibility and connectivity and port cost (Wang and Slack, 2000). Another example of political influence on port competitiveness can be found in Seabrooke *et al*. (2003) that they emphasised on similar important factors for Hong Kong Port competitiveness. The factors were macro-economic conditions, regional competition, the direct trade between China and Taiwan and China joining the WTO (Seabrooke *et al*., 2003).

Tsai and Su (2005) used Delphi method to construct political risk factors for container ports. They suggested 19 factors under five main categories, namely port development policy, port management policy, foreign enterprise policy, political and social systems and macro-economic factors. They concluded that low political risk could help to create a better business environment and attract more container traffics. They also studied how various port stakeholders would react to different political risks. Chan (2005) came to a similar conclusion that regulation influenced logistics activities through looking at state policy and regulations in the US.

3.4 Globalisation, shipping industry and economic liberalism

Globalisation has become particularly important in the last two decades. Its characters, based on Beck (2000), includes the geographical expansion, greater density of international trade, the global finance markets networking and the growing power of transnational corporations. From the 15th and 16th centuries, commercial exchanges are being clearly political and economic since the global market became more inter-related and more competitive owing to the transportation advances and compartmentalising people into states (Haynes *et al*., 2011). The shipping industry, as lifeblood of the international, is closely linked with every aspect of globalisation (Lu *et al.,* 2010). The dynamics between maritime governance and the economic implications can be regarded as the issues of political and economic globalisation. Roe (2013, p. 178) stated that the shipping industry "*can be also seen to present an indicative portrait of the broader globalised world economy*".

There are three broad theoretical approaches to characterise the politics of the international economy in terms of government policies and the global system, namely Mercantilism, Economic Liberalism and Marxism. Liberalism has been said to be the dominant ideology of globalisation (Usher, 2003).

During the 16^{th} and 17th century, the economic policies of the powerful countries and the overall economic system were referred as Mercantilism (Haynes *et al*., 2011). It reached its peak in the middle ages when most of the world was controlled by a small number of states politically and economically (Haynes *et al*., 2011). Countries such as Britain, France and Turkey developed their own international economic system where they asserted a self-serving strategy of supporting exports over imports for wealth accumulation (Haynes *et* *al*., 2011). Haynes *et al*. (2011) stated that there are four core tenets of Mercantilism, which are: (1) the government should interfere in international trade; (2) international economies are competitive not cooperative; (3) self-sufficiency and autarky; and (4) protectionism.

Economic Liberalism emerged in the era of industrialisation and is frequently linked with democracy. International trade has linked nations together. Liberalism believes that in the modern world the boundaries between states are becoming pervious and the states are becoming interdependent and thus are sensitive to other actors' actions (Haynes *et al*., 2011). Technical advances such as nuclear weapons and the Internet have made the boundaries of states even more permeable. Politics is illustrated as mutually beneficial process in which many players seek to resolve issues in international relations (Goodwin, 1982). Liberals acknowledge that establishment of international institutions is necessary to solve the problem of anarchy to gain peace and facilitate cooperation. States are increasingly being compelled to engage in more intensive cooperation which stems regimes to regulate behaviour over a range of issues (Haynes *et al*., 2011). In contemporary IR, Liberals argue that a standalone modern state is unable to meet the complex and diverse needs of their citizens. Cooperating with other states is the only way out (Haynes *et al*., 2011). The interactions among states and other actors are subjected to regulation under a system of rules and practices. Liberal Pluralists point out that the growing importance of multinational corporations (MNCs), non-governmental organisations (NGOs) and pressure entities are no longer the only significant actors in IR. NGOs, MNCs and institutions are important players in contemporary IR as well (Haynes *et al*., 2011).

Liberals' beliefs are reflected in four principles, according to Haynes *et al*. (2011), namely free trade, invisible hand, comparative advantage, and trade brings peace. Classical Liberalism see market as the most efficient approach of organising human production and exchange, like "*an invisible hand'* were guiding and coordinating economic activity (Ricardo, 1971). In free market economics, there is a need for 'inputs' into the production process and some of them are imported from abroad. Companies also seek for new markets overseas for their products. As a result, trade between states is encouraged. Human beings are assumed to act rationally in the economic sphere. 'Rationality' is seen to be a person's ability to weigh up carefully the costs and benefits of action (Haynes *et al*., 2011). Jeremy Bentham who was a 'utilitarian' thinker believed that people who behave rationally would always act to maximise their own 'utility' or interest and a collective of this behaviour could produce beneficial outcomes to match up between consumers' demand and producers' supply.

3.5 Summary

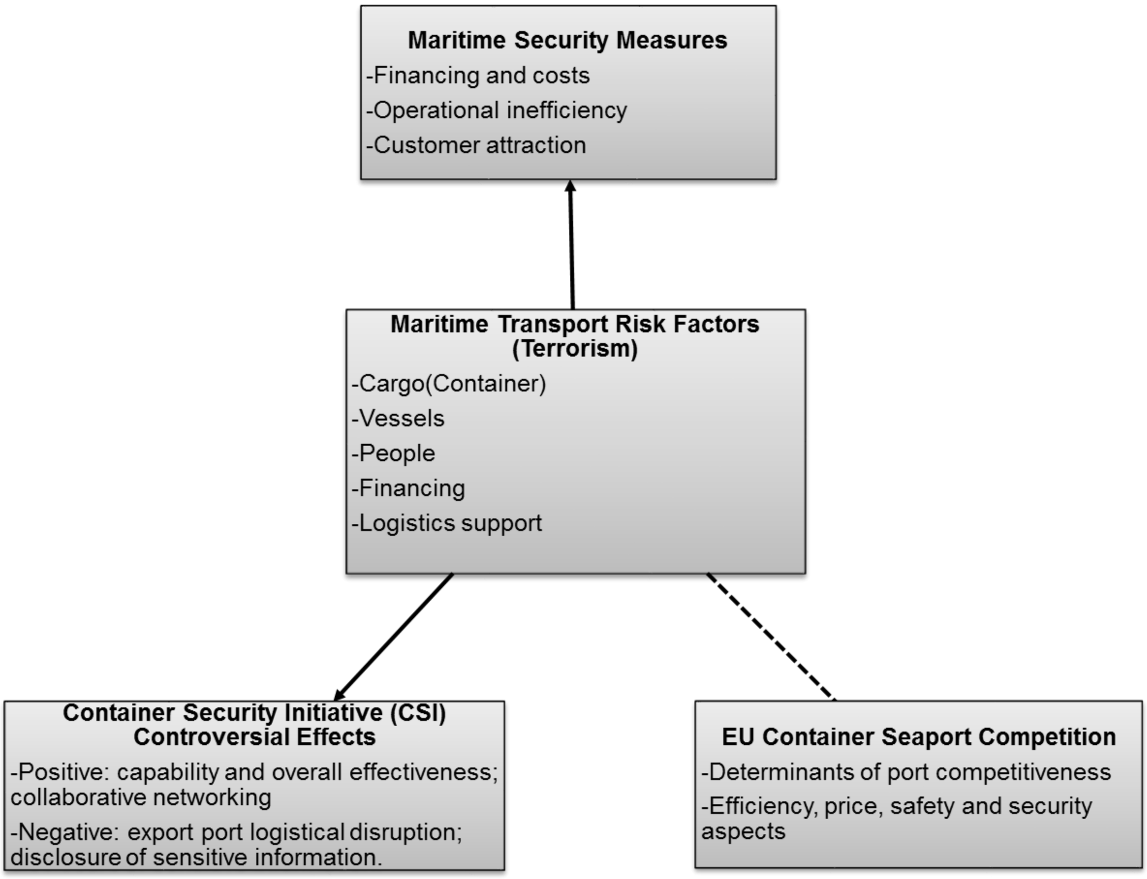
A literature review on port competition and competitiveness was undertaken in this chapter. The definition and features of port competition were given in Section 3.1 and Section 3.2. Port selection and relevant influential factors were discussed by reviewing the literature. Several key port competitiveness components were summarised accordingly in order to form the conceptual assumptions in Chapter 3. In additional, theories of economic liberalism and its relevance to shipping industry were briefly discussed.

Chapter 4. Conceptual model and assumptions

In Chapter 2 and Chapter 3, the related maritime security issues and framework, the Container Security Initiative (CSI) and its controversial implications, and port competition theories have been reviewed. A study on the long-term analysis on the effects of security initiatives on the EU seaports is needed to fill the research gap identified in Chapter 2. Therefore, this research focuses on the CSI and its implications for EU container seaports competition. A conceptual model and five conceptual assumptions are developed to assist this research to achieve the aim and objectives.

4.1 Conceptual model

The conceptual model of this research is presented in Figure 4.1. This model aims to explore the effects of the CSI on EU container seaport competition, rather than testing or explaining relationships.



C.A.=Conceptual Assumption

Figure 4.1 Conceptual model
Source: the author (2016)

The model is based on the research objective O1 that contains two major themes: maritime security measures and EU container seaport competition. As explained in Section 2.1.2 and Section 2.1.2.1, maritime security in this research refers to maritime terrorism. The model illustrates the synthesis of the literature review and consists of four pillars that are: (1) maritime transport risk factors; (2) maritime security measures; (3) the CSI and its controversial effects; and (4) EU container seaport competition. The maritime transport risk factors in maritime terrorism, as the first pillar, is the starting point of this model since various maritime security regulations and measures (see Section 2.1.1) are developed in response to these potential threats. The maritime security measures, as the second pillar, include existing theories and arguments of the positive and negative effects of maritime security measures compliance. According to the discussion in Section 2.3, there is a lack of data and empirical analysis to support these arguments. This pillar directs this research to collect relevant data to fill the research gap discovered in Section 2.3. The third pillar, the CSI and its controversial effects, is built upon the research aim. The CSI, as one of the most influential maritime security measures, have remained controversial since it was established in 2002 (Section 2.2.5, Section 2.3.1 and Section 2.3.2). This research aims at analysing the impacts of the CSI on the EU container seaport competition; hence, this pillar is essential for this model. As was discussed in Section 3.3.1, port competition varies between regions. The influential factors discussed in Chapter 3 have different impacts on port competition to a varying degree. Thus, the fourth pillar is designed to find out the determinants of container seaport competitiveness in the EU. In turn, the impacts of the CSI on the identified factors will be analysed accordingly to deduce how the EU container seaport competition could be altered.

Five conceptual assumptions (C.A.1, C.A.2, C.A.3, C.A.4, C.A.5) are developed to connect each pillar to hypothetically indicate how one pillar affects the other one. These conceptual assumptions are derived from the literature review in Chapter 2 and Chapter 3. C.A.1 aims to find out the importance of implementing maritime security measures, despite the negative implications mentioned by various scholars in Chapter 2 (Allen, 2006; Bichou and Evans, 2007; Miller, 2007; Bichou, 2008a; Dekker and Stevens, 2007; Bichou, 2011). C.A.2 serves two purposes. The connection between the first pillar and third pillar is to find out whether the CSI improves maritime security since it was introduced. The CSI has shared similar arguments with other maritime security measures in terms of its benefits and negativities. However, there has been no evidence to support these arguments. Therefore, the connection between the second and third pillar aims at finding out whether the CSI brings negative impacts on ports and directing data collection to settle the conjuncture. C.A.3. is designed based on the fourth pillar to identify the key determinants of EU container seaport competitiveness. C.A.4 and C.A.5. are designed to achieve the research aim. In addition to directly analysing the collected primary and secondary data, the analyses of these two assumptions will also take two aspects into consideration. The first aspect is how the CSI affects the identified port competitiveness determinants (illustrated by the arrow from the third pillar to the fourth pillar). The second aspect is to conclude how maritime security measures affect port operations and port competition (illustrated by the arrow from the second pillar to the fourth pillar).

4.1.1 Maritime transport risk factors

As Section 2.1.2 explained, the term 'security' in this research refers to terrorism and port/maritime security issues are terrorism-related. Terrorism has been a global concern because various transportation modes have been utilised to transport the weapons or become a target due to the vulnerabilities which lead to economic loss and human casualties. Seaborne transport poses several additional security challenges by its complex and international transportation network nature (OECD, 2003). Sea-going vessels can be the target of attacks or used for illegal cargo movement. The OECD (2003) identified five major risk factors in maritime transport: cargo, vessels, people, financing and logistics support (see Figure 2.1 on p.40).

Cargo ships, especially containerised ships, transport most of the global non-bulk cargoes. Containerised shipping's increasing trade volume, its high velocity in the world trade and its uniformity have caused formidable security challenges. Weapons of mass destruction, drugs and illegal goods can be concealed within containers by terrorists and criminals. Vessels can be used as a weapon in a terrorist attack against a population area next to a port or intermodal transportation node to damage port facilities or block access to a port facility (UNCTAD, 2004). Additionally, seafarers and port workers are often directly targeted or indirectly suffer from terrorism attacks. The OECD (2003) mentioned that some seafarers could actually be the terrorist group's accomplices or members. In the latter scenario, it would be more difficult to detect terrorism activities. Last but not least, financing and logistic support cannot be overlooked. Terrorist groups can operate vessels to finance and support their logistics operations. An example can be found in a terrorist group named the Liberation Tigers of Tamil Eelam (LTTE). The LTTE has developed its own extensive and sophisticated network of forwarders and a seaborne transport network since the mid 1980's (OECD, 2003). LTTE funded ships to carry weapons for a possible war against the Sri Lankan government.

Taking the above risk factors into consideration, several maritime security measures are developed to secure the international seaborne trade.

4.1.2 Maritime security measures

In response to the potential maritime security threats, various supply chain and maritime security measures have been developed and imposed by regulatory bodies. The categories and significance have been discussed in Chapter 2. The benefits such as increasing the level of security awareness and lowering the possibility of a terrorist attack have been stressed by many studies (Stasinopoulos, 2003; Bichou *et al.*, 2007; Park, 2013). Thibault *et al*. (2006) found that the security initiatives have formed a cooperative security relationship between industry and government. Security improvements resulting from maritime security requirements have enhanced service quality in terms of service reliability, social responsibility awareness and operation and management efficiency (Thai, 2007).

Financing and costs

Arguments arise out of the potential problems caused by maritime security requirements. Additional costs and operational inefficiency are the two major issues raised by many studies (OECD, 2003; Dekker and Stevens, 2007; Miller, 2007; Bichou and Evans, 2007; UNCTAD, 2007; Kruk and Donner, 2008; Bichou, 2011). A major cause of cost burden comes from container scanning required by the security regime. In order to comply with the regime, initialisation costs occur for purchasing, installation, initial training and civil engineering works. Moreover, operational costs happen as ongoing expenses incurred for operating the container scanning equipment. The cost estimation conducted by various researchers implies that the additional cost could cause issues for both low-volume export container ports and high-volume export container ports (OECD, 2003; Miller, 2007; Bichou and Evans, 2007; UNCTAD, 2007; Dekker and Stevens, 2007). However, there are some studies focusing mostly on cost-efficiency of regime compliance. Thai (2007) pointed out that ports and terminals could increase revenue by creating a new income stream. The total cost of cargo inspection can be lower than conventional random physical inspections (Bichou, 2007; Gutiérrez *et al*., 2007). Compliance can also provide fast-lane treatment and access certificates as well as reduced insurance costs (Bichou, 2011). According to much research, the unresolved debate is over whether port security should be paid for by jurisdictional stakeholders, export stakeholders or import stakeholders. Although costs would ultimately cascade down to importers and final customers, the stakeholders may absorb some of the costs themselves due to political or strategic factors.

Efficiency

While security regimes enhance maritime security, they slow down cargo movement due to additional inspections. According to the WSC (2007), Asian port operations were predicted to suffer the most from a range of US supply chain security initiatives, since China heavily relies on export to the US. Bichou (2011) argued that procedural requirements of security regime harm operational and logistical efficiency. Direct functional redundancies and indirect supply chain disruptions stemming from longer lead times could both lead to less reliable demand and supply scenarios (Bichou, 2011). Nevertheless, literature advocates that the productivity of the entire supply chain can be improved due to better procedural arrangements. Security regime compliance is also commercially rewarding. Many papers focus on positive impacts regarding logistical efficiency (Crutch, 2006; Gutiérrez *et al*., 2007; Thai, 2007). Positive impacts include reduced transit time and improvement of lead-time predictability (Thai, 2007; Bichou, 2011), reductions in stowaways (Timlen, 2007), improved manpower utilisation (Thai, 2007), better document processing and cargo handling (Thai, 2007), and improve customers' satisfaction and enhanced branding (Gutiérrez *et al*., 2007; Thai, 2007; Bichou, 2011)

However, to date, there is not much data and empirical analysis to support the positive and negative operational and financial impacts of maritime security regime compliance (Bichou, 2008a). There are a few studies that have examined the existence of these impacts, based on conceptual work, economic situation or anecdotal evidence (Babione *et al*., 2003; Lee and Whang, 2005; Thai, 2007; Rabadi *et al*., 2007; Gutiérrez *et al*., 2007; Bennett and Chin, 2008; Yang, 2010; Urciuoli *et al*., 2010; Voss *et al*., 2009; Talas and Menachof, 2009). Therefore, to fill the research gap, the conceptual model developed for this research includes the operational and cost factors caused by maritime security regime compliance.

4.1.3 The CSI and its controversial effects

As one of the voluntary maritime security programmes, the CSI has received increasing attention in recent years. It aims at protecting container trading systems between CSI ports and US ports by forming a bilateral agreement between the US and foreign-trade country partners.

The CBP claimed a number of benefits that the CSI brings, including increasing the level of security awareness, and improvement of overall effectiveness through international collaboration between customs. However, some benefits still remain controversial. In similar vein to the maritime security initiative, the additional security checks transferred from container unloading point in the US to loading point overseas may bring costs and logistical interference to the affiliated ports. Additionally, CSI's development of a collaborative network among joined ports inevitably involves sensitive business information disclosure that port operators and users are not willing to cooperate. From this viewpoint, CSI compliance could be a 'hidden' burden for participant ports. The overlaps between the IMO and WCO measures and the CSI (Figure 2.2) may potentially lead to administrative confusion and an overly bureaucratic system which is contrary to the initial purposes of these initiatives (Parliament of Australia, 2003). Another feature of the CSI programme is that it is voluntary. It is possible that smaller and less economically independent countries would be intimidated by US threats of isolation in the event of a terrorist attack and would join the programme simply to ensure US constant support (Parliament of Australia, 2003). Not joining the programme may cause ports to lose their competitiveness and the market share of US-inbound container trade. On the other hand, the smaller participating ports could suffer from the high initialisation cost and operational cost of CSI compliance. The CSI programme may put these ports in a dilemma.

Nevertheless, there is little research to investigate and analyse the implications of the CSI programme to participated ports and non-participated ports. Therefore, this conceptual model sets up two major concerns regarding the positive and negative effects of the CSI and allows the researcher to analyse the impacts of the CSI on ports.

4.1.4 EU container seaport competition

It has been widely discussed that the increasingly severe situation of terrorism and the corresponding security initiatives have significantly affected maritime transportation and port operations (Bichou, 2004; Park, 2013). According to Dekker and Stevens (2007), three topics regarding maritime security and maritime transportation were required for further study (see Section 2.3). One of them was to conduct a long-term analysis on how security initiatives influence seaports' competitive positions. Therefore, this research is designed to analyse the CSI's long-term effects on EU seaports' competition.

Much seaport competitiveness analysis concentrated on port selection criteria. The paper of Yeo *et al.* (2008) summarised the port selection criteria from various research since the 1980s. Malchow and Kanafani (2004) studied another significant characteristic of a port, which was its location. In 2005, Tongzon and Heng suggested eight factors that affect port competitiveness. Bichou and Gray (2005) proposed that port competition has shifted to cross-border, cross-industry levels. They also proposed that port competition would shift from *"the institutional, functional and/or spatial levels to channel management level"* (Bichou and Gray, 2005, p.89).

Port environment has become increasingly competitive (Tongzon and Heng, 2005). Port competition varies between regions depending on the extent to which the influential factors have affected the nature of the port environment (Tongzon and Heng, 2005). A variety of regional research projects on the competition among ports has been undertaken, particularly in Asia (Kim, 1993; Jeon *et al*., 1993; Fung, 2001; Tiwari *et al*., 2003; Cullinane *et al*., 2004; Song and Yeo, 2004; Yap *et al*., 2006; and Anderson *et al*., 2008). Therefore, in order to analyse the implications of the CSI for EU container seaport competition, factors that impact upon port competition in the EU should be identified first.

Fleming and Baird (1999) targeted the UK, the US and north-western Europe and suggested six sets of factors that affect port competitiveness. They are: port tradition and organisation, port accessibility by land and sea, state aid and its influence on port costs, port productivity, port selection preferences of carriers and comparative locational advantage (Valentine, 2002). Huybrechts *et al*. (2002) evaluated the attractiveness of the port of Antwerp and concluded that Antwerp needed to address the issue of port accessibility in order to become a market leader within North Europe. The components of port competitiveness that Yeo (2007) and Parola *et al.* (2017) summarised and selected are presented in Table 3.3 (p.99). They are in three categories and include: port location, port facilities including superstructure (berth, depth, channel length), terminal efficiency, hinterland networks, value added logistics; and port services, safety handling of cargoes, confidence in port schedules, operational efficiency, electronic data interchange, IT, integration, simplification of procedures, incentives, operational transparency, and port labor and skills. On the other hand, according to studies focusing on the impacts of maritime security measures on sea transportation, costs/financing and logistical disruption caused by port inefficiency are two major issues affecting port competitiveness. Therefore, the conceptual model developed for this study includes the endogenous factors (cost factor, efficiency factor and service factor), together with safety and security (component of software drivers) to investigate major EU container seaport competitiveness determinants and how they are influenced by the CSI.

4.2 Conceptual Assumptions formulation

The assumptions of the conceptual model are classified under four conceptual categories, which denote the main four issues of maritime safety and security in container shipping identified in the conceptual model (Figure 4.1). They are: (1) the necessity of pursuing maritime security initiatives; (2) introduction of the CSI and its controversial influences; (3) determinants of EU container seaport competitiveness; (4) the implications of the CSI for EU container seaport competition. A set of conceptual assumptions are developed based on each of these conceptual categories. The conceptual assumptions of this study attempt to direct the research to analyse the implications of the CSI for EU container seaport transportation critically. Each of these conceptual assumptions derives a set of statements, which form the basis for the Delphi survey introduced in the following chapters. These statements were developed from the results of a research synthesis from Chapter 2 and Chapter 3. Each statement contains controversial and debatable viewpoints taken from the extant literature. The sources will be presented in Table 5.5 (p.161) in Section 5.6.

Conceptual Category 1: The necessity of pursuing maritime security initiatives.

Conceptual Assumption 1: It is necessary to carry out a maritime security initiative despite the fact that additional inspections may cause supply chain disruption and financial burden.

Statements:

S1.1 - Maritime security has become a great concern worldwide. The increasing volume of container movements, their relatively high velocity in the international trade and their uniformity have posed formidable security challenges. As the loading and unloading points of a sea transport process, container ports are the most important nodes for maritime safety. However, only around 2% to 10% of containers are actually inspected. US ports normally inspect roughly 5% of the 17 million containers arriving at the border every year. A great concern about container security emerged from this low inspection rate. Container security is far more important than efficiency and profit for the port. Therefore, security should be seen as the first priority.

S1.2 - As the world's largest national economy, United States plays a vital role in global trade. After 9/11, the US has reacted to the needs for strengthening security measures to enhance maritime transport safety. Some of the maritime security initiatives have influence on some export ports in terms of logistics efficiency and financing. Nevertheless, those export ports should be prepared to comply with the US container port security initiatives for maritime safety.

Conceptual Category 2: Introduction of the CSI and its controversial influences.

Conceptual Assumption 2: The Container Security Initiative (CSI) can facilitate global container seaborne trade safety and security, adding competitiveness to CSI-affiliated ports.

S2.1 - The Container Security Initiative (CSI) programme managed by the US Customs and Border Protection (CBP) is an influential voluntary initiative. The CSI was proposed to ensure that all containers that pose a potential risk for terrorism are identified and inspected at foreign ports before they are loaded on to vessels and imported to the US. Without a doubt, the CSI has dramatically increased the level of awareness for the need to secure global trade.

S2.2 - Unlike the 24 Hour Rule, the CSI is a voluntary initiative. However, in order to keep the market share for US inbound trade, the major exporters have to join the programme. Not joining the programme could make the exports lose competitiveness over their rivals.

Conceptual Category 3: Determinants of EU container seaport competitiveness

Conceptual Assumption 3: The EU container port industry is highly competitive. Port efficiency, service and cost related elements are still the most important competitiveness components.

S3 - The port environment generally has become increasingly competitive, it varies between regions and places depending upon the extent to which these forces have impacted upon the nature of the port environment. According to prior studies, the components of port competitiveness are: port location, port facilities, overall efficiency, hinterland networks, value added logistics; and port services, safety handling of cargoes, confidence in port schedules, simplification of procedures, operational transparency, and port labour and skills. Among these factors, for EU ports, since port location is static, port efficiency, service and cost related elements are still the most important competitiveness components. Port safety and security is not an incentive for port selection.

Conceptual Category 4: The implications of the CSI for EU container seaport competition

Conceptual Assumption 4: CSI compliance does not cause global supply chain disruption or financial problems for the EU container ports.

S4.1 - To obtain the minimum required level of compliance, ports need to implement technical and organisational measures that will bring additional costs to maritime industries. Enhancing the technical measures due to security regulations, such as the ISPS Code, has brought additional costs to European maritime industries. Smaller ports in the EU may stop their US-inbound business since they cannot bear the financial costs. Larger ports may “steal” new business from smaller ports which are financially strained to meet the scanning requirements. A distortion of EU container port market share will arise.

S4.2 - While port security measures enhance port security, procedural requirements of the new security regime act against operational and logistical efficiency. The proponents of this view list a number of operational inefficiencies ranging from direct functional redundancies such as additional inspections and lengthy procedures to indirect supply chain disruptions stemming from longer lead times and less reliable demand and supply scenarios.

S4.3- Productivity could improve due to better procedural arrangements. With the reinforcement of security, there is reduced likelihood of security incidents, a probability of fewer incidents being recorded and higher port reliability. Increased reliability which leads to higher trust between a port and its upstream and downstream partners in a container supply chain, contributes to the reduction of cargo processing time and results in reduction of cargo processing cost. Decreased cargo processing cost has a positive effect on port selection, thus attracting more container volume. Consequently, from the viewpoint of the above analysis, improving security level and increasing port reliability can attract more containers. Compliant participants would benefit from access certification and fast-lane treatment as well as reduced insurance costs and risk exposure.

S4.4 - Although the US Customs and Border Protection stated that the CSI can bring benefits to member ports, those benefits are still controversial. The CSI has negative effects on port profit. In addition to the significant initial investment in new equipment, the CSI makes cargo inspection process more complicated, creating an increase in cargo processing time and cargo processing cost. That can change important performance characteristics of the port such as the port efficiency and price. On the perspective of a long-term economic model, these consequences produce the negative impacts on relative attractiveness of ports for various stakeholders, namely exporters, and cargo carriers. The reduced attractiveness will decrease the competitiveness of a port. Moreover, the deepening cost and time may initiate a vicious circle of decreasing port competitiveness. The CSI is actually a heavy burden for those ports that have joined.

S4.5 - The CSI could improve the capabilities and the overall effectiveness of the targeting process. However, this programme transfers the container examinations from unloading ports in the US to the loading ports overseas. On the other hand, all the checks are carried out in the host countries which bear the equipment cost. In case of unloading and emptying of any potential threat posed by a dangerous container, the costs are borne by the importer to a US port. The US Customs sacrifices the export ports to save the US unloading port's time and cost. The CSI is a unilateral and unfair programme without considering the host ports.

S4.6 - CSI bilateral system of information exchange requires a host country to offer to conduct a security check on containers shipping to a US port. In return, the host country can send its officers to any US port to target ocean-going containerised cargo being exported to their country. Under this system, there can be sensitive information exchange, according to the US government, which may be deemed necessary to ensure the safety of any ports involved. However, the host countries are not willing to offer any confidential information.

Conceptual Assumption 5: The introduction of the CSI does not cause small ports to lose market share. EU container port market competition is not disrupted by CSI introduction.

S5 - There are many ports in Europe. However, there are ‘only’ about 130 seaports handling containers of which around 40 accommodate intercontinental container services. About 70% of the total container throughput in the EU port system passes through the top 17 load centres; 14 of those have joined the CSI programme. In the short term, small container ports have to stop their US inbound business and large EU container ports will gain new market share. In the long run, with further CSI implementation, the EU host countries will absorb the extra cost through transferring them to customers. However, the distortion in the competitiveness of large EU container ports will be minor.

Chapter 5. Research methodology

Clough and Nutbrown (2002) discussed research purpose and the importance of research methodology. They claimed that the purpose of methodology is to explain and justify the particularity of the methods used for a given research. Saunders *et al*. (2012) described a methodology as a set of methods that are important to a particular subject and it involves a procedure or a set of procedures to be undertaken to identify a result or solution to an issue. The procedures could take a 'Qualitative' or a 'Quantitative' approach or use mixed methods to analyse and identify a solution. Trauth (2001) suggested that there are three factors that influence the choice of a research method. They are: *“the nature of the research problem”; “the researcher's theoretical lens”*; and *“the degree of uncertainty surrounding the phenomenon”* (Rowlands, 2005, p.82). Therefore, the aim of this chapter is to identify and provide rationale for the choice of method adopted to achieve and fulfil the research aim and objectives.

This chapter will start with a discussion of the research philosophy, approach and identification of trade-offs that exist among different research methods. It is followed by the justification for the use of a qualitative method to address the research aim within the scope of the impacts of maritime security measures on port competition. Delphi technique, as a qualitative approach, will then be justified and described.

5.1 Research philosophy

The theoretical lens is referred as *“philosophical issues of epistemology and a choice between positive, interpretive and critical studies”* (Rowlands, 2005, p.83). For researchers, identifying one's philosophical and theoretical assumptions is the starting point for the research leading to choosing an appropriate methodology. The research philosophy adopted by a researcher will affect the way in which he or she views the world (Saunders *et al*., 2012). There are three major research philosophies that have been widely used by researchers, namely Pragmatism, Positivism and Interpretivism (Saunders *et al*., 2012).

Pragmatists believe that there are many different ways to interpret the social world; hence concepts are only relevant when they support an action (Saunders *et al.,* 2012; Sindi, 2016). The practical application of ideas and thoughts is emphasised through acting on them to test human experiences (Saunders *et al.,* 2012; Corbin and Strauss*,* 2014). Thoughts are considered as an instrument for prediction, action and problem solving. Knowledge is used for practice or practical affairs (Corbin and Strauss*,* 2014). Goldkuhl (2012) noted that pragmatism is more appropriate for researcher approaches intervening into the world rather than merely observing it. The role of a pragmatism researcher is to engage in changing (Goldkuhl, 2012). As this research aims at finding out and interpreting the effect of the CSI on EU port competitiveness rather than changing it, pragmatism is not the suitable philosophy.

Positivists believe that there is a single reality and it can be measured and known (Guba and Lincoln, 1994). Sindi (2016) explained the data collection process is to seek relationships in the data and to create law-like generalisation. Trochim and Donnelly (2006) stated that positivists use existing theory to develop and test hypotheses, and then confirm or reject them for further theory development which is tested by another study. Therefore, research should be done in a value-free way and the outcome should be objective and unbiased. Quantitative methods are favoured as they lead to statistical analysis (Saunders *et al*., 2012). From this perspective, positivism is not suitable for this research since this research will collect opinions from different stakeholders who hold various values and a qualitative approach will be chosen.

Interpretivism is adopted as the philosophy for this specific research. The development of interpretivism is derived from the critique of positivism in social science (Sindi, 2016). According to Wilson (1990), unlike positivism, interpretivism advocates interpreting the differences between human roles in the social sector. Interpretivists seek to interpret the social world from a cultural and historical perspective and emphasise process rather than facts. Based on Cunningham (2006), interpretive researchers assume that social constructions such as language, consciousness, shared meanings and instruments are the only way to access reality (given or socially constructed). Sindi (2016) explained two variations of interpretivism: phenomenology and symbolic. Phenomenology is the philosophical tradition that aims to understand the world through experiencing the phenomena directly (Littlejohn and Foss, 2009). Symbolic is a continual process that interprets others' actions and accepts symbols as culturally derived social objects in order to understand the world (Sindi, 2016). This research looks at how a security regulation affects port competition from the perspective of cost, efficiency and service quality by analysing stakeholders' views. Various stakeholders who hold different values and interests play different roles in the shipping and port industry. The data of this research is based on their opinions which are subjective, and the data analysis will be based on meanings and understanding of the current maritime environment. Therefore, interpretivism is the philosophy that affects this specific research.

5.2 Research approach

There are three types of research approach: deductive, inductive and abductive approaches (Kovács and Spens, 2005). Saunders *et al*. (2012) differentiated deductive and inductive by hypotheses formulation. A deductive approach refers to research that starts with developing a theory or hypotheses (assumptions) and then designs a research strategy to test the formulated theory or hypotheses (Collis and Hussey, 2009). An inductive approach is known as theory building, in which the research starts with data collection and build new theories (Saunders *et al*., 2012). An abductive approach aims to address the weaknesses related to deductive and inductive approaches. Saunders *et al*. (2012) and Dudovskiy (2016) asserted that there is a lack of in clarity regarding how to select theory to be tested by hypotheses formulation in a deductive approach. With inductive logic, opposite to the deductive path, the knowledge of a general frame or literature is not necessary (Kovács and Spens, 2005). A start with data collection to develop propositions and a new theory is more appropriate for the inductive research as the researcher should not be constrained by existing theories (Trauth, 2005). However, since this research is to find out how the CSI affects EU port competition, relevant extant theories and concepts on maritime security, maritime governance and port competition must be reviewed and considered. Therefore, inductive approach is not suitable for this research. This specific research is shaped by adopting an abductive approach. It started with exploring and collecting information from different sources to form incomplete observations of how maritime security measures affect port competition. Next a set of conceptual assumptions were developed as hypotheses to predict and explain the research problem that was discovered from the literature review. A Delphi survey was then designed to test the formulated assumptions. A new model was developed to explain the results from this Delphi research which cannot be explained by existing theories. Therefore, this research follows an abductive approach since the process is devoted to explain 'incomplete observations' or 'surprising facts' specified at the beginning of the study (Dudovskiy, 2016).

5.3 Research strategy and method

The choice of research strategy is determined by the research objectives as well as the literature. In order to achieve the research aim, it is important to use a suitable methodology by which the impacts on EU port competition will be determined. In choosing the methodology for data collection, the available and applicable methods need to be considered first. Whether these techniques suit the research aim and objectives is another substantial consideration (Cottam, 2012). The methodology for data collection and analysis will be discussed and presented in this chapter.

Outlining a framework of research aim and objectives is essential to guide methodological development (see Section 1.3). The purpose of this study is to explore and explain the implications of the CSI for EU container port competition. The limited amount of research related to this subject means that this research is exploratory, aiming at identification and description. Moreover, due to the abductive research approach, a model was developed to interpret the facts discovered in the Delphi survey.

5.3.1 A revision of research methods on port competitiveness studies

In Chapter 3, research on port competitiveness was reviewed. The methods extant scholars adopted, mainly quantitative and qualitative methods, together with major influential factors were identified (see Table 3.1 and Table 3.2 on p.93).

Kent and Ashar (2001) suggested a conceptual model that consists of four elements for monitoring port competitiveness. The four elements were: transportation, operational performance, tariff comparison and financial performance. Cullinane *et al*. (2002) used the economic inputs of capital and labour for analysing port efficiency. Tiwari *et al.* (2003) used a discrete choice model to analyse how shippers select liner companies and ports. They examined the characteristics of ports, shipping line and shipper by analysing proxies. Veldman and Buckmann (2003) originally intended to analyse port competition and choice using two factors which are cost and service quality. However, owing to limitations in obtaining sufficient data, only service factors were analysed.

5.3.2 The choice of qualitative approach for this research

In Chapter 2, studies regarding the implications of maritime security measures on ports were reviewed. Much of the available research is based on conceptual work, modelling techniques, economic situation, and efficiency measurement which are in the field of quantitative research (see Section 2.3.2). However, there is rarely a qualitative analysis to explore how the maritime security measures affect port competitive positions. On the other hand, in previous research which adopted a quantitative approach to investigate port competitiveness, very limited and abstracted input factors have been used. To obtain these quantitative data, major obstacles such as business confidentiality, evaluation complexities, difficulties in measurement and unavailability still remain.

For example, Cullinane *et al.* (2002) had problems in data collection regarding the port cost since there were no secondary sources available for the targeted areas. As a result, an alternative approach using the physical characteristics of ports was adopted. Kent and Ashar (2001) also stated that difficulties existed in data collection since the assumptions they made for the model were based on industry standards which may vary from country to country. Sanchez *et al.* (2003) did not include transport cost charged to the shippers in their analysis on measured international transport costs owing to the problems with obtaining key information. Malchow and Kanafani (2004) were restrained by data availability and the complexities of port tariffs, and finding data on port charges, the transport cost and the intermodal transfer process was very difficult. Tiwari *et al.* *(*2003) had to exclude the shipping line service factors and variables from their input factors due to lack of information. Tongzon and Heng (2005) omitted factors such as cargo handling charges, average delayed time and product differentiation because of confidentiality issues and technological difficulties.

Bearing in mind the research aim, according to Cottam (2012), the opinions of port industrial and administrative experts on ideological issues as well as obtaining attitudes concerning the application of this ideology to EU container ports, a qualitative approach will stimulate a more in-depth response than a quantitative survey because of the obstacles in obtaining data for a quantitative research. Therefore, the data required for this research is qualitative.

5.3.3 Primary and Secondary data collection

This research will gather primary data and secondary data to fulfil the research objectives. Secondary data collected from the literature review will be used to achieve Objective 1, 2 and partially Objective 3. To fully achieve Objective 3 and 4, primary data will be collected through a Delphi survey. Developing the Delphi survey will be based on key areas in the literature review on the implications of maritime security measures and influential factors of port competition. Discussion of the findings will be made based on a synthesis of the literature view and the Delphi results. As this research is shaped by an abductive approach, a model will be developed to interpret the findings. In order to build such a model, secondary data including existing theories and port related data will be collected. Figure 5.1 illustrates the research phases and data sources for this abductive research.

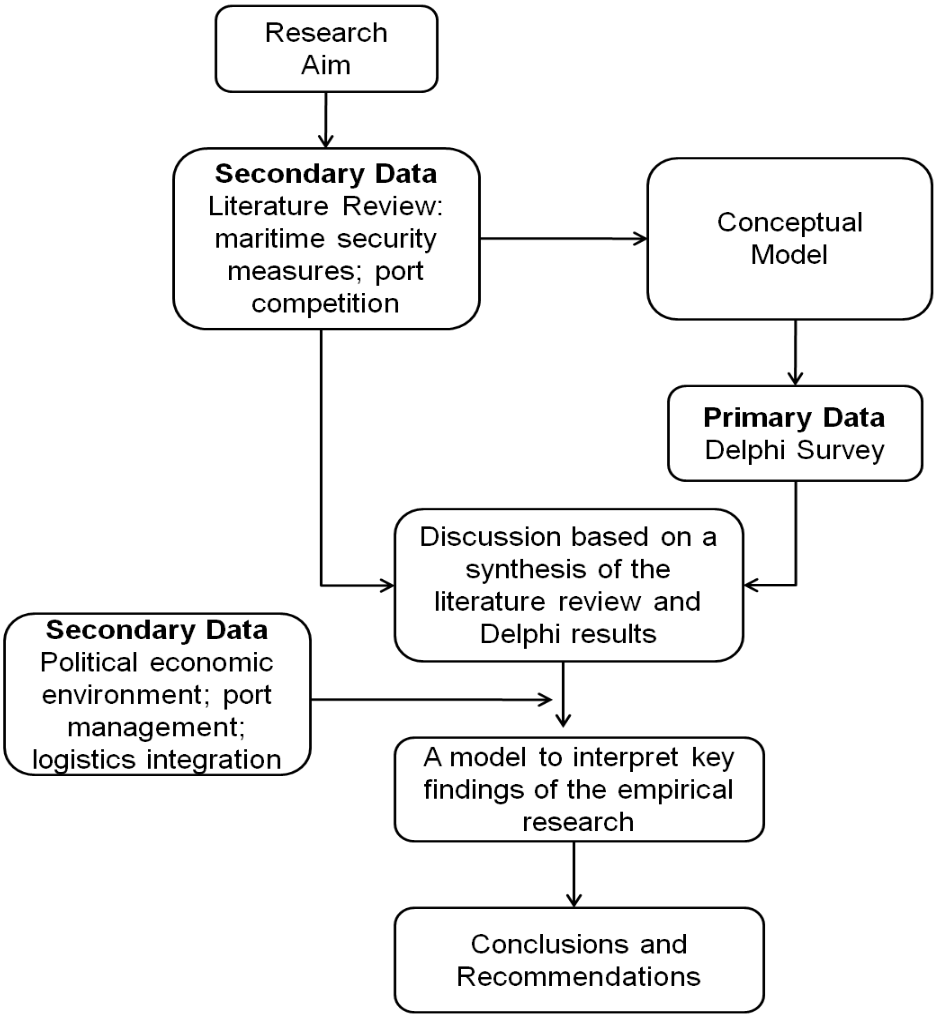


Figure 5.1 Abductive research phases
Source: the author (2015)

5.3.4 Rationale for adopting Delphi technique as the qualitative approach

According to Berg (1995) and Wengraf (2004), there are three main approaches for qualitative data gathering: group discussions or focus groups, in-depth interviews and questionnaires or surveys.

The process of group discussion or focus groups involves the researcher and a specific group of people, which could be structure, semi-structured or unstructured (Barbour, 2007). The researcher acts as a moderator or facilitator (Rubie-Davies, 2007). Group discussion or focus groups are used when the researcher is guided by research objectives and aims to initiate a dialogue between group members (Denzin and Lincoln, 2011). However, this method was criticised by Flick (2009) that the discussion could be dominated by a strong personality and other group members may just agree. Therefore, bearing in mind the research aim, this method has not been selected. This could lead to an opposite direction to the purpose of this research which aims to collect varying views from experts with different backgrounds.

Hannes and Lockwood (2012) described questionnaires or surveys as the sending out of a list of questions to specific individuals, and the individuals then send back their responses. The questions can be structured, semi-structured or unstructured (Saunders *et al.,* 2012). The logical sequencing of questions and the context setting should be taken into consideration (Barbour, 2007). The researcher needs to identify and select a large enough sample to detect statistically significant effects because the goal is to generalise the findings to a larger population (Okoli and Pawlowski, 2004). However, regarding a research topic that involves political and security issues and port operations, there are a limited number of potential participants who are willing to contribute their professional opinions. Moreover, limitations of questionnaires emerge when visual aids, open-ended questions and complex questions are needed (Neuman, 2011). In addition, according to Silverman (2011), Myers (2008) and Gibbs (2008), a poor respondent return rate, lacking controlling over who responds to the questionnaire and potential person-specific and situation-specific bias constitute other limitations.

Considering the limitations discussed above, the primary data for this research will be collected by a Delphi study. According to Keeney *et al.* (2001), a Delphi survey involves sending out a number of rounds until consensus is reached, where in each round the panellists are asked to comment on a specific subject. Unlike a traditional questionnaire or survey, Delphi does not require visual aids and open-ended questions. Brooks (1979), Linstone and Turoff (2002) and Geist (2010) highlighted that Delphi could prevent a few dominant individuals from imposing their ideologies on other members. In addition, the limitation over who respond to the questionnaire does not exist in this case since the questionnaires will be sent directly to the identified participants who have agreed in advance to answer all the questions (Cottam, 2012). Consequently, the rate of return will increase. Based on aforementioned aspects, Delphi is the most appropriate method for this research topic because it offers a systematic qualitative approach for data collection and analysis, and reporting the findings. This enables the researcher to gain a greater depth of understanding regarding the targeted issue.

Wechsler (1978, p.23) gave a fully comprehensive definition for Delphi as *"it is a survey which is steered by a monitoring group, comprises several rounds of a group of experts, who are anonymous among each other and for whose* *subjective-intuitive prognoses a consensus is aimed"*. The Delphi technique has been identified by many researchers as a means for consensus-building through using a set of questionnaires to collect data from a panel of specific experts (Hsu and Sandford, 2007). The selected experts are encouraged to reassess their initial opinions on the provided information in previous iteration during the Delphi feedback process (Hsu and Sandford, 2007). Thereby, *"in a Delphi study, the results of previous iterations regarding specific statements and/or items can changed or be modified by individual panel members in later iterations based on their ability to review and assess the comments and feedback provided by the other Delphi panellists"* (Hsu and Sandford, 2007, p.2).

5.3.5 The origins and use of Delphi

The Delphi technique was mainly developed by Dalkey and Helmer at the RAND Corporation in the 1950s (Dalkey and Helmer, 1963). It has been widely adopted and accepted for achieving convergence of opinions from experts on real-world knowledge within certain topic areas, such as programme planning, needs assessment, and resource utilisation, explore assumptions, and correlate judgments on a topic cross a wide range of disciplines (Hsu and Sandford, 2007; Turoff and Hiltz, 1996). Over the years, both the number and diversity of research topics using Delphi have grown, thereby confirming the flexibility of this method (Bryman, 2012). Cottam (2012, p.213) reviewed varying Delphi research projects and noted that research fields implementing Delphi include: nursing (Keeney *et al.,* 2001); administration and planning (Watkins, 2011); leadership (Shaw, 2011); business (Bleicher, 2011); marketing (Brunner, 2010); education (Zeedick, 2011); and management. Delphi has been used for research on supply chain management (SCM) and transport fields. Professor

J.B. Schneider at the University of Washington used the Delphi technique for the exploration of transportation planning (Linstone and Turoff, 2002). In 1987, Kapoor adopted Delphi to examine the international trade system and to develop a model to identify areas of system failure regarding maritime fraud (Kapoor, 1987). Cooper (1994) used Delphi technique to analyse future logistics in Europe. Akkermans *et al*. (2003) concluded a Delphi study on how Enterprise Resource Planning (ERP) affected SCM. Brett and Roe (2010) adopted Delphi to study if Ireland has the potential ability to develop as a maritime service centre of excellence. Islam *et al.* (2006) applied Delphi to collect local experts' opinion on how to develop effective multimodal freight transport in Bangladesh. Mason and Alamdari (2007) used a Delphi panel of 26 experts in air transport to predict the structure of air transport in the EU in 2015 regarding network carriers, low cost airlines and passenger behaviour. Seuring and Müller (2008) used Delphi for sustainable SCM topic and stated that the Delphi study allowed a structured gathering of opinions. Piecyk and McKinnon (2009) conducted a Delphi survey with 100 logistics specialists to analyse future freight transport and environmental trends in the UK up to 2020. Parsons *et al.* (2011) included the Delphi technique to collect opinions from stakeholders and experts towards Arctic icebreaking services. Schuckmann *et al*. (2012) ran a Delphi-based scenario in terms of the factors that would affect transport infrastructure future development up to the year of 2030. Dinwoodie *et al.* (2013) used the classic Delphi to analyse perceptions of changing patterns of maritime oil freight flows to 2050. The Delphi technique was chosen since it could facilitate remote group communications and ensure anonymity (Dinwoodie et al., 2013). In the research of Dinwoodie *et al.* (2014), a classic quantitative Delphi was chosen as the most appropriate method to explore the dry bulk shipping flows to 2050. Liimatainen *et al*. (2014) used the Delphi technique to investigate the future of carbon dioxide (CO2) emissions of road transport in Finland.

5.3.6 Characteristics of Delphi technique

According to Powell (2003), the Delphi technique has six common characteristics. Firstly, it focuses on topics which are unresearched: in the future or areas about which little is known. Delphi can be used for developing estimations of future events and conceptualising (Aligica and Herritt, 2009).

Secondly, Delphi relies on the use of experts in a certain subject brought together in groups via the structure of panels (Clayton, 1997). An expert is a person who has profound knowledge about a specific subject (Davidson *et al*., 1997). Their informed opinions are the source of information for the Delphi study (Powell, 2003). Panel members can be national or international, from industry, government or academia, or from different social/ professional stratifications (Okoli and Pawlowski, 2004). In terms of this research, the panel memberships are international, mainly from port industry in the US and the EU since the study of the CSI and EU port competition crosses nations, cultures and political and economic groupings.

Another primary characteristic and advantage of adopting the Delphi technique for this research is that the anonymity can reduce the effects of dominant individuals during group-based processes in which information is collected and synthesised (Dalkey *et al*., 1972). Delphi can also be used to avoid direct confrontation of the experts with one other (Dalkey and Helmer, 1963). Dalkey and Helmer (1963, p.4) observed the disadvantages of direct confrontation with experts included *"induces the hasty formulation of preconceived notions, an* *inclination to close one's mind to novel ideas, a tendency to defend a stand once taken, or alternatively and sometimes alternately, a predisposition to be swayed by persuasively stated opinions of others*". Anonymity is vital to this research since it allows experts with different backgrounds such as port users, government officials, and academics from different countries to express their true opinion without physically participating in the research. Only the Delphi facilitator knows all panellists. It helps to improve judgmental accuracy as the Delphi study is conducted anonymously, which ensures that the participants focus on the study rather than being affected by the other participants' opinion (Rowe *et al*., 2005). Additionally, *"the issue of confidentiality is facilitated by geographic dispersion of the subjects as well as the use of electronic communication such as e-mail to solicit and exchange information"* (Hsu and Sandford, 2007, p.2).

Fourthly, Delphi adopts an iterative research process (Hasson *et al*., 2000). The process is viewed as a series of rounds (questionnaires), are required to be responded to by the panel members (Ludwig, 1994). Each round includes synthesised information derived from an earlier round to allow panel members to refine and reassess their opinions from round to round (Zeedick, 2011). The iteration of Delphi provides this research with flexibility and adaptability to suit the complex competition environment of EU ports.

In addition, the possibility to control feedback in the process to reduce the effect of noise by using the Delphi technique also calls for the use of a Delphi study (Hsu and Sandford, 2007). Dalkey *et al.* (1972) defined noise as communication which distorts the data and concerns group and/or individual interests rather than focusing on problem solving in a group process. According to Hsu and

Sandford (2007), the information extracted from ‘noise’ is generally constituted by bias irrelevant to the purpose of the study. The feedback procedures assure that only directly relevant information is offered to the panellists and they are asked to make judgements (Greatorex and Dexter, 2000). Controlled feedback allows the panel members stimulated thinking to achieve a valid and reliable set of conclusions. Through this Delphi can create a consensus of opinion.

Types of Delphi

There are many different types of Delphi that vary in their difficulty to plan and conduct (Table 5.1). Four main Delphi techniques were discussed by van Zolingen and Klaassen (2003), namely the classical Delphi, the policy Delphi, the decision Delphi and the group Delphi/expert workshop. Additionally, some other types of Delphi, such as modified Delphi, real-time Delphi, e-Delphi, technological Delphi, disaggregative Delphi and fuzzy Delphi, have been adopted in various research. Generally speaking, they share similar difficulties in planning and conducting. They are all time-consuming and labour intensive and require expert preparation in advance; hence, they are relatively expensive (Sindi, 2016).

Types of Delphi	Description and features
Classical Delphi	Individual basis, data gathering from anonymous experts in a number of rounds, stability reached through iteration, consensus achieved for forecast. (Dalkey and Helmer, 1962)
Policy Delphi	Policy issue and social situation, various number of rounds, anonymity, not decision making, clarifying an understanding of different plurality standpoints. (Linstone and Turoff, 2002; Rauch, 1979)
Decision Delphi	Prepare, help and make decisions, actual decision-makers form panellists for analysis of decisions, deals with reality rather than predicted or described. (Rauch, 1979)
Group Delphi/expert workshop	Efficient for lessening doubt around knowledge of predictions and interpretations, more convenient than classical Delphi, provides a rationale behind disagreement and tests them in a 'peer review', provides only a brief summary of expert opinions. (Webler *et al*., 1991)
Real Time Delphi	Sometimes referred to as a consensus conference, aims to ensure expert availability to reduce drop-out rates and increase processes efficiency, participants are provided with a hyperlink to a welcome page where they read the details of the study and what is required and access the initial questionnaire. The process uses a refined interface, and the authors argue the outcomes. (Gnatzy *et al*., 2011)
e-Delphi (adopted for this research)	Similar to real time Delphi, replicates the classical Delphi process, the questionnaire, feedback, and participation of the expert panel is all done via email or online surveys. It can be argued that this approach is categorised under modified Delphi. (Gnatzy *et al*., 2011)
Technological Delphi	Similar to real time Delphi, difference is that the technological Delphi uses handheld devices to respond immediately to the questions. (Passig, 2004)
Disaggregative Delphi	Critical of classical Delphi, consensus is formed when panellists are asked to give estimates of probable and preferable futures, uses cluster analysis to disaggregative responses of key variables, first round contains quantitative questions, second round is qualitative. (Davison, 2013)
Fuzzy Delphi	Traditional forecasting, mostly utilised to generate a professional consensus for complex topics, reduces time of investigation and consumption of cost and time, round vary and anonymity. (Wu *et al*., 2013)

Table 5.1 Different types of Delphi techniques
Source: the author 2016 adapted from Sindi (2016) and Elgarhy (2016)

5.4 Delphi method for this research

The literature review in Chapter 2 indicated that there is a lack of empirical data in the case of how maritime security measures affect port competition. In order to find out how the CSI impacts upon EU port competition, Delphi can help to get comprehensive opinions and judgements in terms of the past, present and future. Additionally, Delphi can be applied to a wide range of subjects, such as policy-making and industry predictions (Cottam, 2012). It can expose all the different opinions (agreement and disagreement) and arguements on these opinions (Iqbal and Pipon-Young, 2009). A broader spectrum of responses can be gathered since the panel is made by stakeholders with a variety of backgrounds. Moreover, anonymity between panellists is important because the participants are freer to state their position in a less pressed environment without being influenced by others (De Meyrick, 2003). With regard to this research topic, which involves politics, terrorism and interest conflicts among different interest groups, the anonymity of Delphi could encourage varying individuals to contribute with both their knowledge and problem-solving skills to the research topic. In addition, participants can explore the original conceptual assumptions and subsequent developments to offer a range of inclusive indicators for the research. Furthermore, Delphi questionnaires can be facilitated through email which is cost-effective and time saving for the participants and the author since Delphi does not involve physical contact like interviews to collect the required data (Iqbal and Pipon-Young, 2009). Since this research focuses on industrial and political issues, people who contribute data to this research are most likely to have busy schedules and prefer to remain anonymous. As a result, taking into account various factors such as cost, timing and anonymity, the e-Delphi which utilise email and an online survey is the most suitable method for this in-depth qualitative research.

5.4.1The criticisms of Delphi

Despite the advantages of the Delphi technique, some criticisms have been expressed. According to Tzeng *et al.* (2002), person-specific and situation-specific biases can be possible and impact upon the reliability of Delphi as a judgement method. In this research, person-specific bias can be difficult to avoid since there are 58 CSI container seaports globally and the number of experts who have interests in maritime security and port operations is quite limited. As a result, the study relies on experts' professionalism to gather unbiased opinions.

Another criticism is that whether participants commit to complete the Delphi process often depends upon their interest and their involvement in the research topic (Rowe and Wright, 2011). Some participants drop out from the survey during the process, especially after the first round (For-Learn, no date). Therefore, to increase the commitment level, the researcher must give a great deal of attention when choosing participants. The Delphi questionnaire must be carefully prepared and tested to avoid ambiguity (For-Learn, no date). The Delphi process must be managed and scheduled rigidly. In addition, the high level of anonymity helps to maintain the participation rate (Landeta *et al*., 2011). However, Sackman (1975) argued that anonymity may lead to unaccountability since the response is untraceable. However, in this research, anonymity is considered as a good quality which allows participants to express their opinions freely and reduce the dropout rate. Hasson *et al.* (2000) also criticised that consensus cannot be well explained in studies that employ Delphi. It has also been argued that a consensus approach may lead to "*a diluted version of the best opinion and the result representing the lowest common denominator*"

(Cottam, 2012, p.236). However, all approaches to gain consensus have the same risk. Regarding this research, the most suitable consensus approach will be chosen to avoid unrepresentative views or missing out important sources of knowledge, considering various key factors such as sample size and previous Delphi study (For-Learn, no date). Furthermore, it is claimed in Cottam (2012) that other opponents cite time and labour-intensity as negative attributes, therefore leading to high costs. However, in terms of this study, **e-Delphi** was adopted whereby email communication was used as the major communication approach and an online survey was set up to acquire the experts' opinions.

5.4.2 The Delphi Study process

Scholars have presented a variety of means of carrying out Delphi studies. Based on Linstone and Turoff (2002, pp.5-6), usually Delphi undergoes four distinct phases as follows:

- *"Characterised by exploration of the subject under discussion, wherein each individual contributes additional information he feels is pertinent to the issue".*
- *"The process of reaching an understanding of how the group views the issue".*
- *"If there is significant disagreement, then that disagreement is explored in the third phase to bring out the underlying reasons for the differences and possibly to evaluate them".*
- *"A final evaluation occurs when all previously gathered information has been initially analysed and the evaluations have been fed back for consideration".*

According to Beech (1997), two or three rounds are ideal and have proven sufficient to reach consensus. More rounds would not increase the decision's accuracy (Powell, 2003). In terms of this research, it was anticipated that two to three rounds of Delphi would be utilised to analyse how EU container port competition changes with the implementation of the CSI. Figure 5.2 illustrates this study's Delphi process, consisting of ten stages used from the design of the research conceptual statements to the validity of the third round.

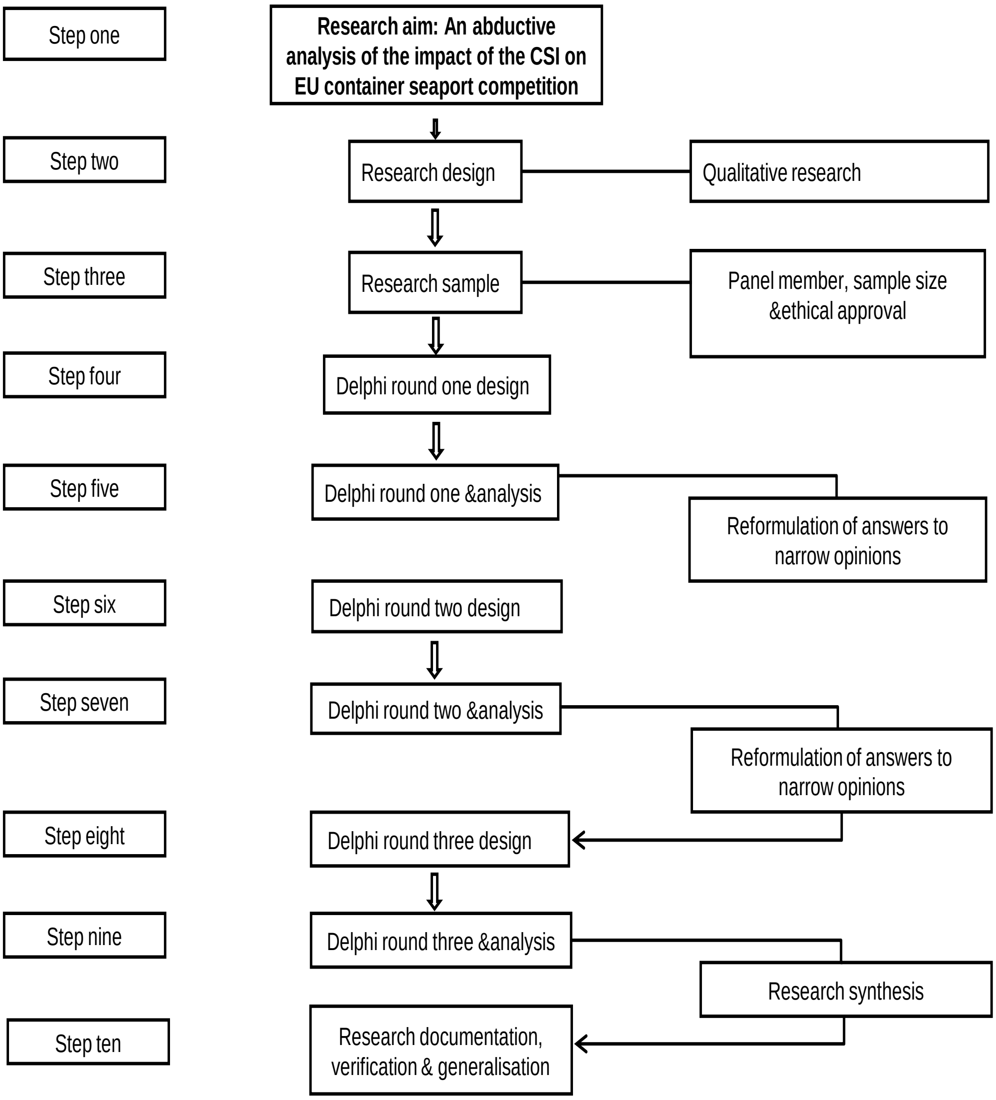


Figure 5.2 The Delphi process
Source: the author 2014 adapted from Fowles (1978) and Linstone and Turoff (2002)

Based on Cottam (2012), formulating research conceptual assumptions is the very first step towards implementing the Delphi technique. The conceptual assumptions of this research endeavoured to direct the research to find out the implications of the CSI for EU container seaport competition. In Chapter 4, the assumptions were classified under four conceptual categories. They are: (1) the necessity of pursuing maritime security initiative; (2) introduction of the CSI and its controversial influences; (3) determinants of EU container seaport competitiveness; (4) the implications of the CSI for EU container seaport competition. Each conceptual category led to a set of conceptual assumptions. The conceptual assumptions directed the research to analyse the impacts of the CSI on EU container seaport transportation critically. Each of these conceptual assumptions derived a set of statements, which were sent out to panel experts for data collection. The objectives of the Delphi study are: to gain consensus about the necessity of maritime security initiatives; to gain consensus about the positive effects of the CSI on maritime industry; to gain consensus about the EU container port competitiveness components; and to gain consensus about the implications of the CSI implementation for EU container seaports through affecting the identified competitiveness components.

After developing a series of feasible assumptions, the next step is to design the Delphi survey at the micro level (Cottam, 2012). Selecting Delphi panel members is the next critical step since the outcomes of the Delphi are based on the experts' opinions.

5.4.3 Panellist formation

The selection of appropriate participants, as the first stage in Delphi process, has been described as the 'linchpin of the method' (Green *et al.*, 1999, p.200). The knowledge and cooperation of the experts are the key factors that determine the success of a Delphi study. Therefore, it is essential to include people who are likely to contribute valuable ideas. The selection of the panellist is not a random process. Unlike a statistically based study in which participants are assumed to be representative of a larger population, the Delphi needs non-representative and knowledgeable people (Linstone and Turoff, 2002). This means that each respondent is an expert who also has an incentive and is motivated to participate in the area of the research (Day and Bobeva, 2005). Experts can be a group of 'informed individuals' and specialists in their domain or a knowledgeable person in a specific subject (McKenna, 1994; Goodman, 1987). This research adopted four main criteria for experts summarised by Cottam (2012, p.219): *"(i) knowledge and experience with the issues under investigation; (ii) capacity and willingness to participate; (iii) sufficient time to participate in the survey; and (iv) effective communication skills*". Delphi participants must be highly trained in their specialised field and richly knowledgeable with regard to the targeted academic field (Powell, 2003). Therefore, the panel selection for this study is extremely rigorous.

Panellists with different backgrounds

Bichou (2008a, p.26) argued that "*a problem with survey inquiries occurs when the findings of a case-specific survey are generalised to all stakeholders and security programmes*" and "*even when survey inquiries investigate a single security programme, their results may show inconsistent cost figures, either over time or between participants"*. In order to study whether the CSI is beneficial to the whole community or not, it is very important to consider the differences between stakeholders' values and perspectives. Therefore, for this specific Delphi research, participants with various backgrounds and interests are needed for analysing the fragmented maritime industry.

The Delphi research comprises three groups: (i) academics who encompass the opinions and expertise of scholars researching maritime security and container port competition; (ii) industrial experts, specifically holding the opinions and industry experience of EU container port management and the CSI implementation; (iii) administrators, occupying positions and experience in major organisations involved in maritime security regulation and maritime governance on international, supranational and national levels. All participants will remain anonymous, with rigorous attention to protect their identity and the integrity of the companies and organisations involved (Cottam, 2012).

Panel size

There is no agreement on the Delphi panel size (Keeney *et al.*, 2001) or precise approach for identifying it in any individual research, and it is impossible to recognise a positive relationship between Delphi group size and Delphi group performance (Rowe and Wright, 2011). Keeney *et al.* (2001) suggested that the panel size should depend on the research aim, design selected and time frame for data collection. In addition, the nature of the different viewpoints included and the resources available can help to determine the panel size (Landeta *et al*., 2011; Sharkey and Sharples, 2003). Previous Delphi research used different techniques for panel formation. van Zolingen and Klassen (2003) formed one panel with four different stakeholder groups. Wang *et al*. (2003) included two panels with two different nationalities: Chinese and international. Therefore the panel size varies and ultimately depends upon the nature of the research (Nowack *et al.*, 2011). Delbecq *et al.* (1975) recommended a panel with 10–15 similar panellists as the ideal number. Warner (2014) suggested that at least 13 experts should be included to achieve a reliable (reliability of 0.9) sample. Kapoor (1987) included 39 experts in his Delphi. Delbecq *et al.* (1975) argued that using too many panellists would lead to extreme difficulty in data analysis.

However, Whitman (1990) had a study with 75 experts, and Campbell *et al*. (2000) sent the first questionnaire to 305 experts across the England. Therefore, there is no optimum number for panels or participants (Lai *et al*., 2002). Nowack *et al.* (2011) commented that the panel size can be much larger in a Real Time Delphi, whereas for a Delphi which relies on interviews, the panel size would be much smaller for practical reasons.

In the context of this study, a single panel of experts with different backgrounds, namely academics, industrial experts and administrators was chosen for the research. The single panel was chosen because the study would be less complex than that of multiple panels (Hanafin, 2004) and it allowed the opportunity to share their ideas across all panel members through feedback between rounds (Nowack *et al.*, 2011; Goluchowicz and Blind, 2011). However, experts are required to state their background in the questionnaire in order to let the author interpret their different viewpoints. In addition, experts may have overlaps between the three backgrounds. An expert who is categorised as academic may also have working experience as an industrial consultant. Therefore, it is essential for them to identify themselves and express opinions based on how they position themselves in this specific research. As many as experts are needed so that rich data on maritime security and port competition can be collected for deep analysis.

Process of panel selection

Academic panellist selection

Identification of individuals forming the academic group was difficult and complex. In order to guarantee the quantity and quality of the potential participants, the researcher took two steps to identify the desired academic experts. Firstly, two groups of academic experts were identified separately: (i) experts in maritime security policies, and (ii) experts in port competition. A laborious task was taken to identify the first group because there is an absence of a central database for maritime security academics or researchers. Therefore, the researcher searched refereed publications and books to obtain the names of authors writing in the area of maritime security especially container port security and its influence on port performance. The names were populated using the function of "related articles" in academic and industrial journals. It was relatively easier to identify the experts of port competition since a considerable number of studies have been conducted since the 1970s. The names were mostly obtained at the stage of literature review and a few experts were recommended by the contacted academicians. The second step was to identify overlaps between two groups. The overlapping experts were chosen as potential participants who have expertise in both maritime security and port competition. After identification of experts' names, various search tools such as Google and LinkedIn were used to gain their contacts. Most of the candidates' contacts were available on the Internet, especially the academics. Therefore, emails were quite easy to acquire on Google. Some participants' emails were provided by their co-workers/colleagues or the institutions they work for. Linkedin, as an auxiliary tool, helped to identify desired individuals since various interest groups and their contact methods are available on it. A total of 30 academic experts were identified and received the invitation email for participation. Table 5.2 shows the number of the academic participants contacted and their current occupations.

Panellist category	No. of participants	% of the total panellists	Current positions of employment/ qualification
Academic	30	36.14%	PhD, post-doctoral, senior research fellow, professor, associate professor
Industrial	28	33.73%	Operation manager, harbour master, CEO, COO, CFO, infrastructure director, port safety and security supervisor, liner manager, port agency, broker, port operation consultant
Administrative	25	30.12%	Maritime security policy maker, consultant, secretary, committee member
Total	83	100%	N/A

Table 5.2 Delphi participants contacted
Source: the author (2017)

Industrial panellist selection

It was necessary to identify individual participants with industrial backgrounds. In order to validate their response, stakeholders who are relevant to EU container seaports would constitute the industrial panel experts. Therefore, identifying and selecting relevant EU container ports is essential. Table 5.3 below provides an overview of the Top 20 container ports in Europe. According to Notteboom (2012), many of them *"act as almost pure transhipment hubs with a transshipment incidence of 75% or more (i.e. Gioia Tauro, Marsaxlokk, Algeciras) while other load centres can be considered as almost pure gateways or a combination of a dominant gateway function with sea-sea transhipment activities (e.g. Hamburg, Rotterdam, Le Havre, Antwerp)"* (Notteboom, 2012, p.2).

Rank	Name	Country	Handling Volume in million TEU
1	Rotterdam	Netherlands	11.87
2	Hamburg	Germany	8.86
3	Antwerp	Belgium	8.64
4	Bremen	Germany	6.12
5	Valencia	Spain	4.47
6	Algeciras	Spain	4.11
7	Felixstowe	UK	3.70
8	Ambarli	Turkey	3.10 Not EU
9	Piraeus	Greece	2.75
10	GionaTauro	Italy	2.72
11	Duisburg	Germany	2.60
12	Maarsaxlokk	Malta	2.54
13	St Petersburg	Russia	2.52 Not EU
14	Le Havre	France	2.31
15	Genoa	Italy	2.06
16	Zeebrugge	Belgium	1.95
17	Barcelona	Spain	1.76
18	Southampton	UK	1.48
19	Mersin	Turkey	1.26 Not EU
20	Las Palmas	Spain	1.25
Share of Top 20 of Europe total container throughput: 80%			

Table 5.3 The Top 20 European container ports in 2013
Source: the author 2014 adapted from Lloyd's list (2014)

Table 5.3 shows that about 80% of the total container throughput in the European port system passes through the top 20 load centres. However, Russia and Turkey are not EU members. Since this research focuses on EU container ports, the ports of Ambarli, St Petersburg and Mersin were not included. As a result, only 17 ports were chosen as sample ports. The relevant stakeholders of those ports, such as port management team, port users and port authorities were selected as the experts with industrial background to form the Delphi panel. In addition, trans-Atlantic line managers from major container shipping companies, consultants of liner shipping agents and consultants of port management and operations were also included as industrial experts. Names were obtained from online sources such as company official websites, industrial seminars or conference records. Nevertheless, most of their contacts were not shown on the websites. Therefore, in order to acquire the experts' emails, the companies' headquarters and management teams were contacted as intermediaries. Twenty-eight practitioners were identified and invited as the industrial experts, of which 20 experts were from the 17 CSI ports in the EU. Eight experts were from trans-Atlantic shipping lines and port consulting companies. Their current positions are presented in Table 5.2.

Administrative panellist selection

Identification of policy-makers was the most difficult procedure, due to security and confidentiality issues. Distinguishing the level of maritime security regulating body, selecting the candidates to contact, and obtaining contact details were time-consuming and laborious operations. A three-tiered approach based on current maritime governance jurisdiction was taken: national, supranational and international. Since the CSI was established as part of the CBP layered cargo security strategy, the CBP was contacted as the most suitable organisation in terms of national level. However, the CBP, as the largest US federal law enforcement agent, was unlikely to get in touch with an unsponsored PhD researcher. A general invitation email was sent to its team through its online contact page and no response was received from them. At the other end of the spectrum: the United Nations Conference on Trade and Development (UNCTAD); the Organisation for Economic Co-operation and Development (OECD); and the International Maritime Organisation (IMO) were all liaised with as part of panel formation. Relevant experts were identified from the organisations' official website. Phone calls were made to the headquarters', asking for emails. Invitations emails were sent out to those experts. Although no expert from the CBP was contacted, some experts from the aforementioned organisations have experiences either working with the CBP or working for the US relevant entities. The number of invited administrative participants was 25 and their current job roles are presented in Table 5.2 (p.153).

Table 5.2 (p.153) shows that the total experts invited to participate was 83. The researcher attempted to make each category proportional. Nevertheless, academic experts have the largest proportion, accounting for 33.73% of the total number. This is because identifying academicians and acquiring their contacts is the easiest among three categories. The second largest group is the industrial experts. Most of them are from the EU container port/terminal operators, ranking from top management team to operation supervisors. Other industrial participants also include trans-Atlantic liner operators, consultants and brokers. The administrative expert group has the least portion but still accounts for more than 30% of the total. This is not surprising, considering the difficulty of acquiring their contacts.

5.4.4 Other issues in Delphi design

This Delphi survey consists of three rounds in which experts were invited to comment on the main conceptual statements of the study. Participants were asked to state if they 'agree', 'disagree' or are 'either agree or disagree' on 12 statements and answer one additional open-ended question. Statements were developed from the literature review and the conceptual model (see Chapter 4) derived from the research objectives.

When adopting a Delphi method, a researcher not only needs to achieve a desirable response rate in the first round but also to maintain response rates in the following rounds (Ludwig, 1997). Regarding the potential scarcity of qualified participants for panel formation, based on Parente and Anderson-Parente (2011), the ability to achieve and maintain a desirable response rate is vital to the validity of a Delphi study. Cottam (2012, p.222) reviewed a number of key approaches used by existing research to decrease attrition between rounds and summarised them as "*making contact with the participant prior to the launch of the survey (Zeedick, 2011); ensuring participants are fully informed about the study (Hasson et al.,2000); having short follow up periods between rounds, issuing reminders by email, telephone and personal contact (Gupta and Clarke, 1996); and offering incentives such as stamped addressed envelopes and thank you notes (Campbell et al., 2004)*".

In this study, each selected panel member was sent an invitation email. The content of the invitation email was based on Cottam (2012), stating: (1) the participant would be personally written to, to invite them to participate in the Delphi study; (2) the reasons why they have been chosen; (3) a concise description and justification of the research project; (4) a time frame for the Delphi; (5) confidentiality and anonymity assurances; (6) importance and contribution of their views; (7) contact details for further information about this research; and (8) the survey link and the instruction of participation. Appendix 1 presents a sample copy of the invitation email.

The next stage after the identification of panel experts was to formulate the Delphi round one questionnaire. The initial conceptual category derives and guides the context in which the statements are placed (Cottam, 2012). The role of round one is to generate ideas (Keeney *et al.*, 2001) and identify issues to be addressed in later iterations (Crisp *et al.,* 1997). Nowack *et al.* (2011) suggested using open-ended questions when the Delphi serves the purpose of idea generation. In terms of this research, a judgement was to be made on whether the CSI has negatively influenced ports operations and EU port competition based on the Delphi results. According to Nowack *et al.* (2011), if the Delphi is used for judgement purpose, its success depends upon the extent of creativity needed. Cottam (2012) noted that open-ended questions can increase the richness of the data collected. Therefore, in light of the nature of the research topic and the disciplines involved, a combination of open-ended and structured questions were used in the study (Cottam and Roe, 2004).

5.5 Survey method for identification of EU port competitiveness

This research aims to find out how the CSI affects EU container port competition. As Section 3.3.1 discussed, the port competition environment varies between regions. Hence, regarding this particular research on EU container seaport competition, factors that influence EU port competition need to be identified first.

Aronietis *et al.* (2010) reviewed and summarised numerous studies on port competitiveness and adopted approaches. Methods that have been used for studying port competitiveness are summarised in Table 5.4.

Source	**Participants**	**Methods**
Slack (1985)	Shippers; Forwarders	Survey
Bird and Bland (1988)	Forwarders	Survey
Frankel (1992)	Governmental bodies; Shipping companies; Shippers; Freight forwarders	Analytic hierarchy process
Murphy *et al.* (1992)	Large/small shippers; International water carriers; International water ports; International freights forwarders	Survey; Univariate analysis; Multivariate factor analysis

Table 5.4 Summary of adopted methods for port competitiveness components identification
Source: the author 2014 adapted from Aronietis *et al*. (2010, pp.4-7)

Table 5.4 continued

Murphy and Daley (1994)	Purchasing manager (shipper)	Survey
Kumar and Vijay (2002)	Shipper	Analytic hierarchy process
Mangan *et al.* (2002)	Decision makers (on ferry choice) in transport companies	Modelling; Survey
Nir *et al.* (2003)	Shipper	Survey; Revealed preference multinomial logical model
Lirn *et al.* (2004)	Shipping lines	Analytic hierarchy process
Tongzon (1995, 2009), Tongzon and Sawant (2007)	Forwarders	Survey
Tiwari *et al.* (2003)	Shippers	Literature review; Discrete Choice Analysis
Ha (2003)	Shipping companies	Literature review; Discrete choice analysis
Malchow and Kanafani (2001, 2004)	Shippers (commodity types)	Discrete choice model
Song and Yeo (2004)	Ship owners; Shipping companies Shippers; Terminal operators; Academics	Analytic hierarchy process; Experts surveys
Cullinane *et al.* (2005)	Shippers (demand trends) Port authorities (supply)	Relative competitiveness analysis
Guy and Urli (2006)	Shipping companies	Multi-criteria analysis
Ugboma *et al.* (2006)	Shippers	Analytic hierarchy process
Acosta *et al.* (2007)	Terminal operators	Survey
De Langen (2007)	Shippers; Forwarders	Survey
Shintani *et al.* (2007)	Shipping companies	Algorithm-based
De Martino and Morvillo (2008)	Port authorities; Shippers; Forwarders; Shipping companies	Literature review
Grosso and Monteiro (2008)	Forwarding companies	Literature review Survey
Leachman (2008)	Importers	Economic optimisation model
Meersman *et al.* (2008)	Shipping companies Terminal operating companies Port authorities	Analysis of expected trends
Wiegmans *et al.* (2008)	Container terminal operators	Interviews Literature review
Karlaftis *et al.* (2009)	Shipping company	Modeling

Table 5.4 Summary of adopted methods for port competitiveness components identification
Source: the author 2014 adapted from Aronietis *et al*. (2010, pp.4-7)

As the table shows, the most popular methodology for approaching the problem of port competitiveness is the survey instrument. It was widely taken in the papers which study port choice and port competitiveness determinants. In 1985, Slack conducted a survey which focused on shippers and forwarders of trans-Atlantic container trades to identify criteria of port selection. After that, as Table 5.4 shows, Bird and Bland (1988), Murphy *et al.* (1992), Murphy and Daley (1994), Mangan *et al.* (2002), Nir *et al.* (2003), Tongzon (1995; 2009), Ha (2003), Tongzon and Sawant (2007), Acosta *et al.* (2007), De Langen (2007) and Grosso and Monteiro (2008) all adopted survey instruments to study port competitiveness and selection criteria. Therefore, the survey instrument is adopted to find out the determinants of EU container seaport competitiveness.

According to prior studies (see Section 3.3.2), the components of port competitiveness were presented in Table 3.3. These determinants include: port location, port facilities, overall efficiency, hinterland networks, value added logistics; and port services, safety handling of cargoes, confidence in port schedules, simplification of procedures, operational transparency, and port labour and skills (Yeo, 2007). Since the choice of survey for EU container seaport competitiveness components identification is consistent with the choice of Delphi as a survey method, the above competitiveness components, together with port safety and security are hypothesised as influential in affecting EU container seaport competitive position and can be tested in this Delphi survey. Therefore, through analysing how maritime security initiatives influence these components, the effects on port competition can be then concluded.

5.6 Delphi conceptual statements and rationale

The conceptualised assumptions identified in Chapter 4, formed the 13 questions for Delphi round one, including 12 statements and one open-ended question. The statements were developed from the results of a numerical research synthesis. Each statement contains controversial and debatable viewpoints taken from the literature. Table 5.5 indicates the sources for each statement. The 13 questions are categorised into four topics (see Section 4.2) and one open-ended question for experts to express their comments that help to answer the original research question.

Statement	**Sources**
1.1	OECD (2003); Koch (2002)
1.2	WC) (2003); Martonosi *et al.* (2005); Allen (2006); Dekker and Stevens (2007); Bichou (2008a); Metaparti, (2010)
2.1	Thai (2007); CBP (2006, 2013, 2014)
2.2	Parliament of Australia (2003); Banomyong (2005); Dallimore (2008); Donner and Kruk (2009)
3	Haezendonck and Notteboom (2002); Ha (2003); Veldman and Buckmann (2003); Cullinane *et al.* (2005); Tongzon and Heng (2005); Yap and Lam (2006a, 2006b); Yeo (2007); Notteboom and Yap (2012)
4.1	Parliament of Australia (2003); UNCTAD (2003); Banomyong (2005); Dallimore (2008); Dekker and Stevens (2007); Bichou (2008a); Donner and Kruk (2009).
4.2	Martonosi *et al.* (2005); Bennett and Chin (2008); Bichou(2008b; 2011)
4.3	World Bank (2004); Allen (2006); CBP (2006); Thai (2007); Bichou (2011)
4.4	Allen (2006); Dekker and Stevens (2007); Bichou (2005, 2009, 2011); CBP (2006, 2011,2014); Yeo *et al.* (2013)
4.5	Machalaba (2001); Limao and Venables, (2001); Bichou (2011)
4.6	Parliament of Australia (2003); Metaparti (2010); CBP (2011)
5	Allen (2006); Dallimore (2008); OECD (2011)

Table 5.5 Delphi statements literature synthesis sources
Source: the author (2017)

5.6.1 Delphi conceptual category, assumption and statements

Conceptual Category 1: The necessity of carrying out maritime security initiative

Conceptual Assumption 1: It is necessary to carry out maritime security initiative despite the fact that additional inspections may cause supply chain disruption and financial burden.

S1.1 - Maritime security has become a great concern worldwide. The increasing volume of container movements, their relatively high velocity in the international trade and their uniformity have posed formidable security challenges. As the loading and unloading points of a sea transport process, container ports are the most important nodes for maritime safety. However, only around 2% to 10% of containers are actually inspected. US ports normally inspect roughly 5% of the 17 million containers arriving at the border every year. A great concern about container security emerged from this low inspection rate. Container security is far more important than efficiency and profit for the port. Therefore, security should be seen as the first priority.

The design of this statement is to test expert's opinion on the importance of maritime security. Containerised shipping has been playing an increasingly important role in global transportation, largely due to the numerous technical and economic advantages. According to the OECD (2003), the increasing volume of container movements, their relatively high velocity in the international trade and their uniformity have posed formidable security challenges. However, by contrast, the inspection rate of containers is considerably low. Therefore, expert's opinion is essential to testify the need for improving the inspection rate. What is more, it can also help to compare the different perceptions of experts who have different backgrounds, i.e. academic, policy-maker and industry, and what they value the most as the first priority.

S1.2 - As the world's largest national economy, United States plays a vital role in global trade. After 9/11, the US has reacted to the needs for strengthening security measures to enhance maritime transport safety. Some of the maritime security initiatives have influence on some export ports in terms of logistics efficiency and financing. Nevertheless, those export ports should be prepared to comply with the US container port security initiatives for maritime safety.

This statement serves two purposes. The first one is to give a brief description of the background of the topic. As the biggest import and export country, the US has become a major target of terrorism. Many security programmes and legislations were proposed and developed by the US. The second purpose is to collect expert's opinions on the fact that most exports ports need to react to US unilateral security initiatives.

Conceptual Category 2: Introduction of the CSI and the its controversial influences

Conceptual Assumption 2: The Container Security Initiative (CSI) can facilitate global container seaborne trade safety and security, adding competitiveness to CSI-affiliated ports.

S2.1 - The Container Security Initiative (CSI) programme managed by the US Customs and Border Protection (CBP) is an influential voluntary initiative. The CSI was proposed to ensure that all containers that pose a potential risk for terrorism are identified and inspected at foreign ports before they are loaded on to vessels imported to the US. Without a doubt, the CSI has dramatically increased the level of awareness for the need to secure global trade.

The CBP is one of the DHS's largest and most complex components. Its priority mission is keeping terrorists and their weapons out of the US. The CSI, as one of the CBP's multi-layer approach measurements, has affected the maritime security to some extent. The design of this statement is to test to what extent the experts appreciate the CSI's can affect maritime security.

S2.2 - Unlike the 24 Hour Rule, the CSI is a voluntary initiative. However, in order to keep the market share for US inbound trade, the major exporters have to join the programme. Not joining the programme could make the exports lose competitiveness over their rivals.

Based on the literature review, there is an argument about the need to join the CSI programme. With the premise of 24-hour rule and 100% scanning, the voluntary CSI could improve the overall process efficiency. The possibility of gaining competitive advantage in terms of overall efficiency could be one of the reasons why the export ports join the CSI. This statement is designed to test expert's opinions over that conjecture.

Conceptual Category 3: determinants of the EU container seaport competitiveness

Conceptual Assumption 3: The EU container port industry is highly competitive. Port efficiency, service and cost related elements are still the most important competitiveness components.

S3 - The port environment generally has become increasingly competitive, it varies between regions and places depending upon the extent to which these forces have impacted upon the nature of the port environment. According to prior studies, the components of port competitiveness are: port location, port facilities, overall efficiency, hinterland networks, value added logistics; and port services, safety handling of cargoes, confidence in port schedules, simplification of procedures, operational transparency, and port labour and skills. Among these factors, for the EU ports, since port location is static, port efficiency, service and cost related elements are still the most important competitiveness components. Port safety and security is not an incentive for port selection.

This research aims to find out the implications of the CSI for EU port competition. Based on the discussion in Chapter 3, identifying port competitive determinants is essential. Therefore, this statement is designed to test expert's opinions on the determinants which are going to be applied in this research. Although there have been a number of studies on port competitiveness, this research studies the EU ports specifically. Port competition and competitiveness vary in different regions and places (Section 3.3.1). As a result, the identification of key factors that determine EU port competitiveness is necessary. According to the discussion and Table 3.3 in Section 3.3.2, costs, service factors and efficiency factors are included in this statement, assuming they are the major competitiveness drivers for EU ports. Based on the synthesis of the literature review in Section 3.3.2 and Section 3.3.4 and the research aim, 'port safety and security' constitutes the last part of the statement and will be commented on by the panellists.

Conceptual Category 4: The implications of introduction of the CSI on EU port competition

Conceptual Assumption 4: CSI compliance does not cause global supply chain disruption or financial problems for the EU container ports.

S4.1 - To obtain the minimum required level of compliance, ports need to implement technical and organisational measures that will bring additional costs to maritime industries. Enhancing the technical measures due to security regulations, such as the ISPS Code, has brought additional costs to European maritime industries. Smaller ports in the EU may stop their US-inbound business since they cannot bear the financial costs. Larger ports may "steal" new business from smaller ports which are financially strained to meet the scanning requirements. A distortion of EU container port market share will arise.

This statement is designed to test an expert's opinion on how the CSI could affect EU port competition from the aspect of financial burden. Based on the literature, it is strongly believed that the implementation of the CSI could bring a considerable amount of extra cost to ports, which would be a particular burden for smaller ports. Since cost is closely related to port competitiveness, it can be deduced that joining the CSI programme could influence the EU port competitive position. Therefore, this statement can collect expert's opinions on this issue.

S4.2 - While port security measures enhance port security, procedural requirements of the new security regime act against operational and logistical efficiency. The proponents of this view list a number of operational inefficiencies ranging from direct functional redundancies such as additional inspections and lengthy procedures to indirect supply chain disruptions stemming from longer lead times and less reliable demand and supply scenarios.

This statement is designed to test expert's opinion on the negative effects in terms of operational and logistics efficiency that the CSI may bring. There has been some debate about the inefficiencies mentioned by Bichou (2008a, 2011) which has not been testified. Therefore, this statement can help to collect the expert's point of view on this issue.

S4.3- Productivity could improve due to better procedural arrangements. With the reinforcement of security, there is reduced likelihood of security incidents, a probability of fewer incidents being recorded and higher port reliability. Increased reliability which leads to higher trust between a port and its upstream and downstream partners in a container supply chain, contributes to the reduction of cargo processing time and results in reduction of cargo processing cost. Decreased cargo processing cost has a positive effect on port selection, thus attracting more container volume. Consequently, from the viewpoint of the above analysis, improving security level and increasing port reliability can attract more containers. Compliant participants would benefit from access certification and fast-lane treatment as well as reduced insurance costs and risk exposure.

This statement is designed to test expert's opinions on the positive effect brought by the CSI. The benefits brought by the CSI are controversial. Measures such as the CSI fundamentally emphasize prevention and source inspection, which theoretically be more cost-effective and less time-consuming than conventional random physical checks (Bichou, 2011). The CBP claimed that due to a better procedural arrangement, the overall efficiency of the process can be improved, which could decrease the overall handling time and cost. In addition to lower incidents records and higher port reliability, both increased port reliability and decreased cost could increase customer attraction. However, according to the literature review, there might be a possibility that the CBP neglects the operational inefficiencies that include direct functional redundancies and indirect supply chain disruptions. These factors may have negative effects on the EU export ports. Therefore, experts with different backgrounds may have different points of view on this statement that will contribute to the result analysis.

S4.4 - Although the US Customs and Border Protection stated that the CSI can bring benefits to member ports, those benefits are still controversial. The CSI has negative effects on port profit. In addition to the significant initial investment in new equipment, the CSI makes cargo inspection process more complicated, creating an increase in cargo processing time and cargo processing cost. That can change important performance characteristics of the port such as the port efficiency and price. On the perspective of a long-term economic model, these consequences produce the negative impacts on relative attractiveness of ports for various stakeholders, namely exporters, and cargo carriers. The reduced attractiveness will decrease the competitiveness of a port. Moreover, the deepening cost and time may initiate a vicious circle of decreasing port competitiveness. The CSI is actually a heavy burden for those ports that have joined.

This statement aims at testing expert’s opinion on the negative effects CSI has on port competitiveness. According to the literature review, the positive effects the CSI brings to joining ports are disputable. There are more than one result could be deducted according to CBP’s claim about how the CSI can benefit the joining ports. For example, a better procedural arrangement for container scanning could lead to higher efficiency of the whole process. However, it will have negative effect on export terminal operators. Moreover, in order to absorb extra costs, a port could increase the port charger for its customers. Port price may still be the first priority for port selection, rather than port reliability. Nevertheless, based on the current literature, there is rarely no evidence to support both arguments. Therefore, this statement can help to collect expert’s opinion on this controversial topic.

S4.5 - The CSI could improve the capabilities and the overall effectiveness of the targeting process. However, this programme transfers the container examinations from unloading ports in the US to the loading ports overseas. On the other hand, all the checks are carried out in the host countries which bear the equipment cost. In case of unloading and emptying of any potential threat posed by a dangerous container, the costs are borne by the importer to a US port. The US Customs sacrifices the export ports to save the US unloading port’s time and cost. The CSI is a unilateral and unfair programme without considering the host ports.

This statement is designed to test expert’s opinion on the negative effects CSI could bring to the joining EU exports. Based on the literature review, there are two major debates over port efficiency due to CSI programme. Some literature indicates that joining the CSI will bring negative effects on export ports such as lower efficiency. However, there is no evidence to support this argument. As a result, this statement aims at testing expert’s point of view.

S4.6 - CSI bilateral system of information exchange requires a host country to offer to conduct a security check on containers shipping to a US port. In return, the host country can send its officers to any US port to target ocean –going containerised cargo being exported to their country. Under this system, there can be sensitive information exchange, according to the US government, which may be deemed necessary to ensure safety of any ports involved. However, the host countries are not willing to offer any confidential information.

This statement aims at testing expert's opinions on sensitive information exchange involved within CSI. It is specifically designed for experts with industrial background such as port management team or terminal operators since they are more concerned about their business confidentiality. The CSI program aims at fostering a collaborative working relationship with the participating foreign authorities. Donner and Kruk (2009) commented that this collaborative work is vital when deals with increased risk, heightened threat levels, and re-establishment of commerce flow in the event of a terrorist attack. However, this network involves confidential business information that port operators and users are not willing to offer.

Conceptual Assumption 5: The introduction of the CSI does not cause small ports to lose market share. EU container port market competition is not disrupted by the CSI introduction.

S5 - There are many ports in Europe. However, there are 'only' about 130 seaports handling containers of which around 40 accommodate intercontinental container services. About 70% of the total container throughput in the EU port system passes through the top 17 load centres. 14 of those have joined the CSI programme. In the short term, small container ports have to stop their US inbound business and large EU container ports will gain new market share. In the long run, with further CSI implementation, the EU host countries will absorb the extra cost through transferring them to customers. However, the distortion in the competitiveness of large EU container ports will be minor.

This statement aims at testing expert's opinion on how the CSI implementation would affect EU port competition in long term. The increasing maritime security level is inevitable and CSI has increased the level of awareness of stakeholders for enhancing global trade security. The programme is participating in developing a world standard. It adds protection for the primary system of international trade on which the worldwide economy depends. At the early stage of its introduction and implementation, CSI would have certain effects on joining port competitiveness. However, in the long term, it is possible that the situation can be stabilised and minimized. Therefore, this statement is designed to test the long-term result.

Q13 - Are there any further comments you would like to make on these statements and how do you think the CSI will change the EU container port competition? In addition to cost, efficiency and port charges, what other aspect do you think the CSI will/have affected in short/long-term?

This question is to encourage experts to express different points of view as supplementary. This question will not be analysed as a single statement. Information obtained from this question will be treated as supplementary opinions to relevant statements.

5.7 Outlining Delphi design and process

Good practices in the development of the first Delphi round was followed, based on Cottam (2012). This included: the questionnaire length; the ambiguousness of the statements, the response format; and having a heterogeneous group of participations (Cottam, 2012). Nevertheless, it is the correlation between the statements and the original research conceptual assumptions that is most important. The correlation is addressed by the following questions: (1) are the statements applicable and relevant to the implications of maritime security initiatives on EU container port competition? (2) are the statements completed without requiring additional support to address the issues? (3) are the statements understandable?

In order to ensure the success of the Delphi study, a pilot testing was conducted before formal survey was sent out. Polit *et al.* (2001) explained a pilot study is a small-scale version or trial run when preparing for a major study. Pilot testing was argued by Powell (2003) as optional, nevertheless, its benefits such as testing instructions, clearness of the statements and formatting were stated by Creswell (2014). Further, a pilot survey could also save financial resources (Powell, 2003). Therefore, a pilot survey that contains an invitation email and round one questionnaire was sent to six current active senior academic experts in related fields who did not take part in the main study. Peat (2002) suggested the procedures for a pilot study to improve the internal validity of a questionnaire. In terms of this specific pilot survey, the following measures were conducted:

- The participants were asked for feedback to identify ambiguities and difficult questions.
- The time taken to complete the round one questionnaire was recorded.
- Whether each question was answered adequately was assessed.
- It was established that replies could be interpreted regarding the information that was required.

Based on the result of the pilot survey and the recommendations of participants in the pilot, the survey was changed. The implementation of the pilot survey is discussed in Chapter 6.

After the Delphi statement formation and pilot testing, the next step was to distribute the round one questionnaire to participants by emails, to be completed on the Delphi 'Qualtrics' site. On return of the questionnaire (after the participants click on finish button), the results were then analysed based on the research paradigm (Cottam, 2012). In this research, statements failing to reach the consensus (measured by Average Percent of Majority Opinion) entered into the second round.

Based on the Delphi process illustrated in Figure 5.2, after Delphi round one analysis, the next step was to form questions for Delphi round two. The questionnaire of round two was developed on the basis of round one responses. Rowe and Wright (2011), cited in Cottam (2012), mentioned that the researcher may direct the focus of the research, or be directed by the participants' opinions. Regarding this Delphi, expert opinions on maritime security and the CSI were analysed and where appropriate used in Delphi round two.

The round two questionnaire was then sent out and returned for analysis. Statements not reaching the consensus level were included in Delphi round three.

In a similar way to the second round Delphi statements formation, developing the round three questionnaire required the researcher to have an understanding of the research boundaries and where the results could be extended (Neuman, 2011; Okoli and Pawlowski, 2004). The questions became more focused and specific as the iterations continue (Aligica and Herritt, 2009). With regard to this research, as the rounds progressed, controversial viewpoints were collected and analysed, namely in the fields of: maritime security measure implementation and impacts, impacts of the CSI on EU container seaport competition, and distortion on EU container port competition in the short run and long run.

The following step was to analyse final round results, following a similar process used to analyse the data in first and second round (Cottam, 2012). The participants were also given the opportunity to verify and share their answers with other panel experts. The Delphi iteration ceased when the research question was answered, which meant that consensus was achieved and theoretical stability was reached (Cottam, 2012). In this research, statement stability continues was measured by Average Percent of Majority Opinion (APMO).

Feedback on questionnaire analysis was provided to participants after the first round. Feedback is defined by Rowe and Wright (1999, p. 370) as *"the means by which information is passed between panellists so that individual judgement* *may be improved and debiasing may occur"*. Experts can revise their own judgement in light of the judgement of the others (van Zolingen and Klaassen, 2003). According to von der Gracht (2008), three types of feedback situations can be distinguished. They are: "*feedback in case of numerical estimations; feedback in case of evaluation of developments, succeeding problems, scenarios; and feedback in case of open questions*" (von der Gracht, 2008, p.50). Numerical data is the simplest way to provide feedback. In terms of this research of maritime security initiatives, feedback was provided between the first and second round, providing participants with the percentage of 'agree', 'disagree' and 'unable to comment' under each statement. According to Cottam (2012), the timing of feedback is important too since the quality of the Delphi increases as the time between responding a questionnaire and the next round being sent out shortens. Although it is difficult to control the duration that participants needed to fill the questionnaire, the researcher managed to send out the next round with feedback within three weeks once all responses were received.

5.7.1 Consensus level

Consensus is defined as an agreement in opinion of all concerned, or as a major view, and it is one of the most controversial components of the Delphi technique (Cottam, 2012). According to Williams and Webb (1994), Delphi originates from an ancient Greek method for future forecasting. As a long-term forecasting method, the early Delphi surveys used consensus as a stopping criterion, that is, to decide when to stop (Cottam, 2012). However, consensus is not a straightforward concept. Keeney *et al.* (2001) addressed that consensus does not indicate the correct answer. Bolger *et al.* (2011) described consensus as more like the explanation for decreased variance since panel experts could simply alter their estimates to comply with the group without actual opinions changing. Goluchowicz and Blind (2011) found that most changes in response occur in the first two rounds. Cottam (2012) stated that some authors judge consensus from a qualitative angle such as Millar (2001), but an empirical approach is taken in most studies. According to Hanafin (2004, p.36), consensus can be determined by *"statistically measuring the variance in responses across rounds"*. Rowe and Wright (1999) argued that less variance can be seen as greater consensus, although this interpretation has been controversial. Rowe and Wright (2011) stated that participants with more extreme views were more likely to leave the research than those with relatively moderate views. The decreasing in variance can be a result of attrition rather than consensus (Hanafin, 2004).

Hussler *et al.* (2011), cited in Cottam (2012), noted that stability of results between two rounds can be a more appropriate stopping criterion since little changes will be made to the responses after two rounds. Before the second round it has to be decided which statements from the first round proceed to the second round, and then the same for the second to third round (Cottam, 2012). In terms of this study, consensus was adopted to determine which statements entered into the next round. A further interpretation was applied to statements that still did not reach consensus after three rounds.

5.7.2 Average Percent of Majority Opinions

Aligica and Herritt (2009) argued that in most Delphi studies when a certain percentage of the votes which can be either agreement or disagreement is in a predetermined range, consensus is assumed to have been achieved (Saldanha and Gray, 2002; Aligica and Herritt, 2009). There is no universally agreed guideline to determine when a consensus level is achieved, similar to the panel size and the Delphi rounds. McKenna (1994) recommended 51% of agreement amongst the experts as a consensus. Sumsion (1998) suggested 70% as a consensus level, while 80% agreement is suggested by Green *et al*. (1999) to form a consensus. von der Gracht (2008) summarised a few identified consensus measures, including stipulated number of rounds, subjective analysis, certain level of agreement, APMO Cut-off Rate, standard deviation and mean, coefficient of variation, Spearman's rank-order correlation coefficient, interquartile range (IQR), and post-group consensus. Among the measures, the APMO equation defined by Kapoor (1987) as a specific consensus measure has been sporadically used in British Delphi research (von der Gracht, 2008). The Delphi studies of Abdel-Fattah (1997), Kapoor (1987), Saldanha and Gray (2002), Makukha and Gray (2004), Cottam and Roe (2004) and Cottam (2012) are further examples for the employment of APMO rate. APMO produces a cut off rate to determine if consensus has been achieved (Cottam, 2012). Therefore, to reach consensus level, a statement must achieve a percentage which can be either 'agree' or 'disagree' that is higher than the APMO cut-off rate, otherwise statements have to proceed to the next round until agreement (Kapoor, 1987).

$$\mathrm{APMO} = \frac{\text{Majority Agreements} + \text{Majority Disagreements}}{\sum \text{Opinions Expressed}}$$

Equation 1 APMO cut-off rate for consensus
Source: Kapoor (1987)

Cottam (2012) described the APMO equation in detail. Firstly, the number of majority agreements and disagreements need to be calculated by counting the comments 'agree', 'disagree', and 'unable to comment' in percentages per statement. A comment's majority is reached when its percentage is above 50% (Kapoor, 1987). Secondly, the majority agreements and disagreements need to be summed up. These sums are then divided by the total number of opinions expressed as Equation 1 presents. However, different scholars have different ways to interpret this equation. For example, although majority has been defined as a percentage above 50%, Cottam (2012) counted 48% and 49% as majority. In the Delphi studies of Makukha and Gray (2004), 50% was accepted as majority disagreement rate while rejected when considered as a majority agreement rate. What is more, it is difficult to define the 'total opinions expressed'. In the Delphi studies of Cottam *et al*. (2004), Cottam (2012), Makukha and Gray (2004) and Saldanha and Gray (2002), 'unable to comment' was excluded from 'total opinions expressed'. Nevertheless, in Briouig (2013), 'total opinions expressed' included the 'unable to comment'. Therefore, it is difficult to have a definitive way to define each variable in the APMO cut-off rate equation. In terms of this research, the majority agreement, majority disagreement and the total opinions expressed of the APMO equation were justified for each round and slightly differed for each round.

5.8 Research ethics

It has been suggested by Punch (2005) that ethical issues affect and should be integrated into all stages of the research process. The researcher's topic and methodology should be carefully chosen with ethical consideration. According to Grix (2004), a researcher must be guided by a set of moral principles to conduct the study when the topics involve issues of confidentiality, anonymity, legality, professionalism and privacy (Grix, 2004). Therefore, the researcher needs to check with any person involved in the research if they agree to participate in the first place and instruct them in the data collection and analysis approach (Cottam, 2012).

Regarding this research, the choice of a Delphi technique is believed to be ethical to achieve the research aim and objectives. First of all, compared to other group methods, Delphi stipulates and facilitates the engagement of more expertise in relevant fields. It provides each participant with an equal opportunity to have their opinions taken into account to give a fairer representation of the viewpoints than focus groups (Cottam, 2012). Secondly, the researcher gave careful attention to ethical issues including consent, privacy and confidentiality of data at the beginning of each Delphi round and make sure the participants gave informed consent throughout the process. The four main criteria for ‘expert’ (Section 5.4.3) were the only basis when choosing the participants. Hence, the potential for harm in this research is relatively low. The Faculty Research Ethics Committee (FREC) set out the guidelines which are to be adhered in order to make sure no harm for participants. A description of the ethical protocol, and how the study corresponds is presented in Appendix 10.

Participants were informed about the research purpose, the procedures, the anticipated time commitment and contact details of the researcher. Their privacy was protected in every possible way. The participants’ information is confidential, and they remained anonymous throughout the research. The core of anonymity is that *“information provided by participants should in no way reveal their identity”* (Hanafin, 2004, p.43), and such anonymity is ensured by the Delphi technique (Cottam, 2012). The survey feedback showed no link between the names or positions of participants and their responses. This Delphi study also paid careful attention to ensure confidentiality since anonymity is one key feature of Delphi. Any primary data collected including its sources are and will remain confidential unless participants agree to their disclosure.

Chapter 6. The Delphi research process

The previous chapter discussed and confirmed the Delphi technique is a suitable methodology for primary data collection in the analysis of the impacts of the CSI on EU container seaport competition. Various sources have claimed that the US maritime security initiatives have either positive or negative effects on EU container port competitiveness. Based on that, the conceptual model and related assumptions were developed to achieve the research aim and objectives. The conceptual model structured five assumptions that derived a list of statements, which in turn used to formulate Delphi round one.

This chapter presents the process used to analyse the results from the Delphi survey. It starts with the presentation of the pilot study, and then outlines the process of each round of Delphi. The results of the three rounds are presented, including the response rate, the consensus level and formulation of next round statement if one does not reach consensus. For statements that reach consensus level, comments and discussions will be presented in Chapter 7.

6.1 Pilot Delphi study

The necessity and benefits of conducting a pilot study have been discussed in Chapter 5. In order to test the validity, reliability and credibility of the Delphi research, a preliminary pilot Delphi study was undertaken. Baker (1994) suggested that a sample size of 10-20% of the sample size for the actual study is a reasonable number for pilot study participants. The total number potential participants for the main Delphi study was 83. Therefore, the pilot survey that contained an invitation email and round one questionnaire was sent to six current active senior academic experts in related field who were not included in the 83 potential participants for the main study. The participants were identified using the same panel selection procedure as the main survey. The invitation email included a brief introduction of this specific Delphi research and an instruction of using the Qualtrics online survey tool. Three weeks were given to participants to finish the pilot study and provide recommendations. The pilot Delphi study was conducted over a four-week period, from June 2015 to July 2015 since it only contains round one questionnaire instead of three rounds. Two out of the six pilot study participants sent back their feedbacks within one week. One more participant finished the survey before the required deadline. Hence, there were three participants took part in the pilot survey, accounting for 50% of total participants invited. Based on the procedures suggested by Peat (2002), the following measures were conducted:

- The participants were asked for feedback to identify ambiguities and difficult questions.
- The time taken to complete the round one questionnaire was recorded.
- Assess whether each question was answered adequately.
- Establish that replies could be interpreted regarding the information that is required.

Based on the result of the pilot survey and the recommendations of participants in the pilot, the layout and the invitation letter of the survey were changed to provide a clearer instruction and better user friendliness. Further, the time limit of each round has increased from three weeks to five weeks in order to get a higher response rate. The sample of invitation email of the pilot survey is presented in Appendix 3.

6.2 The Delphi survey

The Delphi study began in September 2015 and did not complete until the mid of May 2016. The study included three rounds of questionnaires, consisting of 12 statements and one open-ended question. An average of five weeks was given to participants to complete the questionnaire. The length of time between rounds was designed to be ample to encourage experts to participate. This research utilised Qualtrics which is an online survey tool to collect primary qualitative data. A three-week turnaround time was employed, to maintain momentum, increase accuracy and reduce the occurrence of any changes in the context of the actual research (Goodman, 1987; Cottam, 2012).

After the appropriate amendments and corrections based on the pilot study, invitation emails were sent out to the potential 83 participants on 1st September 2015. The email contained an explanatory covering letter which presented the aim and context of the research and explained how they were chosen as panel members. It provided a survey link, utilising the Qualtrics online survey tool. A clear instruction of how to use the Qualtrics was included too. A word document that briefly described the research background, methodology and research justification was attached to the email as well. The author's contact detail was given in the end for further information. Appendix 1 presents a sample copy of the invitation email and Appendix 2 presents the attached word document.

On 15th September 2015, a reminder email was sent to participants who had not completed the survey, addressing the significance of their contribution to the research. The reminder email also includes the original copy of the invitation email. Appendix 4 shows a sample copy of reminder email of Delphi round one.

The Delphi round one closed October 2015. It took around three weeks to analyse Delphi round one responses and reformulate round two statements. The Delphi round two survey was sent out on 1st December 2015. Eight weeks were given to the participants to complete the second round considering the Christmas break. The Delphi round three survey was sent out on 1st April 2016 and closed in mid of May 2016. All experts who were included in round two finish round three within three weeks as required.

6.2.1 Panel participation

Of the initial 83 potential participants that were invited to participate in the survey, 17 agreed to participate and completed the first-round survey, 65 did not respond the invitation email, and 1 agreed to participate but did not complete the survey. Table 6.1 presents panel participation rate to Delphi round one.

Delphi round one participation rate		
Responses	Actual participant	Percentage
Participate	17	21%
No response	65	78%
Participate but did not complete	1	1%
Total contacted	83	100%

Table 6.1 Delphi round one panel participation rate
Source: the author (2015)

People do not respond to a survey due to a variety of reasons. For examples, a time factor, poor survey design, a lack of interest in the subject, incomprehensive instructions and inappropriate language use could influence non-participation (Grix, 2004; Yin, 2009; Denzin and Lincoln, 2011; Goluchowicz and Blind, 2011). However, since a pilot study was conducted before the Delphi was launched, poor design, incomprehensive instructions and ambiguous language use are not the overriding factors for non-participation.

The time factor could have an effect on the experts and their response rate (Grix, 2004). Many of them have a quite busy schedule or the time span of the survey does not fit their schedule. Another major reason is a lack of interest in the subject of study. This research looks at one specific initiative and port operations. Therefore, the participant needs to have expertise in both container port security and EU container port operations. This leads to a quite limited number of potential participants.

6.2.2 Size and structure of panel

There were 17 participants in the first round Delphi. According to Section 5.4.3, the panel is categorised into three categories that are academic, industrial and administrative. Table 6.2 presents the initial size and structure of the panel.

Category	Response	Percentage
Academic	9	53%
Industrial	3	18%
Administrative	2	12%
Other	3	17%
Total	17	100%

Table 6.2 Size and structure of panel based on Delphi round one responses
Source: the author (2015)

According to Table 6.2, besides academic, industrial and administrative categories, three panel members identified themselves as ‘other background’. However, they stated their background as 'government' 'transportation advisor' and 'academic' respectively. Therefore, after the author modified 'government' as 'administrative' and 'transportation advisor' as 'industrial', Table 6.2 was amended as Table 6.3.

Category	Response	Percentage
Academic	10	56%
Industrial	4	25%
Administrative	3	19%
Total	17	100%

Table 6.3 Adjusted size and structure of panel: Delphi round one
Source: the author (2015)

According to Cottam (2012), stakeholders are mutual interdependent among interest groups holding different rights, objectives, expectations and responsibilities. Therefore, they can contribute different perceptions with their experience and knowledge. Academics are people who have rich knowledge in maritime security and port competition. The identification of ‘academics’ implies that their viewpoints are from their experiences in academia and have no personal interests in port industry or maritime administration. Therefore, their opinions will be the most neutral amongst three expert groups. The industrial group experts are the stakeholders who have commercial interests in port industry. As Section 2.3 presented, maritime security measures compliance would bring negative impacts on port operations, the shipping and port industry expressed concern about the negativities. Therefore, the viewpoints from the industrial group are anticipated to be opposed to additional security checks and to speak for their commercial interests. Practical and historical information on maritime security initiative implementation is expected and rich qualitative data can be obtained from their comments. Administrative experts are estimated to provide opposite perceptions to the industrial experts. They are the policy-makers and regulatory bodies, and their viewpoints are expected to stress the necessity of implementing security measures. A comprehensive consideration of all three groups’ viewpoints and perceptions is necessary to maintain the trustworthiness of this Delphi study.

The first category contributing to the Delphi are academics that consists of the largest number of participants, representing 56% of the panel. Among the 83 initial participants, 30 were academics, counting as the largest portion of the total contacts (see Table 5.2 on p.153). The actual number of participants is 10, which means 20 academic experts did not respond to the survey. This proportion is predictable since academics are most often found in subject and they contribute most to the relevant field. As this research is designed to study the maritime security measures and port competition, academics who have a personal interest in the subject or know of another who does were contacted first.

The second largest category is industrial, given that the aim of this research is to study the EU container seaport competition, representing 25% of the panel. As Table 5.2 presents, the number of initial industrial experts is 28 that counts as the second largest category of the initial panel. The number of actual participants is 4, which means 24 initial participants failed to complete the survey. According to the literature review and conceptual model, there are only a few scholars discussing negative impacts of maritime security management. The lack of empirical research of the negative impacts of maritime security management on port operation requires industrial stakeholders such as port/terminal operators, shippers and carriers to contribute their opinions. Stakeholders such as managers and directors from the Top 17 EU container seaports based on the TEU throughput were contacted to join the Delphi panel. What is more, consultants on the EU port operation and liner brokers who work for trans-Atlantic lines were invited to take part as well.

The last category is professional with administrative background, making up 19% of the panel. Judging from the number of initial participants and actual participants (Table 5.2 on p.153 and Table 6.3 on p.186), 22 administrative experts did not complete the survey. This proportion is not surprising since administrative stakeholders are more conservative than academic and industrial stakeholders. Nevertheless, their knowledge and contribution to this research is undeniable. Administrative professionals influence, determine and supervise the implementation of maritime security regimes. Therefore, they are the source of knowledge on seaborne trade security and safety, providing a different insight from academics and industrial.

6.3 Analysis of Delphi round one

Analysing the Delphi study serves important purposes. Analysis between each round could provide feedback and allow the researcher to identify when consensus has been reached (Rowe and Wright, 1999). Statements have not reached the consensus will enter into revaluation. This study employs APMO as the statistical measure to identify consensus for each Delphi round. According to Cottam *et al*. (2004) and von der Gracht (2008), the numbers of majority agreements and disagreements are calculated based on participants comment 'agree', 'disagree', and 'unable to comment' in percentages per statements. Majority is defined by percentage over 50% (von der Gracht, 2008). The majority agreements and disagreements need to be summed up by the researcher and then divided by the total number of opinions expressed. Table 6.4 below presents the full results from round one and Equation 2 shows the equation and calculation of the APMO.

Delphi round one, Average Percent of Majority Opinions(APMO)	
Majority agreements	73
Majority disagreements	8
Total opinions expressed (excl. U.C)	146
APMO	56%
Number of statements reached Consensus	5
Number of statements to be formulated into Delphi round two	7

Table 6.4 APMO cut-off rate for consensus in Delphi round one
Source: the author (2015)

$$\mathrm{APMO} = \frac{\text{Majority Agreements} + \text{Majority Disagreements}}{\sum \text{Opinions Expressed}} = \frac{73+8}{146} = 56\%$$

Equation 2 APMO cut-off rate equation and calculation
Source: the author (2015)

Table 6.4 and Equation 2illustrate the process of calculation of APMO cut-off rates. As they show, 56% is the APMO rate that will be used in the first round Delphi analysis. In other words, if the percentage of either 'agreement' or 'disagreement' for each statement is greater than 56 %, consensus is reached. Table 6.5 illustrates the rate of 'agreement', 'disagreement' and 'unable to comment' for Delphi round one analysis.

Figure 6.1 below demonstrates a conceptualisation of the various phases used to identify consensus in individual statements from each Delphi round (Cottam, 2012). As Figure 6.1 shows, the process is repeated until an optimal consensus level is achieved and utilised to support all three rounds.

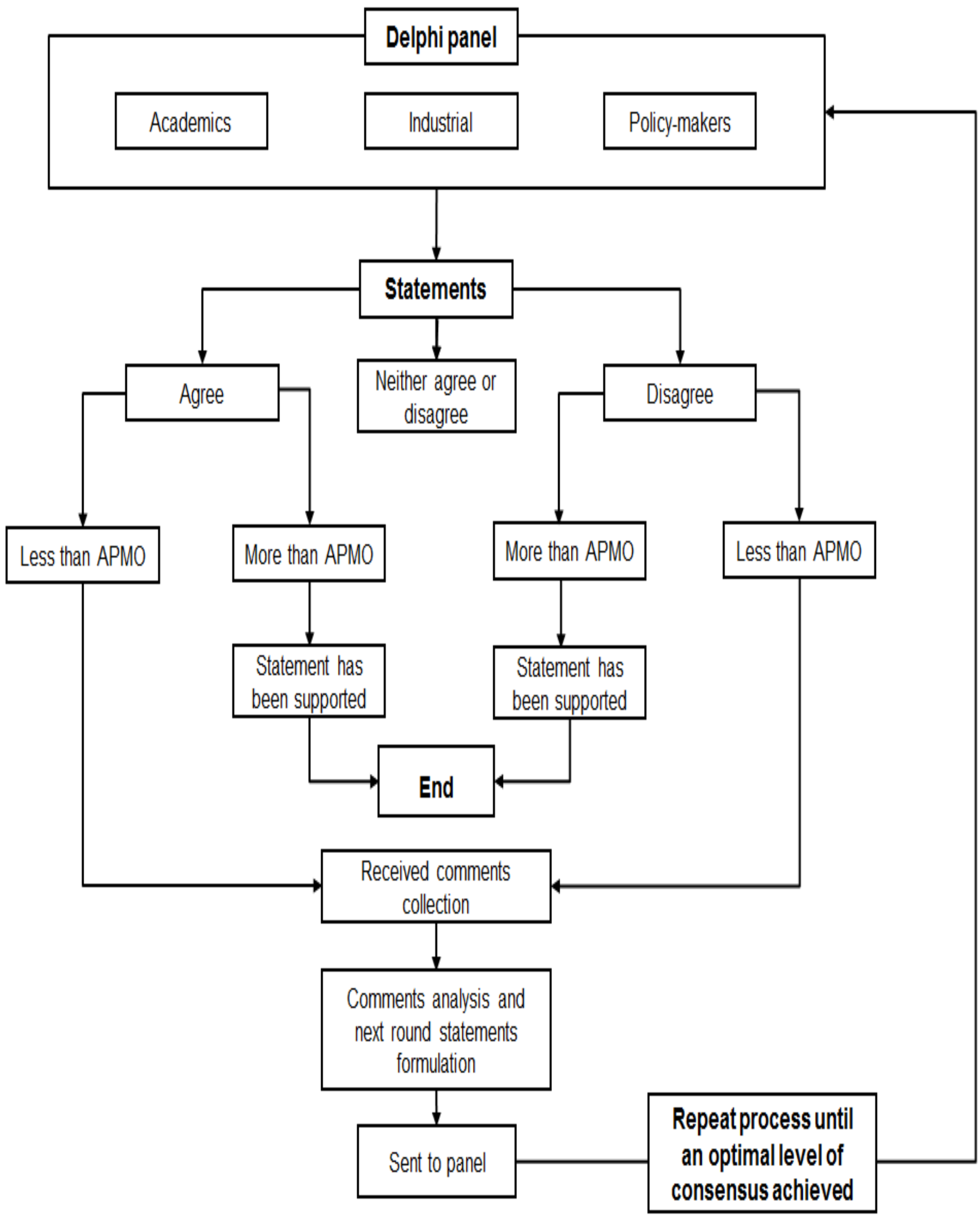


Figure 6.1 APMO cut-off rate between Delphi rounds
Source: the author 2015 adapted from Abdel-Fattah (1997)

Conceptual Category	Statement No.	Agreed		Disagreed		U.C		Total Opinion expressed (excl. U.C)	Consensus
		No.	%	No.	%	No.	%		
The necessity of pursuing maritime security initiative	1.1	10	58.8	3	17.6	4	23.5	13	Yes Agreed with 58.8%
	1.2	11	64.7	2	11.8	4	23.5	13	Yes Agreed with 64.7%
Introduction of the CSI and its controversial influences	2.1	15	88.2	0	0	2	11.8	15	Yes Agreed with 88.2%
	2.2	10	58.8	1	5.9	6	35.3	11	Yes Agreed with 58.8%
Determinants of EU container seaport competitiveness	3	9	52.9	7	41.2	1	5.9	16	No
The implication of the CSI for EU container seaport competition	4.1	5	29.4	4	23.5	8	47.1	9	No
	4.2	7	41.2	6	35.3	4	23.5	13	No
	4.3	10	58.8	3	17.6	4	23.5	13	Yes Agreed with 58.8%
	4.4	4	23.5	7	41.2	6	35.3	11	No
	4.5	4	23.5	8	47.1	5	29.4	12	No
	4.6	5	29.4	4	23.5	8	47.1	9	No
	5	8	47.1	3	17.6	6	35.3	11	No
	Majority agreed /disagreed	73		8				146	

U.C=Unable to comment

Table 6.5 Delphi round one analysis
Source: the author (2015)

6.3.1 Consensus reached after round one

With the result of the AMPO calculation, it can be determined which statements from round one have achieved consensus level. As Table 6.5 demonstrates, five statements-S1.1, S1.2, S2.1, S2.2, and S4.3- have achieved a percentage of agreement over 56%, and therefore reached consensus. The panellists' comments will be discussed in Section 7.1.

6.3.2 Reformulation of statements for Delphi round two

The statements that did not reached the consensus level from Delphi round one were reformulated based on panel comments and included in round two. Based on the first-round result, there were seven statements agreed less than 55%. Therefore, those seven statements were brought into the second round. Delphi statements become more focused and specific on research aim and objectives as each round comes to pass (Cottam, 2012). The original Delphi round one statements and the reformulated statements entered into round two are specified in the following sections.

S3 Original statement

The port environment generally has become increasingly competitive, it varies between regions and places depending upon the extent to which these forces have impacted upon the nature of the port environment. According to prior studies, the components of port competitiveness are: port location, port facilities, overall efficiency, hinterland networks, value added logistics; and port services, safety handling of cargoes, confidence in port schedules, simplification of procedures, operational transparency, and port labour and skills. Among these factors, for the EU ports, since port location is static, port efficiency, service and cost related elements are still the most important competitiveness components. Port safety and security is not an incentive for port selection.

Reformulated statement

The port environment generally has become increasingly competitive; it varies between regions and places. Ports and terminals no longer enjoy defacto monopolies. Ports need to compete for individual hinterlands and terminals need to compete with other operators within one port. According to prior studies, the components of port competitiveness are: port location, port facilities, overall efficiency, hinterland networks, value added logistics; and port services, safety handling of cargoes, confidence in port schedules, simplification of procedures, operational transparency, and port labour and skills. Among these factors, for EU ports, carriers will use multitude of tangible criteria such as port efficiency, and cost related elements which are still the most important competitiveness components. Port safety and security are considered as intangible criteria. These criteria are also important and ports/terminals as an absolute minimum need to match industry standards and best practices.

Arguments

This statement achieved 53% agreement which is lower than the APMO rate. Panellists agreed that most with the current port competition situation. Historically, ports and terminals enjoyed defacto monopolies and there was little competition among them. However, at present and in the future, the reality is that several ports compete for individual hinterlands and within one port several terminals exist. As a result, ports and terminals need to adapt to this environment and those who fail to do so will suffer profit losses and ultimately exit the industry. The panel members, if not all, agreed with that efficiency and price are still most important components of port competitiveness. They stated that carriers use a multitude of tangible criteria which is related to Total Cost of Ownership to select the best ports and terminals for their networks. All costs including direct and indirect cost will be considered. Moreover, numerous intangible criteria such as port security and safety are becoming more evident, along with “*ease of doing business*”. Therefore, port security and safety are also important factors on port selection.

S4.1Original statement

To obtain the minimum required level of compliance, ports need to implement technical and organisational measures that will bring additional costs to maritime industries. Enhancing the technical measures due to security regulations, such as the ISPS Code, has brought additional costs to European maritime industries. Smaller ports in the EU may stop their US-inbound business since they cannot bear the financial costs. Larger ports may “steal” new business from smaller ports which are financially strained to meet the scanning requirements. A distortion of EU container port market share will arise.

Reformulated statement

To obtain the minimum required level of the ISPS compliance, ports need to implement technical and organisational measures. Theoretically, the additional cost brought by security regulations would affect EU container ports, making some small EU ports lose business. Nevertheless, the constraint of handling ever larger container ships efficiently is the major reason behind that. The influence of additional cost is minor and it depends on what level of security that the smaller ports are willing to agree to. Moreover, European consumers are contributing to the costs since port/terminals pass them onto shippers/forwarders/3PL’s and ultimately to retailers and then end consumers. Larger ports may gain new business from smaller ports. A distortion of EU container port market share will arise. Nevertheless, the positive effect of increasing worldwide maritime security overcomes the negative distortion.

Arguments

Smaller ports are far more likely to lose business due to not being able to handle mega container ships efficiently rather than ISPS compliance. Additionally, the US is not the main business for the smaller container ports. Therefore, based on the panellists, the market share changes are not serious. The compliance costs from ports and terminals are levied to Line/Carriers who in turn pass them onto shippers, forwarders and 3PL's and ultimately to retailers and then end consumers. Moreover, this has created a new revenue stream for ports and terminal operators. A few more cents/pence per consumer pays can create a better and safer maritime environment. Therefore, the positive effects of spending extra compliance costs outweigh the negative market share changes.

S4.2 Original statement

While port security measures enhance port security, procedural requirements of the new security regime act against operational and logistical efficiency. The proponents of this view list a number of operational inefficiencies ranging from direct functional redundancies such as additional inspections and lengthy procedures to indirect supply chain disruptions stemming from longer lead times and less reliable demand and supply scenarios.

Reformulated statement

While port security measures enhance port security, procedural requirements of the new security regime act against operational and logistical efficiency. The proponents of this view list a number of operational inefficiencies ranging from direct functional redundancies such as additional inspections and lengthy procedures to indirect supply chain disruptions stemming from longer lead times and less reliable demand and supply scenarios. However, security inspections cannot be repealed. Better administrative processes and better IT tools can help to mitigated inefficiency. Port operations consist of many factors and efficiency and security are two of them. If a port is efficient, good security will not cause it not to be.

Arguments

Experts who agreed with this statement believed that security procedure does bring additional inspections and lengthy procedures. However, opinions against it argues that inefficiency always exist in an inefficient port regardless of what kind of operations there are. Port operations consist of many factors and security is one of them. A better utility of IT tools and administrative processes could facilitate the security procedure. The supply chain and logistics process can be managed and disruptions can be mitigated through process enhancement.

S4.4 Original statement

Although the US Customs and Border Protection stated that the CSI can bring benefits to joined ports, those benefits are still controversial. The CSI has negative effects on port profit. In addition to the significant initial investment in new equipment, the CSI makes cargo inspection process more complicated, creating an increase in cargo processing time and cargo processing cost. That can change important performance characteristics of the port such as the port efficiency and price. From the perspective of a long-term economic model, these consequences produce the negative impacts on relative attractiveness of ports for various stakeholders, namely exporters and cargo carriers. The reduced attractiveness will decrease the competitiveness of a port. Moreover, the deepening cost and time may initiate a vicious circle of decreasing port competitiveness. The CSI is actually a heavy burden for those ports that have joined.

Reformulated statements

Although the US Customs and Border Protection stated that the CSI can bring benefits to joined ports, those benefits are still controversial. This programme transfers the container examinations from unloading ports in the US to the loading ports overseas. On the other hand, all the checks are carried out in the host countries which bear the equipment cost. Some research claims that CSI creates competitive disadvantages due to additional investment and running cost. However, in reality, all terminal/ port investment are surcharged to direct customers, with the costs ultimately being born by the Beneficial Cargo Owners (BCOs). The real burden falls to the BCOs, and ultimately to US importers/retailers and the end consumers. In fact, security regulations compliance such as ISPS has created new revenue streams.

Argument

It was pointed out by panellists that a policy will have its good and bad impacts and its implementation is key to its success. As current security inspection has been improved, there is no evidence to show that the CSI has created heavy burden for joined ports. The levels of compliance to the CSI are very similar among competing ports and terminals that share the same hinterland and foreland. The ISPS has compliance has created new revenue stream and therefore ports and terminals levy very similar security surcharges/fees. The extra costs are passed down to the Beneficial Cargo Owners (BCOs). Notwithstanding all ports and terminals being vocal about additional costs during the launch of the CSI, no port or terminal claimed that the CSI negatively affect the volume or profitability since they joined it.

S4.5 Original statement

The CSI could improve the capabilities and the overall effectiveness of the targeting process. However, this programme transfers the container examinations from unloading ports in the US to the loading ports overseas, on the other hand, all the checks are carried out in the host countries which bear the equipment cost. In case of unloading and emptying of any potential threat posed by a dangerous container, the costs are borne by the importer to a US port. The US Customs sacrificed the export ports to save the US unloading port's time and cost. The CSI is a unilateral and unfair programme without considering the host ports.

Reformulated statement

The CSI could improve the capabilities and the overall effectiveness of the targeting process. However, this programme transfers the container examinations from unloading ports in the US to the loading ports overseas. Opponents argue that it would slow down the loading port efficiency. However, from a security perspective, the best is to intercept suspect containers as early as possible in the logistics chain. Moreover, the CSI is merely a documentation process in which terminals and ports are not directly involved. Very few containers experience a physical inspection. The process is driven by pre-shipment submission of cargo manifests, from which a few containers require non-obtrusive inspections, and very few of these actual physical inspections.

Arguments

The CSI can improve the overall effectiveness of port operations theoretically. Nevertheless, arguments denounced that the CSI is not considered comprehensively and does not have better performance on improving port efficiency. Proponents of the CSI mentioned that it is a behaviour that ought to be implemented worldwide. For any perceived security threat, scanning and physical inspection will be required. Carrying out the essential inspection at destination has been described as "*closing the gate of the pen after all the sheep have run away*". From a security perspective, interception suspect containers as early as possible are the best solution in supply chain. Moreover, with the US having the lease efficient ports and highest labour cost, performing the inspection at loading ports can achieve cost reduction and efficient improvement for the entire supply chain.

S4.6 Original statement

CSI bilateral system of information exchange requires a host country to offer to conduct a security check on containers shipping to a US port. In return, the host country can send its officers to any US port to target ocean-going containerised cargo being exported to their country. Under this system, there can be sensitive information exchange, according to the US government, which may be deemed necessary to ensure safety of any ports involved. However, the host countries are not willing to offer any confidential information.

Reformulated statement

The CSI bilateral system of information exchange requires a host country to conduct a security check on containers shipping to a US port. In return, the host country can send its officers to any US port to target ocean –going containerised cargo being exported to their country. It is somewhat improbable that a security threat to a country originates from the US, so the reciprocal arrangement does not (today) really add a tangible value to others. Under this system, there can be sensitive information exchange, which is deemed necessary to ensure safety of any ports involved. The US could cease trading with the export ports if they refuse to provide information. Although the host countries may not be willing to offer any confidential information, most export nations depend upon trade with the US, so they freely cooperate in varying degrees.

Arguments

The sharing of security information between various countries is not new. There are many global councils such as the UNSC and the WCO, which have existed for many years prior to 9/11. Information sharing adds significant value on overall supply chain. It is somewhat improbable that a security threat to a country originates from the US, therefore the reciprocal arrangement does not really add a tangible value to others. The US would cease trading with countries that refuses to cooperate, depending upon other circumstances.

S5 Original statement

There are many ports in Europe. However, there are 'only' about 130 seaports handling containers of which around 40 accommodate intercontinental container services. About 70% of the total container throughput in the EU port system passes through the top17 load centres. 14 of those have joined the CSI programme. In the short term, small container ports have to stop their US inbound business and large EU container ports will gain new market share. In the long run, with further CSI implementation, the EU host countries will absorb the extra cost through transferring them to customers. However, the distortion in the competitiveness of large EU container ports will be minor.

Reformulated statement

There are many ports in Europe. However, there are 'only' about 130 seaports handling containers of which around 40 accommodate intercontinental container services. About 70% of the total container throughput in the EU port system passes through the top 17 load centres. 14 of the top 17 ports have joined the CSI programme. In the short term, small container ports have to stop their US inbound business and large EU container ports will gain new market share which may be minor. In the long run, with further CSI implementation, the EU host countries will absorb the extra cost through transferring them to customers. However, the distortion amongst large EU container port competition will be major, which is due primarily to liner network design and costs to the CSI

Arguments

According to the panellists, the distortion will be major and there has already been distortion. As of 15th April 2015, there are 58 ports globally which participate in the CSI. These accounted for 85% of the total inbound US containers shipped. 23 of them are in Europe. Notwithstanding there are several more container ports, many of them are not suited to direct mainline port calls due to their location or scale. Deep-sea lines are instead served through transhipment at one of the 23 main European ports and that is due primarily to liner network design and costs rather than CSI membership or compliance. What is more, the reason why smaller ports lose market share is lacking capacity of handling ever large container vessel rather than the CSI compliance. If smaller ports' main business is not with the US, the impact of security measures will not be huge.

6.4 Administration of Delphi round two

The Delphi round two began on 1st December 2015. Seventeen participants who completed the Delphi round one received an invitation email to ask for taking part in the Delphi round two. The email acknowledged their contribution and an appreciation of their time in Delphi round one. It also contained an explanatory covering letter which presented the aim and context of the research and explains how they were chosen as panel members. It gave a survey link for the Delphi round two, utilising the Qualtrics online survey tool. A clear instruction of how to use the Qualtrics was included too. The author's contact detail was given in the end for further information. Appendix 5presents a sample copy of the invitation email for Delphi round two, a word document that summarises the result of Delphi round one (Appendix 6), and the attached word document (Appendix 2). Eight weeks were given to the participants to complete the second round considering the Christmas break. Five weeks later, on 5th January 2016, a reminder letter was sent to participants who had not completed their survey, addressing the significance of their contribution to the research. The reminder email also includes the original copy of the Delphi round two invitation email. Appendix 7 shows a sample copy of reminder email of Delphi round two.

6.4.1 Response rate of Delphi round two

Delphi round two was sent out to 17 panel members based on the first-round responses, and 14 completed the questionnaires, providing a 83% response rate. Table 6.6 shows the size and structure of the participants for the second round Delphi.

Categories	**Response**	**Percentage**
Academic	8	57%
Industrial	4	29%
Administrative	2	14%
Total	14	100%

Table 6.6 Size and structure of panel participants: Delphi round two
Source: the author (2016)

As the Delphi round one, panel members were the categories of academic, industrial and administrative. Academics formed the largest category, with 57% of the total participants. Industrial-experts remained in-between, with 29% of the total number of participants. Experts with administrative background formed the smallest category, with only 14% of the total number of participants. In comparison with Table 6.3 Adjusted size and structure of panel participants: Delphi round one (p.186), two notable changes occurred. Firstly, the total number of participants decreased from 17 to 14. Secondly, 2 academics and 1 administrative departed from the study. Nevertheless, the panel structure remains the same as the Delphi round one as it still contains three categories.

6.4.2 Analysis of the responses to Delphi round two

As the first-round analysis, the APMO was calculated based on the responses showed in Table 6.7. The actual APMO cut-off rate for consensus in Delphi round two is illustrated in Equation 3. The full results are presented in Table 6.8.

Delphi round two, Average Percent of Majority Opinions(APMO)	
Majority agreements	86
Majority disagreements	0
Total opinions expressed	98
APMO	87.8%
Number of statements reached Consensus	4
Number of statements to be formulated into Delphi round three	3

Table 6.7 APMO cut-off rate for consensus in Delphi round two
Source: the author (2016)

$$\mathrm{APMO} = \frac{\text{Majority Agreements} + \text{Majority Disagreements}}{\sum \text{Opinions Expressed}} = \frac{86 + 0}{98} = 87.8\%$$

Equation 3 APMO cut-off rate for consensus in Delphi round two
Source: the author 2016 adapted from Kapoor (1987)

Conceptual category	Statements No.	Agreed		Disagreed		U.C		Total Opinion expressed (incl. U.C)	Consensus
		No.	%	No.	%	No.	%		
Determinants of EU container seaport competitiveness	3	14	100	0	0	0	0	14	Yes Agreed with 100%
The implications of the CSI for EU container seaport competition	4.1	10	71.4	1	7	3	22	14	No
	4.2	11	78.6	0	0	3	21.4	14	No
	4.4	13	92.8	0	0	1	7.2	14	Yes Agreed with 92.8%
	4.5	13	92.8	1	7.2	0	0	14	Yes Agreed with 92.8%
	4.6	14	100	0	0	0	0	14	Yes Agreed with 100%
	5	11	78.6	0	0	3	21.4	14	No
	Majority agreed /disagreed	86		0				98	

Table 6.8 Delphi round two analysis
Source: the author (2016)

Table 6.7 and Equation 3 illustrate the process of calculation for APMO cut-off rate for round two. It should be noticed that the calculation differs from round one APMO since it has been adjusted by the author for the second round. As it has been discussed in Chapter 5, there is no unified way to calculate the APMO cut-off rate. Therefore, in this research, the formula will be adjusted each round. Since the participants decreased to 14 people, the effect of one expert’s opinion is more influential on final results. One subjective and biased comment could lead to a less inclusive and comprehensive conclusion. Hence, the 'unable to comment' was considered in the equation to lower the effect of a biased opinion by increasing the denominator of the APMO equation, which made 'the total opinions expressed' in the second round as 98 responses. As Equation 3 shows, 87.8% is the APMO rate that will be used in the second round Delphi analysis.

In other words, if the percentage of either 'agreement' or 'disagreement' for each statement is greater than 87.8%, consensus is reached. Among the seven statements entered into second round, four statements have reached 87.8%, therefore, three statements were reformulated into Delphi round three.

6.4.3 Consensus reached after Delphi round two

The results of Equation 3 determine which of the statements from Delphi round two have achieved consensus. Four statements-S3, S4.4, S4.5, S4.6-reached a percentage of agreement that was higher than 87.8%, and therefore reached consensus. Each of the statement will be discussed in Section 7.2, making use of the comments made by panellists.

6.4.4 Reformulation of statements for Delphi round three

The statements that did not reach consensus after the second round were reformulated and entered into the third round of Delphi. The reformulated statements are based on the comments made by panellists in round two; therefore, they have attempted to reflect panellists’ viewpoints. There are three statements which failed to reach the consensus. As a result, they were reformulated. The original statements in round two and the reformulated statements for round three are specified in the following sub-sections, based on arguments made by panellists in accordance with the research objectives set out in Chapter 1.

S4.1 Original statement

To obtain the minimum required level of ISPS compliance, ports need to implement technical and organisational measures. Theoretically, the additional cost brought by security regulations would affect EU container ports, making some small EU ports lose business. Nevertheless, the constraint of handling ever larger container ships effectively is the major reason behind that. The influence of additional cost is minor and it depends on what level of security that the smaller ports are willing to participate. Moreover, European consumers are contributing to the costs since port/terminals pass them onto shippers/forwarders/3PL's and ultimately to retailers and then consumers. Larger ports may gain new business from smaller ports. A distortion of EU container port market share will arise. However, the positive effect of increasing worldwide maritime security overcomes the negative distortion.

Arguments

This statement was agreed at 71.4% by panellists. Gateway hinterland cargoes are usually exported by only a few ports or terminals. They compete in this business by price and efficiency advantage. The ISPS merely required that all ports and terminals have secure perimeters and access controls. The cost for any infrastructure and superstructure required to meet the minimum standards has been over-estimated. The actual incurred costs are low and have been recovered in full through the Container Security Fees which are usually less than US 10 cents per container shipped. The cost of security is extremely minor in the overall scheme of the supply chain. On the other hand, small container ports lose their business largely due to their insufficient capacity of handling mega ships. Therefore, ISPS compliance would not cause financial problems for EU container ports and terminals.

Reformulated statement

The distortion of the EU container port market is largely caused by mega container ships. Ports and terminals do not bear financial burden for ISPS compliance. The compliance cost can be overlooked as it is minor in the overall supply chain. Instead, port and terminals create a new revenue stream by charging the Container Security Fees. A safe and secured maritime trade is an extremely important issue in shipping industry.

S4.2 Original statement

While port security measures enhance port security, procedural requirements of the new security regime act against operational and logistical efficiency. The proponents of this view list a number of operational inefficiencies ranging from direct functional redundancies such as additional inspections and lengthy procedures to indirect supply chain disruptions stemming from longer lead times and less reliable demand and supply scenarios. However, security inspections cannot be repealed. Better administrative processes and better IT tools can help to mitigated inefficiency. Port operations consist of many factors and efficiency and security are two of them. If a port is efficient, good security will not cause it not to be.

Arguments

This statement was agreed at 78.6% by panel members. The 25% was accounted by 'unable to comment' since some of the panellists were confused by the vagueness of ‘good security'. Experts who stood for this statement agreed with the importance of security due to the irreversibility of security incident. Therefore, each player of the supply chain should always make effort to ensure the security and safety of the process. It is an inevitable responsibility for port and terminal regardless of negative influence caused by extra inspection. Moreover, the disruption of container movement has been exaggerated. In practice, the extra procedure is insignificant compared to the 10-14 days of additional transportation time resulted from slow steaming.

Reformulated statement

A safe and secured maritime trade is an extremely important issue in shipping industry that cannot be overlooked. With better administrative processes and IT tools, container security inspection process can be facilitated without causing supply chain disruptions. The extra inspection time in export ports is insignificant compared to the total transportation.

S5 Original statement

There are many ports in Europe. However, there are ‘only’ about 130 seaports handling containers of which around 40 accommodate intercontinental container services. About 70% of the total container throughput in the EU port system passes through the top 17 load centres. 14 of the top17 ports have joined the CSI programme. In the short term, small container ports have to stop their US inbound business and large EU container ports will gain new market share which may be minor. In the long run, with further CSI implementation, the EU host countries will absorb the extra cost through transferring them to customers. However, the distortion amongst large EU container port competition will be major, which is due primarily to liner network design and costs not CSI compliance.

Arguments

This statement was agreed at 78.6%. Panel members agreed that a change will occur and bigger EU ports will benefit but not in a distorted way. There is no distortion between the competition of main European ports when it comes to security and safety. Joining the CSI is at the national level rather than the port level. Small ports are not affected since cargo will be inspected in the US if necessary. Furthermore, it was pointed out that there are no more than 40 ports in Europe which handle ships call direct at US ports. The 24-hour rule only applies to those ports.

Reformulated statement

CSI compliance will not cause container port market distortion in Europe whether in short term or long term since there has been no evidence to show it causes financial burden or logistics disruption. Small ports will be affected by the changing market arises from liner network design which aims at lowering the overall transportation cost.

6.5 Administration of Delphi round three

On 20th April, an email with the Delphi round three Qualtrics online link was sent out to the 14participants who completed Delphi round two. The explanatory email acknowledged an appreciation for their engagement and contribution in Delphi round two. A brief introduction of the aim and objectives of this research was also included to remind participants. Three weeks were given to the participants since there are only three statements. What is more, the author kindly asked the participants to comment on the research topic as much as they like because their opinions would be extremely helpful for data analysis. The author's contact detail was given in the end for further contact. Appendix 8 presents a sample copy of the invitation email for Delphi round three. Three weeks were given to the participants to reply the survey. On 27th April, a reminder email including the original copy of the Delphi round three invitation email was sent to participants who had not replied their survey, addressing the importance of their individual contribution to the research and the importance of this research to EU container port industry. Appendix 9 presents a sample copy of the reminder email for Delphi round three.

6.5.1 Response rates of Delphi round three

Of the 14 panel members who were sent Delphi round two, 14 completed the questionnaire, providing a good response rate of 100%. Table 6.9 presents the size and structure of the panel participant response rates of Delphi round three.

Categories	Response	Percentage
Academic	8	57%
Industrial	4	29%
Administrative	2	14%
Total	14	100%

Table 6.9 Size and structure of the panel participant: Delphi round three
Source: the author (2016)

As Table 6.9 shows, all Delphi round two participants responded and completed the Delphi round three. As the Delphi round one and two, panel members remained as the categories of academic, industrial and administrative. For Delphi round three, academics formed the largest category, with 57% of the total participants. Industrial-experts remained in-between, with 29% of the total number of participants. Experts with administrative background formed the smallest category, with only 14% of the total number of participants.

6.5.2 Analysis of the responses to Delphi round three

In order to analyse Delphi round three, the APMO cut-off rate needs to be calculated first. Table 6.10 illustrates the process of calculation for APMO cut-off rate, Delphi round three. As Delphi round two, the total opinion expressed includes 'unable to comment'. Based on the Equation 4, the APMO cut-off rate for Delphi round three is 90.5%. Table 6.11 presents the percentage of Delphi round three response.

Delphi round two, Average Percent of Majority Opinions(APMO)	
Majority agreements	38
Majority disagreements	0
Total opinions expressed	42
APMO	90.5%
Number of statements reached consensus	2
Number of statements failed to reach consensus	1

Table 6.10 APMO cut-off rate calculation process for Delphi round three
Source: the author (2016)

$$\text{APMO} = \frac{\text{Majority Agreements} + \text{Majority Disagreements}}{\sum \text{Opinions Expressed}} = \frac{38+0}{42} \quad = 90.5\%$$

Equation 4 APMO cut-off rate for consensus in Delphi round three
Source: the author 2016 adapted from Kapoor (1987)

Conceptual Category	**Statement No.**	**Agreed**		**Disagreed**		**U.C**		**Total Opinion expressed (incl.U.C)**	**Consensus**
		No.	**%**	**No.**	**%**	**No.**	**%**		
The implications of the CSI for EU container seaport competition	4.1	11	78.6	1	7.1	2	14.3	14	No
	4.2	14	100	0	0	0	0	14	Yes Agreed with 100%
	5	13	92.8	1	7.2	0	0	14	Yes Agreed with 92.8%
	Majority agreed /disagreed	38		0				42	

Table 6.11 Delphi round three analysis
Source: the author (2016)

6.5.3 Consensus reached after Delphi round three

The results of Equation 4 indicate that the APMO cut-off rate for Delphi round three is 90.5%. This rate can determine which of the statements from Delphi round three have reached consensus. Three statements entered into round three and two of them-S4.2, S5- reached a percentage of agreement that was higher than 90.5%, and thus reached consensus. Each of the statements will be discussed in Section 7.3, incorporating the panellists' comments.

6.5.4 Statement does not reach consensus

S4.1-The distortion of the EU container port market is largely caused by mega container ships rather than additional security procedure. Maritime security initiatives compliance does not bring financial burden on ports and terminals. The compliance cost can be overlook as it is minor in the overall supply chain. Instead, port and terminals create a new revenue stream by charging the Container Security Fees.

This statement was agreed at 78.6% by most of the panel members. However, it fails to reach the 90.5% consensus level. Opponent of this statement believes that both mega ships and maritime security and safety issues have a major impact on the market, therefore would cause distortion. Panellists who agreed with this statement provided certain evidence. They mentioned that financial burden and supply chain disruptions were the initial concerns when the CSI was first introduced. Nevertheless, based on current container port industry, which ports the largest vessels call at today, there is no different to the ports which ships called 20 years ago. They pointed out that Container Security Fees are common at all ports, ranging from US10-20 per container, and have become an additional revenue stream which far outweighs any costs associated with being the CSI compliant.

Chapter 7. The Delphi research results

This chapter aims at presenting the discussion of Delphi statements which reached their consensus after each round, based on the panellists' comments. The conceptual model presented in Chapter 4 will be revised using the results of the Delphi survey. The conceptual assumptions included in the original model are reviewed in the light of the panel members' opinions and the results of the three rounds.

7.1 Delphi round one: statements reaching consensus level and comments

S1.1 - Maritime security has become a great concern worldwide. The increasing volume of container movements, their relatively high velocity in the international trade and their uniformity have posed formidable security challenges. As the loading and unloading points of a sea transport process, container ports are the most important nodes for maritime safety. However, only around 2% to 10% of containers are actually inspected. US ports normally inspect roughly 5% of the 17 million containers arriving at the border every year. A great concern about container security emerged from this low inspection rate. Container security is far more important than efficiency and profit for the port. Therefore, security should be seen as the first priority.

This statement was agreed at 58.8%. Panel members agreed that most, if not all, container shipping have posed security challenges and security issue is important. Argument in support stated that many large sea-ports are situated close to highly populated urban areas, which makes delivery of weapons of mass destruction in a shipping container a reality and risk that needs to be mitigated. Security and safety of container shipping are definitely the key drivers.

Supportive comments also advised that there would always be a need for some physical and manual inspections. Nevertheless, as to the low container inspection rate, some disagreed comments pointed out that inspecting 100% of containers at destination is not a viable solution since it is too far down the supply chain. The rate of inspection is not necessarily a measure of security. There is no evidence to show that security will increase just because the inspection rate increases. Using data, information and applying intelligence are then key tools and resources to keep supply chain safety. The major disagreed comments focus on the priorities between security and efficiency. For shippers and carriers, they considered efficiency more important than security and port efficiency still sits at the very heart of port operations.

S1.2 - As the world's largest national economy, United States plays a vital role in global trade. After 9/11, the US has reacted to the needs for strengthening security measures to enhance maritime transport safety. Some of the maritime security initiatives have influence on some export ports in terms of logistics efficiency and financing. Nevertheless, those export ports should be prepared to comply with the US container port security initiatives for maritime safety.

This statement was agreed a 65%. All panel members acknowledged the importance for strengthening security measures. Comments stated that after 9/11, tightening of security was naturally a high priority. The US, as the world's largest national economy, plays a vital role within the global supply chain. Export countries need to follow US rules if they trade with the US. Security has always been a requirement, however, practiced to differing levels of quality between ports.

Nevertheless, panel experts disagreed with the significant disadvantages that security measures could bring to logistics efficiency and financing. Measures such as the ISPS/C-TPAT guidelines/regulations which standardised the approach to security post 9/11 are no more than common-sense solutions. The compromise if any is very insignificant compared to the overall benefits derived from them. They also suggested that the responsibility is not only for the export ports, but also includes shippers, carriers and forwarders, etc. Security has to be linked to the entire end-to-end journey in order to be more effective and not only depend on inspection at a specific port.

S2.1 - The Container Security Initiative (CSI) programme managed by the US Customs and Border Protection (CBP) is an influential voluntary initiative. The CSI was proposed to ensure all containers that pose a potential risk for terrorism are identified and inspected at foreign ports before they are loaded on to vessels imported to the US. Without a doubt, the CSI has dramatically increased the level of awareness for the need to secure global trade.

Almost all the panellists agreed with this statement, with 88% of agreement. The purpose behind this statement is to testify the viewpoints of panel experts on the benefits that the CSI brings to maritime security. Therefore, it can be concluded that the CSI has increased the awareness of relevant stakeholders to secure global trade.

S2.2 - Unlike the 24 Hour Rule, the CSI is a voluntary initiative. However, in order to keep the market share for US inbound trade, the major exporters have to join the programme. Not joining the programme could make the exports lose competitiveness over their rivals.

This statement was agreed by 58.8% of panel members. Panellists pointed out that fines will be imposed for containers to US without have been properly manifested, thus US government actually make the declaration compulsory. However, disagreements stated that the 24-hour Rule is a primary aspect of the overall CSI. The 24-hour rule has subsequently been adopted in the EU and China. It requires a manifest completed 24 hours prior to loading. This helps to improve the quality of data used in ship and terminal planning processes, facilitated earlier and more accurate release of BsL. The whole ocean trade has benefited. However, the voluntary aspect, based on the comments, is largely not adopted, such as mass scanning, due to the possible efficiency losses. Therefore, at the current stage, most export container ports work in extremely similar ways and there are no commercial or operational competitive advantages of any significance as a direct result of the CSI. Not joining the CSI does not create competitive disadvantages.

S4.3- Productivity could improve due to better procedural arrangements. With the reinforcement of security, there is reduced likelihood of security incidents, a probability of fewer incidents being recorded and higher port reliability. Increased reliability which leads to higher trust between a port and its upstream and downstream partners in a container supply chain, contributes to the reduction of cargo processing time and results in reduction of cargo processing cost. Decreased cargo processing cost has a positive effect on port selection, thus attracting more container volume. Consequently, from the viewpoint of the above analysis, improving security level and increasing port reliability can attract more containers. Compliant participants would benefit from access certification and fast-lane treatment as well as reduced insurance costs and risk exposure.

This statement was agreed at 59%. Panellists agreed most with the contribution of efficient security procedural arrangements. They argued their viewpoints from two aspects. In theory, they agreed that productivity and port reliability can be improved; therefore, more containers will be attracted. However, in practice, the result of additional security processes and requirements are probably more neutral than highly beneficial to the overall supply chain, efficiency, productivity and cost. This may be caused by local authorities and customs that lack of business awareness. Moreover, it is more difficult to achieve a better procedural arrangement in practice. As a result, the positive effects on productivity improvement would be less significant than the theoretical benefits claimed.

7.2 Delphi round two: statements reaching consensus level and comments

S3-The port environment generally has become increasingly competitive; it varies between regions and places. Ports and terminals no longer enjoy *de facto* monopolies. Ports need to compete for individual hinterlands and terminals need to compete with other operators within one port. According to prior studies, the components of port competitiveness are: port location, port facilities, overall efficiency, hinterland networks, value added logistics; and port services, safety handling of cargoes, confidence in port schedules, simplification of procedures, operational transparency, and port labour and skills. Among these factors, for EU ports, carriers will use a multitude of tangible criteria such as port efficiency and cost related elements which are still the most important competitiveness components. Port safety and security are considered as intangible criteria. These criteria are also important and ports/terminals as an absolute minimum need to match industry standards and best practices.

This statement achieved 100% agreement. Panellists stated that it is difficult to assign tangible value to security and safety. However, the minimum standards of security and safety need to be met regardless of the CSI. Adequate security and safety measures are a means to ensure benefits to ship operators, shippers and port/ terminals. As to ship operators and shippers, vessels and the cargo are protected and maintained at all times against theft and damage. Any port or terminal without adequate safety and security would stand at a huge disadvantage against rivals who are in full compliance.

S4.4-Although the US Customs and Border Protection stated that the CSI can bring benefits to linked ports, those benefits are still controversial. This programme transfers the container examinations from unloading ports in the US to the loading ports overseas. On the other hand, all the checks are carried out in the host countries which bear the equipment cost. Some research claims that CSI creates competitive disadvantages due to additional investment and running costs. However, in reality, all terminal/ port investment is surcharged to direct customers, with the costs ultimately being born by the Beneficial Cargo Owners (BCOs). The real burden falls to the BCOs, and ultimately to US importers/retailers and the end consumers. In fact, security regulation compliance such as ISPS has created new revenue streams.

This statement was agreed at 92.8% with no disagreement. Panellists agreed that the security measures have been looked on as a market benefit. It is cost-efficient to transfer the inspection to export ports outside the US due to their high labour cost. On the other hand, there are actually very few containers which are called for inspection in origin ports and those which are conducted are charged to the container operator and passed to shipper and end consumer as so far, no party in the supply chain incurs unrecoverable costs as a result of improved security.

S4.5-The CSI transfers the container examinations from unloading ports in the US to the loading ports overseas. Opponents argue that it would slow down loading port efficiency. However, from a security perspective, the best is to intercept suspect containers as early as possible in the logistics chain. Moreover, CSI is merely a documentation process in which terminals and ports are not directly involved. The process is driven by pre-shipment submission of cargo manifests, from which a few containers require non-obtrusive inspections, and very few of these need actual physical inspections.

This statement was agreed at 92.8% by panel members. All panellists agreed with the necessity of inspecting suspicious containers at the early stages of the supply chain and the CSI does not cause interruption. Panellists pointed out that the manifest needs to be submitted 24 hours before loading which is usually set as the expected date/time when a vessel starts to load intake cargo. Any request for inspection is immediate that will leave ample time for performing inspections. In practice, the number of inspections is a very small percentage, less than 1%. As to the cost side, experts have explained that extra cost will be transferred to shippers and end customers. Therefore, whether conduct the inspections at origin or destination, the results will be the same from cost and time perspectives. Additionally, inspecting containers at origin will prevent potential damage to the vessel caused by hazards. Members also advised that this solution is more applicable to large container ports rather than smaller ones due to their insufficient capability.

S4.6-CSI bilateral system of information exchange requires a host country to conduct a security check on containers shipping to a US port. In return, the host country can send its officers to any US port to target ocean-going containerised cargo being exported to their country. It is somewhat improbable that a security threat to a country originates from the US, so the reciprocal arrangement does not (today) really add a tangible value to others. Under this system, there can be sensitive information exchange, which is deemed necessary to ensure safety of any ports involved. The US could cease trading with the export ports if they refuse to provide information. Although the host countries may not be willing to offer any confidential information, most export nations depend upon trade with the US, so they freely cooperate in varying degrees.

This statement was agreed 100% by panel members. Experts agreed that information exchanging is vital for Euro-US maritime trade security whether the export ports are willing to provide the information. Under the circumstances that US is a major customer for European shippers, there is not much negotiation power as host countries. The disadvantage of sensitive information exchange can be overlooked by the benefits a better security and safe trade brings.

7.3 Delphi round three: statements reaching consensus level and comments

S4.2- A safe and secured maritime trade is an extremely important issue in shipping industry that cannot be overlooked. With better administrative processes and IT tools, container security inspection process can be facilitated without causing supply chain disruptions. The extra inspection time in export ports is insignificant compared to the total transportation.

This statement was agreed 100% by all panel experts. All experts agreed with the necessity of maritime security checks. They also pointed out that safety and security is ensured at multiple levels. The use of intelligence filtering through cargo declaration and manifest is the primary level and does not generate any significant additional costs or delays to the supply chain. Non-obtrusive cargo inspections using scanners is relatively fast to achieve when a consignment does not pass the initial checks. In the event that a consignment does not pass the scanning check, some significant costs could be created, potentially resulting in supply chain delays. Nevertheless, in practice, less than 0.1% of all consignments require a physical examination. For a shipper or ship owner, having security and safety checks performed at origin is far more useful than at destination.

S5-CSI compliance will not cause container port market distortion in Europe whether in short term or long term since there has been no evidence to show it causes financial burden or logistics disruption. Small ports will be affected by the changing market arises from liner network design which aims at lowering the overall transportation cost.

This statement was agreed at 92.8% by the panel experts. Most panellists agreed that the CSI will not cause port market distortion since the industry has matured over the past 20 years and no port has witnessed to decline due to maritime security and safety checks. It is the liner network design caused by mega ships and the aim of lowering overall transportation cost. Port call choice is based on primarily cost and secondarily demand volume. Financial burden and logistical disruption used to be the initial concerns when the CSI was introduced in 2002. Since the additional cost of the CSI compliance has been set off by the Container Security Fees, from the financial perspective there is no evidence to show that container ports have been significantly affected. What is more, the world over, terminals are moving out of cities and away from urban congestion that lead to liner network redesign. Examples can be found in Hamburg, Antwerp and Southampton. However, one expert stood against this statement. It was pointed out that the commencement of the "24-hour rule" which is in conjunction with the CSI alone has resulted in issues such as different time zones, tight documentation deadlines and questions over responsibility. It cannot be denied that operational and financial issues, whether they are significant or not, have affected container ports gradually. As long as there is a disruption caused by the CSI, there will be distortion in the EU container port market.

7.4 The revised model

The revised assumptions are presented in this section under the main four conceptual categories of maritime safety and security in container shipping.

7.4.1 Conceptual Category 1: The necessity of pursuing maritime security initiative

Original Assumption 1: It is necessary to carry out a maritime security initiative despite the fact that additional inspections may cause supply chain disruption and financial burden.

Revised Assumption: It is extremely necessary to carry out a maritime security initiative which needs to be linked to the entire supply chain in order to be effective. Moreover, the supply chain disruption and financial burden are very insignificant compared to the overall benefits derived from effective security measures.

7.4.2 Conceptual Category 2: Introduction of the CSI and its controversial influences

Original Assumption 2: The Container Security Initiative (CSI) can facilitate global container seaborne trade safety and security, adding competitiveness to CSI-affiliated ports.

Revised Assumption 2: The Container Security Initiative (CSI) has increased the level of awareness for the need to secure global trade dramatically and facilitate global container seaborne trade safety and security. However, there are no commercial or operational competitive advantages of any significance as a direct result of the CSI.

7.4.3 Conceptual Category 3: Determinants of EU container seaport competitiveness

Original Assumption 3: The EU container port industry is highly competitive. Port efficiency, service and cost related elements are still the most important competitiveness components.

Revised Assumption 3: The EU container seaport environment generally has become increasingly competitive. A multitude of tangible criteria that include efficiency and cost are the most important competitiveness components. Port safety and security, as intangible criteria, are an absolute minimum need to match industry standards and best practices.

7.4.4 Conceptual Category 4: Implications of introduction of the CSI on EU port competition

Original Assumption 4: CSI compliance does not cause global supply chain disruption or financial problems for the EU container ports.

Revised Assumption 4: The additional inspection process required by CSI compliance can be facilitated without causing supply chain disruptions. The compliance cost has been over-estimated and can be overlooked as it is minor in the overall supply chain. Furthermore, the security requirement has created a new revenue stream for EU export port.

Original Assumption 5: The introduction of the CSI does not cause small ports to lose market share. EU container port market competition is not disrupted by the CSI introduction.

Revised Assumption 5: There has been no evidence to show that maritime security initiatives such as CSI and ISPS cause EU container port or terminals lose their competitiveness. Small ports will be affected by the changing market arises from liner network design which aims at lowering the overall transportation cost.

Using the conceptual model in Chapter 4 and applied throughout the research, the following chapter presents the main findings of the literature review synthesis from Chapter 2 and 3, and the Delphi survey.

Chapter 8. Discussion of the Delphi research

The aim of this chapter is to discuss the findings from the secondary data collected in the literature review and the primary data from the Delphi survey. It starts with a discussion of quality criteria of this Delphi research and then gives a critical analysis of its implementation. The conceptual model will be discussed in this chapter to see if it has succeeded in capturing the complexities and relations among the variables identified in current maritime security area, namely maritime transport risk; maritime security regimes; implementation of the CSI and EU container seaport competition, integrating with the results of the Delphi study. The discussion will make specific consideration with the five conceptual assumptions developed in Chapter 4. This chapter also takes into consideration any changes that have happened in maritime security since this research started.

8.1 Establishing methodological rigour of Delphi method

According to von der Gracht (2008), quality criteria in Delphi should be considered to ensure a certain scientific standard. Reliability and validity are two criteria that usually examined (von der Gracht, 2008). However, Hasson and Heeney (2011) argued that only examining reliability and validity is not convincing enough for a Delphi research. The reasons include the lack of precise definition of Delphi, indeterminacy in panel formation, various consensus meanings and different types of Delphi (Hasson and Heeney, 2011). Qualitative research therefore needs to be evaluated in a qualitative manner, on the basis of trust and credibility (Corbin and Strauss, 2014). Therefore, Hasson and Keeney (2011) and Bryman and Bell (2011) discussed four more elements of trustworthiness for qualitative research, especially the Delphi technique, namely credibility, dependability, confirmability and transferability. Engels and Kennedy (2007) classified confirmability and dependability as auditability.

8.1.1 Reliability

Reliability refers to the accuracy of the actual measuring instrument or procedure (Neuman, 2011). It assesses if the instruments would generate the same results at different times (von der Gracht, 2008). For example, if the same respondent responds to the same questions in the same manner, the data can be considered as highly reliable (Punch, 2005). von der Gracht (2008) explained that Delphi results were reliable if the final statements would be reproduced by other group of panel members under equal condition. Drost (2011, p.108) mentioned several typical methods to test for reliability in behavioural research: *"test-retest reliability, alternative forms, split-halves, inter-rater reliability, and internal consistency"*. For the Delphi research, Hill and Fowles (1975) mentioned two approaches: the variation of internal procedures and the measurement across studies to compares the results of similar Delphi studies. The first approach has been used less frequently. As for the second approach, it is difficult to find two of the same studies for comparison. Researchers have agreed that standardisation and pretesting are two alternative approaches to guarantee the reliability of Delphi survey (Cottam, 2012). In relation to this research, the group size, the number of iterations, the design of the questionnaire and the contents of the questionnaire for round one were modified based on the four distinct phases of Linstone and Turoff (2002) (see Section 5.4.2) which have proven to be reliable over the years (von der Gracht, 2008). Moreover, Oksenberg *et al.* (1991) claim pretesting could be utilised to evaluate the statements and ascertain whether they form a cohesive and smoothly flowing questionnaire. Weak points were identified and improved by the pilot survey before the actual survey was sent out. Hence, the reliability of this Delphi survey is high.

8.1.2 Validity

Based on Wilson (1990), in order to demonstrate that the research is credible, validity has to be tested. Validity is concerned with the *“meaningfulness of research components”* (Drost, 2011, p.114). Validity has external and internal dimensions (Ritchie and Lewis, 2003). External validity refers to the degree to which the research outcomes can be generalised beyond the scope of the sample to the population (Ritchie and Lewis, 2003; von der Gracht, 2008). Internal validity is about the evidence of whether a researcher is measuring what should be measured (Sekaran, 2003). Validity should always be examined regarding the intended purpose of the measuring instrument since one instrument may be valid for one specific field but invalid for others. In relation to this research project that studied implications of the CSI for EU container port competition, a sufficient number of participants who have academic, industrial or administrative backgrounds were chosen and a three round Delphi survey was designed.

Three main forms of validity will be tested, based on Cottam (2012), namely: content validity, criterion validity and construct validity.

Content validity

Content validity measures the logical link between research questions and objectives (Kumar, 2010). It has three aspects: the completeness of the instrument, the balance of the issues being measured and the degree to which statements represent the issue they are supposed to measure (von der Gracht, 2008). The researcher is required to specify the content domain related to the topic and then select items related to the content domain (Rowe and Wright, 2011). In relation to this research, there are four domains of interests that are associated with the research topic: (1) the necessity of carrying out a maritime security initiative; (2) introduction of the CSI and its controversial influences; (3) determinants of EU container port competitiveness; (4) the implications of the CSI for EU container seaport competition. According to Mitchell (1996) and Saunders *et al*. (2007), the three aspects of content validity could be assessed by a comprehensive literature view and expert interview. In relation to this research, a series of steps have been done to ensure content validity to the Delphi method. First of all, a comprehensive literature review associated with the major domains was carried out to specify whether the domain of the content is relevant to the Delphi method. The literature started with developing a good understanding of the history and development of maritime security, including risk factors in seaborne trade and the vulnerability of container shipping. Next, the literature focused on current supply chain and maritime security measures, including the CSI. In addition, a coherent set of arguments on the current and potential implications of maritime security measures for port productivity and financing was formed. Moreover, certain key components of port competitiveness were studied and selected for the Delphi survey. Content validity was also assessed through subjective judgement in the means of the Delphi survey pilot study (Bryman, 2012). In the pilot study, experts were asked to comment on the questionnaire presented to them, and to judge the appropriateness and give feedback on the instrument regarding ambiguities, length, and completeness, and if it raised their interest (Bryman, 2012).

Criterion Validity

Criterion validity is an indicator to measure to what extent the future events are logically related to a construct (Creswell, 2014). It includes concurrent and predictive validity. Concurrent can be determined by how well a measurement compares with another assessment concurrently done (Kumar, 2010). Predictive validity is judged by with the usefulness of the instrument to forecast the outcomes (Kumar, 2010). The aim of this research is to find out the implications of the CSI for EU container port competition, using the Delphi survey. Certain criteria such as port efficiency and port charges have been selected to investigate the changes of port competition. However, this is not to predict how the criteria might have changed before and after the implementation of the CSI. Moreover, the findings of such a study would be subjective and empirical. Therefore, criterion validity does not apply to this research.

Construct validity

von de Gracht (2008, p.65) defined construct validity as "*the extent to which the items actually measure the presence of those constructs intended to measure*". The concept developed in this research is that the implementation of maritime security initiatives would have certain effects on port such as efficiency and financing. Furthermore, these effects could have caused a distortion in container port competition. Several conceptual assumptions were set up based on this concept. In order to test the validity of this concept, the Delphi method has been selected to collect the appropriate data and analyse the data. The validity of the concept will be supported by at least one piece of evidence if the assumptions are accepted (Cottam, 2012). The degree to which the theory investigated in this study is consistent with extant theories also provides an assessment of the validity of the construct (Cottam, 2012).

8.1.3 Qualitative research trustworthiness elements

Hasson and Heeney (2011) stated that the Delphi technique contains both positivist/quantitative and interpretative/qualitative traits, therefore, the trustworthiness criteria are more appropriate for enhancing the rigour of the Delphi. As Section 8.1 mentioned, four elements of trustworthiness were mentioned by both Hasson and Heeney (2011) and Bryman and Bell (2011).

Credibility

Credibility relates to whether the data is believable and if the research is carried out based on good research practice (Bryman and Bell, 2011). Regarding to the Delphi, according to Engels and Kennedy (2007), the centre of credibility is member check. Therefore, the researcher can carry out continued iteration and provide feedbacks to the panellists between each round to ensure the Delphi findings match the realities of the participants (Engels and Kennedy, 2007). Engels and Kenney (2007) also discussed several practicable guidelines utilised by other researchers to enhance the credibility: (1) bias free panel selection and selective dropout; (2) stimulate panellists' commitments and obtain qualitative information in the first round; (3) conduct individual interviews or open-ended questions in the first round; (4) face-to-face meetings with potential participants prior to the formal Delphi; and (5) pilot study comprising individual interviews with potential panel members.

In terms of this Delphi research, the credibility is enhanced in four ways, as Engels and Kenney (2007) suggested. First of all, the panel is comprised of three groups with different backgrounds. The number of invited participants in each group is almost even (see Table 8.1 on p.237). The selection process is non-bias and the term 'experts' is the criterion for panel selection, regardless of gender, age and race. The panellists include both knowledgeable academics and practitioners who have expertise and interests in maritime security practice. Given that this research focus on US-Euro container movement and security, experts whose interests and expertise are close to US-Euro container trade were invited. The participants were offered selective drop out by clicking an opt out link in the invitation letter (see Appendix 1). Secondly, the panel member stayed committed through three rounds and rich qualitative information were obtained, especially in round one. As Table 8.1 shows, only three experts dropped out through three rounds and the 17% overall response rate is higher than average Delphi return rate (Cottam, 2012). Invitation letters with comprehensive explanation of this research and gentle reminders were sent out between each round to keep participants engaged and control time span. The design of the first round statements also helped to stimulate participant's arguments. In addition, the open-ended question (see Appendix 6) encouraged the experts to provide as much information as possible. Thirdly, a pilot Delphi was conducted to ensure not only the reliability but also the credibility. Last but not least, according to Engels and Kennedy (2007) and Dinwoodie *et al.* (2014), iteration occurred when the results of the first round were fed back to participants before the second round (see Appendix 6). The member checks were completed in this way.

Transferability

Transferability is also called applicability (Engels and Kennedy, 2007). It is comparable to the external validity in quantitative research, and it refers to the fittingness of the research findings in real life (Hasson *et al.,* 2000; Engels and Kennedy, 2007). In terms of this Delphi, the transferability is established since the research findings are applicable in real life. First of all, this research aims to analyse a particular industrial initiative and its impacts on EU port industry. The Delphi statements that contained established theories and historical data were designed for this aim. Furthermore, the Delphi panel includes administrative experts and industrial practitioners and the opinions from them were based on their real-life experience and knowledge. The panel members were also encouraged to give solutions to the issues discovered. The applicability of the findings is ensured.

Auditability: Dependability and confirmability

Engels and Kennedy (2007) explained that auditability refers to the adequacy of the inquiry process and includes dependability and confirmability. Dependability can be achieved by including a range of representative experts in the Delphi panel (Cornick, 2006). The considerations of wide range of expert background, panel size and selection process have been discussed in Section 5.4.3. To make sure the representativeness of the panel member, the initial Delphi panel included 83 experts with academic, industrial and administrative backgrounds and the number of experts in each category is similar. Although there were 14 experts completed all three rounds, experts in each category contributed sufficient information in each round. Engels and Kennedy (2007) argued that the Delphi process needs to be sufficiently documented and tracked throughout to enhance the dependability. This Delphi research followed the process suggested by Fowles (1978) and Linstone and Turoff (2002) (see Figure 5.2 on p.147). Moreover, each step of the Delphi research has been recorded and stays trackable on the Qualtrics. Therefore, the dependability is ensured. Confirmability requires *"all the findings can be traced back to their original* *sources"* (Engels and Kennedy, 2007, p.436). Regarding to this Delphi, as Chapter 6 and Chapter 7 presented, the clear record of the selection of panel member, contacts of participants, identification of the consensus level, the construction of the Delphi statements and the administration of each round accords with the practices suggested by Engels and Kennedy (2007). Hence, the confirmability is enhanced.

8.2 Critical analysis of the implementation of Delphi

8.2.1Justification of panel size and response rates

As was discussed in Section 5.4.3, there is no definitive optimal number of participants in a Delphi study (Marchais-Roubelat and Roubelat, 2011). Hasson *et al.* (2000) argued that a larger sample size will generate greater data, which in turn influences the amount of data analysis. According to Witkin and Altschuld (1995), the approximate size of a Delphi panel generally ranges from 20 to 50. Some studies employed over 60 participants to gather representative information (Alexander and Kroposki, 1999), whilst others included as few as 15 participants (Fiander and Burns, 1998). Ludwig (1997) reported that the panel size for majority of Delphi studies are between 15 and 20. Therefore, the size of a Delphi panel is variable (Delbecq *et al.*, 1975). According to Hsu and Sandford (2007), for a Delphi study with a very small sample size, the information contributed by the participants is not considered as representative judgments regarding the topic. However, a large sample size often comes with the problems of *"potentially low response rates and the obligation of large blocks of time by the respondents and the researcher(s)"* (Hsu and Sandford, 2007, p.4). Debecq *et al.* (1975) proposed to employ the minimally sufficient number of respondents. According to Ludwig (1997), a group size of 13 had a correlation coefficient approaching 0.9 for its reliability.

Hasson *et al*. (2000) mentioned that in addition to the panel size, representativeness of participants also affects the Delphi result. This Delphi panel consisted of three groups of experts with different backgrounds to give a good representativeness of opinions. Hence, in consideration of the above discussion, the 14 experts who participated in all three rounds of Delphi made the panel size acceptable. The small number can be explained and interpreted in two ways. First of all, there were only 17 out of 83 experts who responded and completed the Delphi round one. The research topic of the EU container seaport competition and the sensitive topic of maritime security limited the number of potential participants. Experts should have the expertise in both EU port competition and the security requirements of trans-Atlantic seaborne trade. Some of the contacted participants did not consider themselves as an expert in the field; therefore, they did not agree to take part in. Out of the three categories of Delphi panel, academics formed the largest category since they have more intention of contributing on academic research than the industrial experts and administrative professionals. The non-academics are more actively engaged in business-related activities and less willing to express their opinions on a controversial security topic which the US government is involved. Furthermore, industrial experts are conservative in the data which tends to be business confidential and administrative professionals are unwilling to reveal the true intention behind a policy. Secondly, the time span of three round Delphi was10 months that included Christmas and Easter. Many of the panel members were having a quite busy schedule or the time span of the survey did not fit their schedule. Their momentum and interests in the survey would go down as time went. Based on Hasson and Keeney (2011), participants who rate themselves as less-expert are more likely to exhibit over Delphi rounds than self-rated experts. As the statements became more specific and in depth, some experts may find their knowledge is insufficient to contribute to the survey. Therefore, they departed from the panel.

For a Delphi study, Hasson and Keeney (2011) stated that the overall difference between the number of potential participants contacted and the number of actual participants who complete all rounds was another accurate measure of the response rate. Table 8.1 shows the response rates for Delphi three rounds and the change of three categories among each round.

Overall response rates: Delphi study (three rounds)								
Panel	**No. of participants contacted**	**Round one**		**Round two**		**Round Three**		
		No.	%of contacted	No.	%of round one	No.	%of round two	%of contacted
Academics	30	10	33.3	8	80	8	100	27
Industry-users	25	4	16	4	100	4	100	16
Administrative	28	3	11	2	66.7	2	100	7
Total	**83**	**17**	**21%**	**14**	**82.4%**	**14**	**100%**	**17%**

Table 8.1 Delphi three rounds response rates
Source: the author (2016)

Based on Table 8.1, of the initial 83 potential participants contacted, 17 agreed and completed the survey, representing 21% of the total potential participants that were contacted to join the survey. Of the 17 participants that completed round one, 14 went on to round two and completed it, representing 82.4% of the round one participants. From here, all the 14 experts went on the Delphi round three and completed the survey, thus representing 100% of the round two participants. 82.4% and 100% response rate are higher than the 70% response rate suggested by Sumsion (1998) for each round in order to main the rigour of Delphi technique. What is more, 14 panel members went on to complete all three rounds of the Delphi survey, representing 17% of the total potential participants contacted for the research. According to Cottam (2012), the 17% overall response rate is high, comparing to the average Delphi return rate. The response rate for each round and the return rate are both above suggested rate, thereby, the rigour of this Delphi study is maintained.

8.2.2 Advantages of the Delphi study

One notable advantage of applying Delphi technique to this research subject is inclusiveness. A wide range of responses from different stakeholders and professions were gathered and a wide range of views were successfully accommodated. Another advantage is comprehensiveness. The importance of building a comprehensive understanding of the CSI implementation and its implication for the EU port industry is critical to this research. The Delphi technique was considered as a unique approach to gather a holistic response from panel members, therefore, a variety of opinions regarding maritime security regime compliance and its influences were collected. Furthermore, the Delphi method provides a means for prioritisation of key components of EU container seaport competitiveness and how they are affected by the CSI.

8.2.3 Drawbacks of the Delphi survey

A main disadvantage raised during the Delphi survey is that a small number of participants sought for group discussion and dialogue regarding their different viewpoints on one issue. Due to the varying backgrounds of multiple stakeholders and their different understanding of research topic, some participants felt the isolated process of completing questionnaires did not allow them to react and discuss on the grey areas of the study. Participants would have welcomed a seminar or face-to-face meeting to discuss the theoretical and practical context that could lead to a deeper understanding and outcomes.

8.3 The necessity of pursuing maritime security initiative

With no doubt, in the post-9/11 trade environment, the threat posed by seaborne trade can never be overlooked. Making use of shipping networks, terrorists could launch a nuclear attack or other forms of mass destruction attack. Many sea-ports are situated closely to highly populated urban areas, which makes the delivery of a weapon of mass destruction both a reality and a risk. Among the five major risk factors identified by OECD (2003) (see Figure 2.1 on p.40), cargo ships, especially container ships, have caused significant security challenges. Cargo ships, together with vessels, people, financing and logistics support, have been targeted and addressed by a series of compulsory and voluntary maritime security measures.

8.3.1 The negativities of maritime security measures revealed in the literature review

With the introduction of several maritime security measures, industry criticism started to get intense (WSC, 2007; Bennett and Chin, 2008; Miller, 2007). The literature review revealed claims that maritime security measures such as the ISPS, would hamper international trade and impact negatively on the business results of ports and terminals (Thai, 2009) (Section 2.3). Two major reasons behind that were costly security inspections and potential congestions and delays added up in the global supply chain (Bennett and Chin, 2008). A variety of ex-ante and ex-post cost assessment on the ISPS compliance were conducted to express concerns over the capital cost of scanning equipment installment and running cost placed heavy burden on ports and terminals (Table 2.10 on p.73). As to the container scanning required by the US, analysts believed that each port would have to purchase 1 to 10 scanners and the average initialisation cost for one port to be about US$100 million, which was too large to be justifiable for some smaller ports (Miller, 2007). In addition to cost burdens, possible delay and port congestion caused by additional security inspection also drew the industry's attention. Various arguments were presented in Section 2.3.2.

8.3.2 Maritime security measures current implementation

The Delphi results confirmed the necessity of implementing security measures in the shipping industry and suggested that security is the definite aspect that needs to be insured throughout the entire supply chain. Experts pointed out that aviation security has been strengthened but ports have not received the same scrutiny and still remain vulnerable to what could be a devastating attack. Therefore, security can never be overlooked compared with costs and efficiency. In addition, the Delphi results provided a different viewpoint from what the literature review suggested in terms of compliance cost issue and supply chain disruption. The Delphi research suggested that over the past few years, the cost estimation and supply chain disruption have been over estimated and exaggerated.

Over-estimation of supply chain disruption

First of all, most criticism focused on the 100% container scanning proposed by the US. The origin deadline of full implementation globally was 2012. However, the DHS had delayed the implementation of the scanning requirement three times and the deadline has been extended to 2018 (Congressional Budget Office, 2016). The industry group, as well as all foreign government voiced opposition of the requirement, urging US Congress to repeal scanning requirement altogether due to the huge expense, inadequate global infrastructure and prohibitive trade volume. The DHS is advised to focus on practical supply chain security solutions and stick to the risk-based strategy such as the CSI rather than the impractical scanning provision which would bring logistical, financial, jurisdictional, diplomatic, economic and technological challenges. Furthermore, increasing scanning rate does not necessarily reduce potential smuggling of nuclear weapons or materials into the US since the option does not address other paths such as truck and rail at land crossings from Mexico or Canada (Congressional Budget Office, 2016). In fact, terrorists may choose those alternative paths if the US sharply reinforced container scanning. Up to the time of this research, the 100% scanning is still precluded. The port of Qasim in Pakistan is the only port around the world where 100% scanning is conducted under the SFI. This programme is only feasible because of the low volumes from Qasim to the US, little logistical challenges, and strong support from a Pakistani government interested in maintaining trade with the US, (American Shipper, 2014).

The queuing model created to oppose container screening and scanning (see Section 2.3.2) assumed that container was scanned at US ports of entry whereas most maritime security measures require container scanning is conducted at point of loading overseas in practice. Non-obtrusive inspections such as scanners are high efficiency in detecting risks in suspected containers. In practical operations, container can pass through scanners as fast as 60 seconds/TEU which is much quicker than 3 minute/TEU under the assumption of Martonosi *et al*. (2005). Also, under current CBP's multi-layered defence system (see Figure 2.3 on p.50), only a few containers go through physical inspection without causing port/terminal congestions. The inspection rate is as low as 1% and has already caused the Congress to question the effectiveness of the programme (American Shipper, 2014).

Compliance costs recuperation

Ensuring nation's security and preventing from terrorism attack should fall in to the scope of government duty. Scanning services are not mandatory to comply with the ISPS. How the capital and human resource investments could be borne depends on the nature of the port (Section 2.3.1). The way in which these costs are covered depends on the body (i.e. port management, national customs authorities, and terminal operators) that took on the initial capital cost (Allen, 2006). This has direct implications for the surcharges or fees that are passed onto exporters. In practice, government is responsible for purchasing and providing scanning equipment instead of ports and terminals. For example, the port authority of Buenos Aires established a budget for purchasing, installing four container scanners and upgrading existing infrastructure (Ceriotto, 2004) (Section 2.3.1). Ports and terminals are unlikely to bear huge costs due to ISPS compliance. It has been pointed out by the industry that the real cost burden falls to the Beneficial Cargo Owners (BCO) and ultimately to importers/retailers and end consumers. To cover the investment, a security fee per container is applied by the terminal to the carrier, which is passed on to the shipper and ultimately retailer and consumer. The new surcharges in many ports/terminals way exceed the actual investments made. Therefore, on the contrary to the concept of cost burden, security measures compliance actually generates additional revenues. This Delphi result provides empirical evidence to the argument of Thai (2007) who mentioned security compliance could generate additional revenue for ports (see Section 4.1.2). No port or terminal bears the so-called 'heavy burden' estimated by various researches and the investment is nowhere close to US$100million which was proposed by Miller (2007). From the perspective of Return on Invested Capital (ROIC), the Delphi industrial experts confirmed that ports and terminals still remain the most profitable players within the end-to-end supply chain.

Security measures compliance in practice

After 9/11, tightening of security was naturally a high priority. Ports and vessels have since commenced needs to regulate access through perimeter deterrents such as fencing, CCTV, patrols, alarms, and scanning devices. Likewise, for security (and also safety) the persons within a terminal or port need to be authorised persons only. Stowaway on ships has been a recurring problem for decades, and also needs to be combatted. Therefore, security has always been a requirement, however practiced to differing levels of quality between ports, countries and continents. Each entity chooses the most affordable adequate technological enhancements, according to its own specific cost-benefit analysis. The ISPS guidelines/regulations which standardised the approach to security post 9/11 are in fact no more than common-sense solutions which should have already largely been in place for other purposes. For instance, the ISPS Code does not require CCTV or biometrics, but recommends fencing, access control and appropriate lighting of the facility (Donner and Kruk, 2009). The new regulations formalised what constitutes a secure area and what is required to achieve that. On the basis that the container supply chain has never been disrupted by terrorism, the measures implemented need to be considered as successful and appropriate. As to the compromise between security, cost and efficiency, if any is very insignificant compared to the overall benefits derived from them, which go way beyond merely US anti-terrorism initiatives.

8.4 Determinants of EU container seaport competitiveness

The literature review pointed out the port environment generally has become increasingly competitive globally. It is difficult to give an unequivocal definition of port competition since it involves multiple stakeholders with conflicting interests. Van de Voorde and Winkelmans (2002, p.11) explained port competition is influenced by (Section 3.1): *"(1) specific demand from consumers, (2) specific factors of production, (3) supporting industries connected with each operator, and (4) the specific competencies of each operator and their rivals. Finally, port competition is also affected by port authorities and other public bodies* ". Following three levels of container port competition suggested by Van de Voorde and Winkelmans (2002), this thesis focuses on the inter-port competition that can be played out at the national and regional levels or different ports located in different port ranges.

8.4.1 Port competitiveness determinants identified by the literature review

Much port competitiveness analysis studied port selection criteria. The literature reviewed (Section 3.3) reveals a wide range of influential factors of port choice and port competition. Monetary costs (port charges/surcharges/promotion), port efficiency (see Section 3.3.3), service-related factors (service quality) (see Section 3.2 and 3.3.4), as well as geographic location were identified by Yeo (2007), De Martino and Morvillo (2008) and Parola *et al.* (2017) and discussed in existing literature as the most important port competitiveness determinants (Section 3.3.2). Port safety and security, as one of the software components which is related to service quality, is considered as one influential drivers of port competitiveness (Section 3.3.2). Lehtinen and Lehtinen (1991) and Pantouvakis (2006) also suggested port security is part of port service factors (Section 3.3.4). Tongzon and Heng (2005, p.408) suggested *"port (terminal) operation efficiency level, port cargo handling charges, reliability, port selection preferences of carriers and shippers, the depth of the navigation channel, adaptability to the changing market environment, landside accessibility and product differentiation"* as key factors that affect port competitive position. In addition, certain other port related issues such as port policy and management identified by Yeo (2007) would indirectly or directly affect port competitiveness (Section 3.3.5). The literature review also suggested port competitiveness varies between regions and places, affected by how these influential forces influence on the nature of the port environment (Tongzon and Heng, 2005) (Section 3.3.1). Research focused on regional port competition has been undertaken by several researchers (Section 3.3.1) (Kim, 1993; Jeon *et al.*, 1993; Fleming and Baird, 1999; Fung, 2001; Huybrechts *et al*., 2002; Tiwari *et al*., 2003; Song and Yeo, 2004).

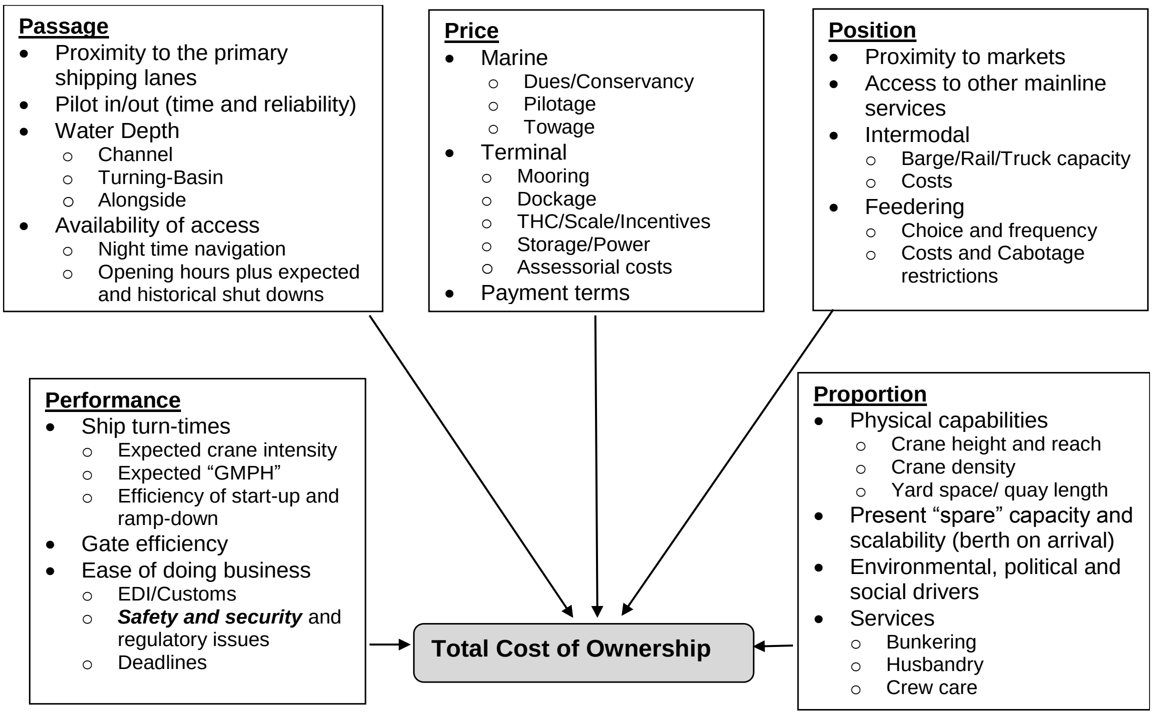
8.4.2 EU container seaport competition and influential factors suggested by the Delphi results

The Delphi survey claimed that the features of containerisation make the container seaport selection a routing choice. The industrial experts suggested that the inter-port competition and the market share of container ports are affected by the routing option for a container flow. *"The growth in the number of intermodal transfer points on the land side, at the sea–land interface in the* *seaports and at the connecting points of liner services in transhipment ports leads to an increasing number of routing options for a container flow between two regions somewhere on the globe"* (Veldman and Buckmann, 2003, p.3). A container seaport is considered as a node in a container routing network. When making the port choice, shippers, forwarders, shipping companies and terminal operators are the major decision makers. Some researchers indicated port authorities and government agencies as affecting port choice of those actors (Aronietis *et al*., 2010). The competitive position and port choice of a container seaport is determined by its competitive offering to the host of shippers and carriers (Notteboom and Yap, 2012).

According to the Delphi results, historically, there has been little competition between container seaport and terminals in Europe. Seaports enjoyed defacto monopolies and never needed to compete. The competition among ports and terminals is becoming increasingly intense, based on the literature review (see Section 3.2) and the Delphi results. At present and in the future, Europe will be served by varying combinations of *"deep-sea shipping lines, seaports and modes of land transport"* (Veldman and Buckmann, 2003, p.4). From a port's perspective, there are great overlaps between the hinterlands of container ports in the EU (Veldman and Buckmann, 2003). For example, the North Sea ports in the Hamburg-Le Havre range also handle the major container flows to and from the West Europe. Competition exists among the ports of Hamburg, Bremen, Rotterdam, Antwerp and Le Harve. UK imports and exports used to be served through Felixstowe and Southampton and now also through London Gateway and Liverpool. Further, within ports several terminal operators also compete with each other. Rotterdam, as one of the busiest container seaport in the EU, has transformed from relying heavily (80%) on ECT Delta Terminal to decentralise the container flow over APM Terminals, ECT Delta Terminal, and DP World Terminals. Therefore, it is essential for ports and terminals to improve their attractiveness and adapt with current competition environment to prevent themselves from suffering profit losses and ultimately existing the industry.

8.4.3 ‘5P’ model suggested by the Delphi for port selection

It is suggested by the Delphi research that for EU container ports/terminals, carriers and to an extent shippers will use a multitude of tangible criteria (physical facility) to select the best ports and terminals for their shipping networks. In addition, numerous intangible criteria are becoming more evident. The Delphi experts suggested a '5P' model (passage, price, performance, position, proportion) developed by the EU container seaport industry (Figure 8.1).



THC: Terminal handling cost GMPH: Gantry moves per hour
Figure 8.1 5P port/terminal selection model
Source: the author 2016 adapted from the Delphi research (2016)

Cost factors and efficiency remain as the major determinants of port competitiveness, which is consistent with the literature review in Section 3.3.2. Port/terminal position which includes proximity to markets, access to other mainline service, inter-model service and feedering is another tangible criterion. In addition to ship turn-times and gate efficiency, safety and security are also considered as port/terminal performance criteria.

Port security and safety as port selection intangible criteria

The Delphi research stated that security regulations and initiatives can improve port security and service quality. This can be explained based on what has been discussed in Section 3.3.4. Chang and Thai (2016) stated service quality was an important element for port competitiveness as it improves customer satisfaction, which in turn may positively influence customer loyalty. Security can be seen as part of the quality of service (Lehtinen and Lehtinen, 1991; Pantouvakis, 2006) (see Section 3.3.4), as well as software driver (De Martino and Morvillo, 2008) (see Section 3.3.2). The competitive nature of the shipping industry challenges port industry to increase the maritime container security. Delphi experts suggested that service providers within the supply chain such as carriers, ports and terminals compete on not only price and efficiency but also security and safety. These aspects fall within the category of software components mentioned by De Martino and Morvillo (2008) (see Section 3.3.2). These service providers serve their customers at a desired level through utilising various combinations of production factors. Company that provides higher security levels than their rivals may raise their prices or cut their other existing services, facing the distinct risk of losing customers to their rivals. Therefore, the principle is a trade-off among key determinants which have impacts on customer choice. An over-emphasis on any production factors could result in losing competitiveness. Hence, according to the Delphi results, adequate security and safety measures are a means to ensure benefits to carriers, shippers and port/terminals. Improving maritime security positively affects service quality, including *“reliability of service, social responsibility awareness, efficiency in operations and management, and image in the market”* (Chang and Thai, 2016, p.724). Any port or terminal without adequate safety and security would stand at a huge disadvantage against rivals who fully meet standards, based on Delphi experts. The Delphi results also suggested that security cannot be separated from the overall business. Port security should be conducted more than a reaction to legal and social regulations. Instead, security should be closely integrated and incorporated into business practices since an enhanced security is part of the service customers seeking from ports.

8.5 The Container Security Initiative (CSI) and its controversial influences

Details of the CSI and the 24-hour rule which is a primary aspect of the CSI were given in Section 2.1.4, including the background, aim, arrangements (see Table 2.5 on p.58) and the minimum standard for participation (see Table 2.6 on p.60). The CSI is to identify and inspect all containers that posing a potential terrorism risk at foreign ports before loading on vessels imported to the US. As discussed in Section 2.2.4, CSI Phase I (see Table 2.7 on p.61) included 9 EU container ports. The number of these EU ports accounts for 45% of the total global initial 'megaports'. During Phase II (see Table 2.8 on p.63), another 12 EU ports joined the programme, which takes percentage of 52% of the total 23 Phase II ports. Currently, the CSI is under Phase III and 58 ports have joined this programme, including North Central, and South America the Caribbean, Europe, Africa, the Middle East, and throughout Asia. The participating ports account for 85% of container traffic destined to the US. There have been 23 EU ports that have joined the CSI that account for 40% of the total 58 CSI ports worldwide and take more percentage in the total global CSI ports than Americas, Caribbean, Asian and African based on number of participation.

Advanced information approach under the 24-hour rule amplifies the importance of ensuring security and safety throughout the entire global supply chain (Section 2.2.3). Under the current global safe situation, any node or link within a supply chain could pose severe terrorism threat to the world. Both the literature review and the Delphi results suggested that using intelligence and automated advance targeting information, and pre-screening at the loading points to identify risks is much more efficient than traditional inspection at the unloading point.

8.5.1 Improvement of security awareness

It has been confirmed by both the literature review and the Delphi study that ever since the implementation of the CSI in 2002, the level of awareness for the need to secure global trade has been increased dramatically. Although, CSI's initial purpose was to protect the US border, it has participated in developing a world standard. It adds protection for the seaborne trade that the worldwide economy depends. Through international collaboration between Customs, the capabilities and the overall effectiveness of the targeting process could be improved. The CSI also brings some significant business benefits. For example, the compliance companies could improve inventory control and reduce administration costs, utilising global logistics management software and other advanced information systems. On the basis that the container supply chain has not encountered disruption by terrorism, the measures implemented should be considered as successful and appropriate for its initial purpose.

8.5.2 Container Security Initiative collaborative networking and existing issues

According to Section 2.2.5, a collaborative network was formed under CSI bilateral arrangement, including intelligence sharing and reciprocal service system. As Haynes et al. (2011) noted, modern states could engage in more intensive cooperation to regulate behaviours over varying issues (Section 3.4). In the case of container security, this cooperation between Customs under the CSI has been effective. The following sessions will discuss the rationale for intelligence sharing and existing issues under such a collaborative network based on the literature review and the Delphi survey.

The rationale of information sharing for the CSI

The literature review and Delphi study stated that current US layered maritime security strategies (Figure 2.3 on p.50) are based on a risk-based security management process. Thai (2009) noted that in order to achieve an effective risk-based security management, three phases must be considered: identifying all possible threat scenarios, characterising each scenario and using gained information to adjust the planned risk management controls. Communication and consultation with internal and external stakeholders in maritime transport industry is the key to the integrated process. It is also believed by the Delphi experts that security information collected and analysed from multiple sources is always better than from a single source (Statement 4.6). Hence, information sharing and exchange runs through the risk-based security management process. Moreover, clear and accountable information should be continuously provided and updated in order to keep security management up with changing security threats and their likelihood of occurrence, and hence, be valid and effective (Thai, 2009).

According to the Delphi study, effective security should be prevention from the source rather than inspection. High inspection rate does not necessarily improve security level and mitigate all risks. In the maritime area, if security is equivalent to final inspection, it has to rely on shipment inspections down the chain at destination ports, which has been proved to be highly costly and inefficient. Prevention from the source philosophy which directs the CSI overseas inspection and advanced manifest is key to ensure security is designed and incorporated right from the beginning of the logistics chain, thereby making everything right the first time. Briefly, effective information lays the foundation for a proactive and cost-effective security measure.

The issues of inequity under CSI bilateral arrangement

Concerns in terms of competition distortion, sensitive information exchange and sovereignty issues under the collaborative network were mentioned by several researches (Section 2.2.5). According to the Delphi research, although the competition distortion mentioned caused by the CSI has not emerged, the sovereignty and administration issue and challenges regarding information sharing were brought up by the panel experts when commented on Statement 4.6.

Challenges posed by intelligence sharing

Information sharing has posed challenges not only on host countries but also on US federal and non-federal stakeholders. Caldwell (2007) summarised several challenges US port security stakeholders encountered, including: obtaining security clearances for port security stakeholders, creating effective working relationships, potential overlapping responsibilities and determining relationships among various centres. Two particular issues brought up by the Delphi expert are the sensitive information sharing and the unbalanced information sharing between host countries and the US government.

Information sharing is the basic requirement of all three regimes (C-TPAT, 24-hour rule and CSI). Countries who are maritime trading partners with the US have concerns over confidentiality of information they provided. Under the CSI, port authorities of host countries must commit to share critical data, intelligence on potential security threats from within the country, and risk management information with the US Customs agents (Allen, 2006). For instance, advanced manifest information is required by the 24-hour rule under the CSI and US company's supply chain information which includes suppliers/manufacturers, freight forwarders, sea and land carriers, and warehouse operators are needed for C-TPAT certification (Allen, 2006). Although the host countries are not willing to share intelligence which may include confidential business, most export nations depend upon trade with the US, so they have to freely cooperate in varying degrees. In fact, the Delphi experts explained that there is not much negotiation power as the host countries since the US could cease trading with the export ports if they refuse to provide information. The host countries' weak positions in this relationship also lead to the unbalanced information sharing.

The Delphi experts, especially the industrial experts, criticised that US government is more 'taking' than 'sharing' in practice.

Despite the issues mentioned above, the Delphi results still suggested security information sharing adds huge value overall. Industrial stakeholders, including local port authorities and representatives of private companies all agreed that the information sharing has increased their awareness for enhancing security at port and allowed them to identify and handle security issues at their facilities. As to national level of maritime security stakeholders, information sharing has helped to reduce and mitigate risks without a doubt. National level departments and agencies also reply on information sharing to identify maritime threat and carry out dissemination efforts to support tactical and operational maritime security.

Sovereignty and administration problem

Sovereignty and administration problem caused by the US jurisdiction outreach have been observed and brought up by the Delphi experts when they commented on the open-ended question (Q13 in Section 5.6). One key element of the CSI is transferring the container examinations from unloading ports in the US to the loading ports overseas. From the industrial perspective solely, it promotes and facilitate security and safety throughout the supply chain efficiently. However, based on the Delphi survey, the pushing out of the US first line of defence and the cooperation between nations claimed by the CBP have triggered stakeholders to suspect the possible unilateralism underneath it. Based on the discussion in Section 2.2.5, the CSI allows US Customs to screen containers at CSI-designated foreign seaports and place a CSI team overseas to identify high-risk containers prior to their arrival at US ports. This 'outsource' made the scope of the programme truly ambitious and costly (Allen, 2006). The purpose behind this 'outsource' can be related to the US National Security Strategy by Bush Administration and the so-called 'self-defence' military action towards Afghanistan after 9/11 (Metaparti, 2010). According to the 'Defense Guidance Strategy' white paper of 1992, the Pentagon-favoured 'no rivals' doctrine pictured US foreign policy as being driven by eliminating all potential challengers to US global hegemony (Bove *et al.,* 2014). On 20th September 2001, the Bush administration announced a change of his direction of foreign policy to terrorism focused. However, the Afghanistan and the Iraqi invasion have revealed US was still implementing the 'no-rivals' doctrine. Combating terrorism provided a reasonable excuse for taking control over the oil reserves. International security is highly politicised and therefore less transparent. The requirements of US maritime security regimes such as the CSI and the C-TPAT are actually dominated from their 'no-rivals' doctrine. Phase I of the CSI was conducted in the top 20 international 'megaports' which must have *"regular, direct and substantial container traffic*" (CBP, 2003a, n.p.). In 2001, approximately 66% of all containers that arrived in US seaports originate from these ‘mega ports’ which are located in 14 nations, including Halifax, Rotterdam, Le Havre, Hamburg, Antwerp, Singapore and Hong Kong, Felixstowe, Genoa, Pusan, Algeciras, Tokyo, Shanghai and Shenzhen, among others (Allen, 2006). Phase II extended to the 'middle-income' developing countries. Phase III included more ports in 'middle income' developed countries and theoretically 100% of the containers enter the US would one day be screened (Allen, 2006). That implies that the US will ultimately allocate their officials to every port overseas that ship containers to the US. According to the CBP (2003b), in the short to medium run, this policy would have significant impacts to specific players in international shipping and trade, and created more obstacles for developing country export-oriented sectors to access the US market.

Furthermore, Maritime Transportation Security Act (MTSA) developed by the US required the Coast Guard to help assess foreign port's security measures under the International Port Security Programme. Under this programme, the Coast Guard makes visits to the ports of foreign nations and review security measures implementation with host nations in the host nation ports against established security standards, such as the ISPS Code. Annual visits are also made to host countries to obtain additional observations on implementation. By April 2007, 86 out of 140 countries who are US maritime trading partners have been visited under this programme (Caldwell, 2007). Notwithstanding host countries can make reciprocal visits to US ports, the Coast Guard have occasionally encountered initial reluctance by some countries due to their concerns over sovereignty. As a matter of fact, the Delphi survey, especially the EU port industrial experts, confirmed there are extraterritorial control actions by US CSI teams at foreign ports, such as controlling non-US inbound containers inspection.

As the world's biggest trading nation and consumer market, shipping is vital to US economy as it moves roughly 75% of the trading goods (Thibault *et al.,* 2006). However, although the US has enacted The Jones Act, 90% of US imports and exports are carried by foreign maritime operators (Thibault *et al.,* 2006). The US has no jurisdiction over foreign companies, cargo, or vessels until they reach US waters. Key business information of exporters, suppliers, and carriers could be very valuable for both political and security purpose for

US government. With information obtained from several maritime security initiatives, the US could collect intelligence from their extended jurisdiction to those 58 CSI affiliation foreign ports. Under the current maritime security and safety environment, there is no doubt that these two initiatives have facilitated global trade while improving security. The CSI could help to detect and prevent container-related terrorism at the earliest point along the supply chain, and the C-TPAT helps to address supply chain vulnerabilities (GAO, 2003). Nevertheless, the outreach of US jurisdiction in the seaborne trade and the information safety risks stem from obtaining intelligence from many developing and developed nations are criticised by relevant stakeholders and should be tackled.

8.6 The implications of the Container Security Initiative for EU container seaport competition

The concern on port competition distortion and discrimination caused by the CSI (see Section 2.3.1) was discussed by various public and private stakeholders. Sea carriers would more likely choose CSI ports for shipping to the US, using non-CSI ports merely for preshipment on 'feeder' vessels that would later be loaded to the cargo of other ships at the closest CSI port (Allen, 2006). CSI ports would obtain a 'preferred' status, as they would be the only export ports with reduced risk of being delayed at the US port of arrival (Allen, 2006) (see Section 2.3.2). However, in fact, based on the Delphi survey, at the current stage, most export container ports work in extremely similar ways and there are no significant commercial or operational competitive advantages as a direct result of the CSI. CSI compliance does not cause EU container seaport market distortion whether in short term or long term. Moreover, Delphi industrial experts claimed that the CSI ports completed a comprehensive and exhaustive list within their respective regions to ensure that the CSI and C-TPAT does not create competitive disadvantages. So long as there is a level-playing field between these ports, which by-and-large there is, none of these ports are suffering in additional costs or burdens. The Delphi survey suggested that there has been no evidence of it causing financial burden or logistics disruption.

8.6.1 Container Security Initiative and 24-hour rule costs recuperation mechanism

Initial cost: government and port authority responsibility

Despite various research have discussed the heavy financial burden the programme may bring for container seaports, the Delphi survey confirmed that the CSI compliance cost and its negative impact on ports/terminals (see Section 8.4.2), like other maritime security measures, have been over-estimated. The initial compliance costs such as equipment purchase and upgrading are borne by the body that took on the initial capital cost (Allen, 2006), including governments, local port authorities (governmental or private) and commercial terminal operators, depending on the nature of port management and national Customs arrangements (OECD, 2003). Based on what has been discussed in Section 8.4.2, the EU CSI compliance initial capital cost falls into the responsibility of government, since it is a joint targeting operation with the host government's customs organisation. The labour costs of the US side fall into the US government budget. As Allen (2006) argued in Section 2.3.2, other costs associated with this initiative such as IT system development and personnel training vary dramatically because of divergent costs of labour in different countries. Private terminal operators are put in place within the cost-recovery mechanisms such as container surcharges and scanning fees to include all initiative-related costs. This mechanism will be discussed in the following sessions.

EU container seaport security cost recuperation and revenue generation

In most EU container seaports, the Delphi pointed out that the advanced systems and processes for security and safety already exist prior to the CSI. Due to the high costs of the non-intrusive devices, ports would not make the initial investment unless they were assured to be included in the CSI (Allen, 2006). Considering the rigorous requirements of joining, these ports make sure they have the financial strength to bear the initial investment at the first place. The Delphi results confirmed what was discussed in Section 2.3.1: the compliance costs of the CSI and 24-hour rule are passed onto carriers, who in turn recover this cost by charging exporters. The Delphi also revealed that the real cost burden falls onto US importers and ultimately the end consumers. Bichou (2011) suggested that one common approach for calculating the ex-post cost of security compliance is looking at how much the market players pass security charges onto final consumers. An average security fee of US$8 per container is charged for the ISPS Code and up to US$40 per bill of lading for the advance manifest fee are related to the 24-hour rule (Bichou, 2011). In the study of Bichou (2011), samples of EU container seaports' security charges are provided as evidence of this practice (Table 8.2).

Port or terminal	US$/TEU
Antwerp	10.98
Aarhus	0.7
Rotterdam	10.37
Le Havre	10.98
GioiaTauro	9.76
Valencia	6.1
Dublin	8.54
Gothenburg	2.6
Felixstowe and Harwich (HPH)	17 for import and 10 for export
Tilbury	12

Table 8.2 EU port/terminal security charges
Source: the author 2016 adapted from Bichou (2011)

Table 8.2 illustrates the security charges of some major container seaports in the EU. In the study of Nijdam *et al.* (2014) on level playing field of seaports, port tariffs between ports within Europe were concluded as largely discrepant. Nijdam *et al.* (2014) also revealed that the rates for port dues in the UK were significantly higher than those in the Hamburg-Le Havre range, while the tariffs in Scandinavia and in the Mediterranean were considerably lower. In terms of security charges, a similar pattern can be observed based on Table 8.2. As one of the biggest ports in EU based on handling volume, Rotterdam charges US$10.37, while Antwerp and Le Harve both charges US$10.98 since they share the same hinterland. The port of Denmark charges the most, up to US$6, however, it is not a CSI port. Among all the CSI ports included in Table 8.2, the port of Gothenburg charges the least which is only US$2.6. As to the UK CSI container seaport, Felixstowe charges US$10 for exports.

In addition to recovering the cost, the Delphi study suggested that the CSI and other security initiatives are seen by ports and carriers as business opportunity and security charges have generated additional revenue for ports and shipping lines. Delphi experts' opinions can be supported by industrial data as well. Take the port of Rotterdam for instance, every outgoing container is charged an average rate of US$10. According to statistics provided by the port of Rotterdam, their container traffic volume of 2011, 2012, 2013, 2014 and 2015 are presented in Table 8.3.

	2015	**2014**	**2013**	**2012**	**2011**
Outgoing TEU	5,882,941	5,882,161	5,583,631	5,787,561	5,777,314
Security surcharges based on the rate of US$10(Unit in US$ million)	59	59	56	58	58
Outgoing TEU grouped to America	784,000	833,000	Unknown	777,000	745,000
Security surcharges based on the rate of US$10(Unit in US$ million)	7.8	8.3	Unknown	7.8	7.5
Percent in Total outgoing TEU security charges	13.2%	14.1%	Unknown	13.4%	12.9%

Table 8.3 Port of Rotterdam container traffic volumes (by sea) 2011-2015
Source: the author 2016 adapted from Port of Rotterdam (2015)

According to the calculation in Table 8.3, in general, the port of Rotterdam generates US$58 million from security surcharges solely each year, not to mention other categories of fees. The security charges of America-inbound containers accounts for 13.4% of the total outgoing containers security charges on average. Port also charges extra for container scanning when needed. It is the importer to a US port who bear the cost of unloading and emptying of any potential threaten posed by dangerous container. The port at host country decides the cost for handling such cargo. For the port of Felixstowe, the Delphi experts claimed at least US$22 million are collected each year in additional. Referring back to the ex-ante and ex-post cost assessment presented in Section 2.1.5, the revenue generated from security charges can definitely offset the compliance cost and other security-related costs. The additional revenues derived from security requirements are used to pay for any additional equipment such as CCTV and sensors, etc. So far, none of these EU CSI ports are suffering uncovered costs or burdens as estimated, and as the industry claimed that security measurements have created a substantial revenue stream for ports.

As to small container ports, the Delphi study explained that the initial investment would be decreased, corresponding to their business scale and container traffic volume, to avoid the unbearable financial situation. It is also pointed out by the port industry that the actual investment, procedural costs and operational costs are much lesser than what have been estimated previously since the advanced systems and processes for security and safety already exist prior to the CSI in most EU container seaports.

The difference between scholar estimation and this Delphi research results exist can be explained by two reasons. Firstly, as Bichou (2004) and Bosk (2006) explained (Section 2.3.1), there are different interpretations of the regulations across global ports and terminals. For instance, the ISPS Code only provides general security provisions in ports without exact compliance instructions. Furthermore, a variety of methods were used to estimate ex-ante and ex-post costs (Section 2.3.1). Bichou (2008a, p.23) commented that "*ex-ante assessments of the compliance cost of maritime and port security are largely based on data and methods from national regulatory risk assessment models such as the US National Risk Assessment Tool (N-RAT) and the UK Risk Assessment Exercise (RAE). These are ad-hoc programmes undertaken by governmental agencies in order to assess the costs and benefits of new regulatory initiatives*".

Secondly, survey was commonly adopted for the ex-post cost assessment. Noted by Bichou (2008a), when survey investigates one single security programme, their results could show inconsistent cost outcomes either over time or between participants. For instance, the figure of US$200,000 initial costs and US$113,000 annual operating costs were widely quoted by the industry as the average compliance cost of C-TPAT for a multinational company in 2004 (Bichou, 2008a). Nevertheless, Diop *et al*. (2007) reported that C-TPAT implementation and operating costs were lower down to US$38,471 and US$69,000. In the same survey, 33% of respondents agreed that C-TPAT benefits outweighed the compliance costs but an additional 25% thought the CTPAT costs and benefits were about the same. This is because the case-specific survey is generalised to all stakeholders, and different viewpoints stem from respondents' various interests and backgrounds. Last but not least, as Thai (2007) and the Delphi experts argued, these ports see security measures as business opportunity to generate extra revenue. Their commercial operation makes sure the security measures are implemented cost effectively.

Carrier's 24-hour rule cost recuperation

Sea carriers are the stakeholders that bear the costs of 24-hour rule compliance. The Delphi experts admitted that the requirement of 24-hour caused shockwaves amongst players in global container shipping industry. It was shipping company who has traditionally controlled the submission of documentation (Holmes, 2004). Companies must provide detailed data about each container shipment, including the origins and the contents. Trading businesses started to worry about gathering the required information in such a tight time frame (Holmes, 2004). These companies-trading companies and shipping companies- need to significantly improve and manage their information flow to ensure consistency in their reporting for planning and auditing back along the supply chain (Holmes, 2004).

They were required to invest in new IT systems, personal training and working hours. In a similar vein to how port recovers cost, carriers pass these costs onto exporters as documentation fees (Table 8.4). Most carriers started to charge between US$25 and US$35 per bill of lading to recover administrative expenses of programme compliance (Allen, 2006). As a matter of fact, all imports to the US are facing this documentation fee whether or not they originated from a CSI port since 24-hour rule targets all US-bound containers. Due to the fact that shipping charges only account for 3% of the market price of goods in the US (Limao and Venables, 2001), the total/average cost passed onto US end consumers due to CSI/security screening is no more than a few cents per item of goods in US market. The Delphi experts claimed that the costs for having an improved maritime and supply chain security accounts for no more than 1% of shippers' total costs that which can be overlooked as it is minor in the overall supply chain.

Hence, it is suggested by both literature review and the Delphi study that the CSI and 24-hour rule does not bring financial burden to participated ports and terminals, instead, CSI-affiliation and security compliance provides them with new business opportunity.

Name of Surcharge	Code	Definition/Application	Scope/Rate (Approximate)
Port Security Fee	ISPS SEC SED ISPS SEO	Charge to cover ISPS code compliance costs	SEC: Russia-US$20 Greece-US$6
AMS Charge - for all countries with Advance Manifesting requirements US, China etc.	AMS	Covers costs associated with the preparation and submission of advance manifest declarations to US, Canadian and Mexican customs authorities for cargo loaded on a vessel at a non-US port is chargeable per Master B/L and each House B/L	UK-£30 per B/L Ireland/Switzerland/Spain/Portugal/Italy/Germany/France/Finland/Denmark/Netherlands/Belgium- €25
AAM Security Charge	AAM	Covers administration costs when SI change requests are received after the Advance Manifesting SI cutoff	UK-£40 per amendment request Ireland/Switzerland/Spain/Portugal/Italy/Germany/France/Finland/Denmark/Netherlands/ Belgium-€30
SEC=Security Charge in Europe SED=Security Charge at Destination SEO= Security Charge at Origin ISPS=International Ship and Port Facility Security AMS=Advance Manifest Security B/L=Bill of Lading AAM=Amendment for Advanced Manifest SI= Shipping Instruction			

Table 8.4 Trans-Atlantic sea carrier security surcharges
Source: the author 2016 adapted from Orient Overseas Container Line (2016)

8.6.2 Container Security Initiative compliance improves port productivity

Two opposite point views regarding the productivity issues has been discussed in the literature review (Section 2.3.2). The Delphi research suggested that operational disruption is inevitable since safety and security measures acts against operational and logistical efficiency that acquires addition procedure, but the same experts also claimed that security regulation could improve port infrastructure and good infrastructure can positively affect efficiency. In the case of maritime security measures, the investments required are productive expenditures to attain efficiency improvements. Nevertheless, they also pointed out that in most cases, it is more difficult to achieve an effective arrangement utilising these expenditures since relevant authorities' lack of business awareness.

Clark *et al*. (2004) suggested that having some level of regulations such as security measures could increase port efficiency, however, an excess of it can start to reverse these gains. Banomyong (2005), Altiok (2011) and Yang (2011) mentioned that a balance between trade facilitation and security needs to be achieved. Therefore, a moderate level of security practice has positive effect on port/terminal efficiency. In 2013, US ports handled 18 million TEUs and about 1% of containers were inspected overseas under CSI (American Shipper, 2014). The Congressional Budget Office (2016) reported that under current container inspection regime discussed in Section 2.2.1 (Figure 2.3 on p.50), the CBP identifies about 5 percent of all seaborne containers entering the US at high risk, although only a small portion of them are flagged for national security reasons. This small fraction of total US inbound containers scanned is consistent with what the EU port industry confirmed in the Delphi study. They claimed that in fact, in practice, using the NII devices required by the CSI can lower the chance a container being physically inspected. Very few containers would experience physical check, which does not cause any operational disruptions.

What is more, all three categories of panel experts agreed that if a port/terminal has efficient and effective operational arrangements, additional security procedure would have minor negative effects on them. Port efficiency *"varies widely from country to country and specially, from region to region"* (Clark et al., 2001, p.17). Clark *et al*. (2001) studied port efficiency in various locations and presented some estimates of port efficiency per geographic region (Table 8.5).

Geographic region	Port efficiency 7=the best,1=the worst	Custom Clearance(days)	Container Handling Charges in Ports(US$/TEU)
North America	6.35	3.50	261.7
Europe (excl. East)	5.29	4.00	166.7
Middle East	4.93	Na	Na
East Asia and the pacific	4.66	5.57	150.5
East and South Africa	4.63	12.00	Na
North Africa	3.72	5.50	Na
East Europe	3.28	2.38	Na
Latin America and the Caribbean	2.90	7.08	251.4
South Asia	2.79	--	Na
West Africa	Na	11.70	Na

Table 8.5 Port efficiency in various regions
Source: the author 2016 adapted from Clark *et al*. (2001)

Table 8.5 shows that EU ports ranked as the second most efficient port ranges. Although these efficiency variables per regions cannot directly compare with each other, it gives a general picture of the EU ports efficiency level (Clark *et al.,* 2001). Moreover, the EU container seaports which are included in the CSI are among the busiest container ports in the EU, which indicates that their existing operations and logistics are efficient. The Delphi experts suggested with better IT arrangement, most of the operational obstructions could be minimised. Additionally, the EU CSI ports increase in communication among terminal operators, liner companies and customs helps reduce delays in the time that containers departs ports (Allen, 2006). With the assistance of US team, the negative consequences of additional procedures could be minimised.

8.6.3 The Container Security Initiative positive effects on trade facilitation

It has been suggested by the literature review and the Delphi study that the CSI has both direct and indirect positive effects on trade facilitation. The most significant direct impact stems from its better procedural arrangement, such as container pre-screening prior to loading. The Delphi study mentioned that previous scholars who criticised the negative influences of the CSI on member ports in fact neglected the role of a container seaport in a global logistics chain. Although container examinations from unloading ports in the US has been transferred to the loading ports overseas, routing through a CSI port represents less time when it clears US Customs due to the 'Green Lane' benefits (see Section 2.1.5). It would lower the risks that containers may be delayed due to US custom clearance and shorten the total transit time from its origin to destination, hence, enhancing trade facilitation. On the other hand, according to the discussion on trade facilitation in Section 2.2.5, efforts in terms of simplifying required paperwork, modernising procedures and harmonising customs requirements can positively affect trade facilitation. A number of supply chain benefits are available to CSI compliant participants, including lower insurance costs, fewer penalties and less risk exposure, reduction in fraud and theft, and better predictability through advanced cargo processing procedures as Bichou (2008a) mentioned (Section 2.3.2). All of the advantages meet the criteria of trade facilitation efforts.

8.6.4 Container Security Initiative implications for small ports

It was estimated by various research that small ports would suffer from security measures such as the ISPS mainly financially based on the compliance cost estimation and market share loss (see Section 2.2.5). Due to the financial and operational constraints of small container seaports, meeting the requirements of security measure and joining the CSI would be difficult. Losing container traffic volumes of US inbound seemed to be inevitable as a result of being a less 'preferred' export container seaport than large CSI seaports. Hence, one major concern about introducing the CSI focused on its negative influence on small ports and the possibility of market share distortion since large CSI ports could gain new market share which small ports lose.

Nevertheless, over a decade since the introduction and implementation of the ISPS and CSI, as the discussion in Section 8.7.1, vast profits have been yielded by large or small container seaports. Additional security charges are not only applied to US-inbound containers but also all containers. These costs from ports/terminals are levied to carriers who in turn pass them onto shippers, forwarders and third-party logistics, and ultimately to retailers and end consumers, which normally account a few cents or pence per consumable purchased. The Delphi experts explained that small container ports would make the proportionate security plan and initial investment to the size of their assets and the operations to be covered to avoid the unbearable financial situation and overcome operational constraints. Their efforts also depend on the level of security that the smaller ports are willing to participate, as a result of a sound risk assessment. Furthermore, US-related trade is not their major business; therefore, they are less affected by US maritime security requirements. The industrial, academics and administrative experts of this Delphi panel all agreed that there could be a slight shift of market share from small ports to large CSI ports in the EU; however, it is a natural consequence of service differentiation. McCalla (1999) (see Section 3.3.4) argued that many ports were facing global issues and the local responses in terms of port service. The increasing vessel size is one of these global issues. The Delphi experts explained that smaller ports are more likely to lose business due to being unable to efficiently handle the ever-larger container ships rather than security measure compliances. This result also provides an empirical evidence to what McCalla (1999) suggested.

Chapter 9. Maritime governance, security measures and port competition in the EU

The impacts of the CSI on the EU container seaports competition have been discussed in Chapter 8 through analysing the conceptual assumptions developed in Chapter 4. The analyses were based on the secondary data collected from literature review and primary data from the Delphi survey. The Delphi results suggested that the CSI has not caused competition distortion in EU container seaport industry and no evidence has shown that ports are suffering unrecoverable burden from CSI compliance in terms of costs and efficiency within the EU. The findings are quite different from what were suggested by previous research. There is a lack of existing theories or models to explain such differences. As this research is shaped with adopting abductive approach (Section 5.2), a model (Figure 9.1) is developed and will be explained in this chapter to interpret the findings from this Delphi survey. Although this model is built upon existing knowledge and theories, it provides a new perspective which originates from political and economic environment to investigate how the maritime security measures affects port industry, rather than looking at individual determinants. The model classes the reasons into four groups, which are: (1) economic Liberalism rationality; (2) EU port management ideology, ownership structure and level playing field; (3) logistics vertical integration; (4) principal-agent relation and information asymmetries.

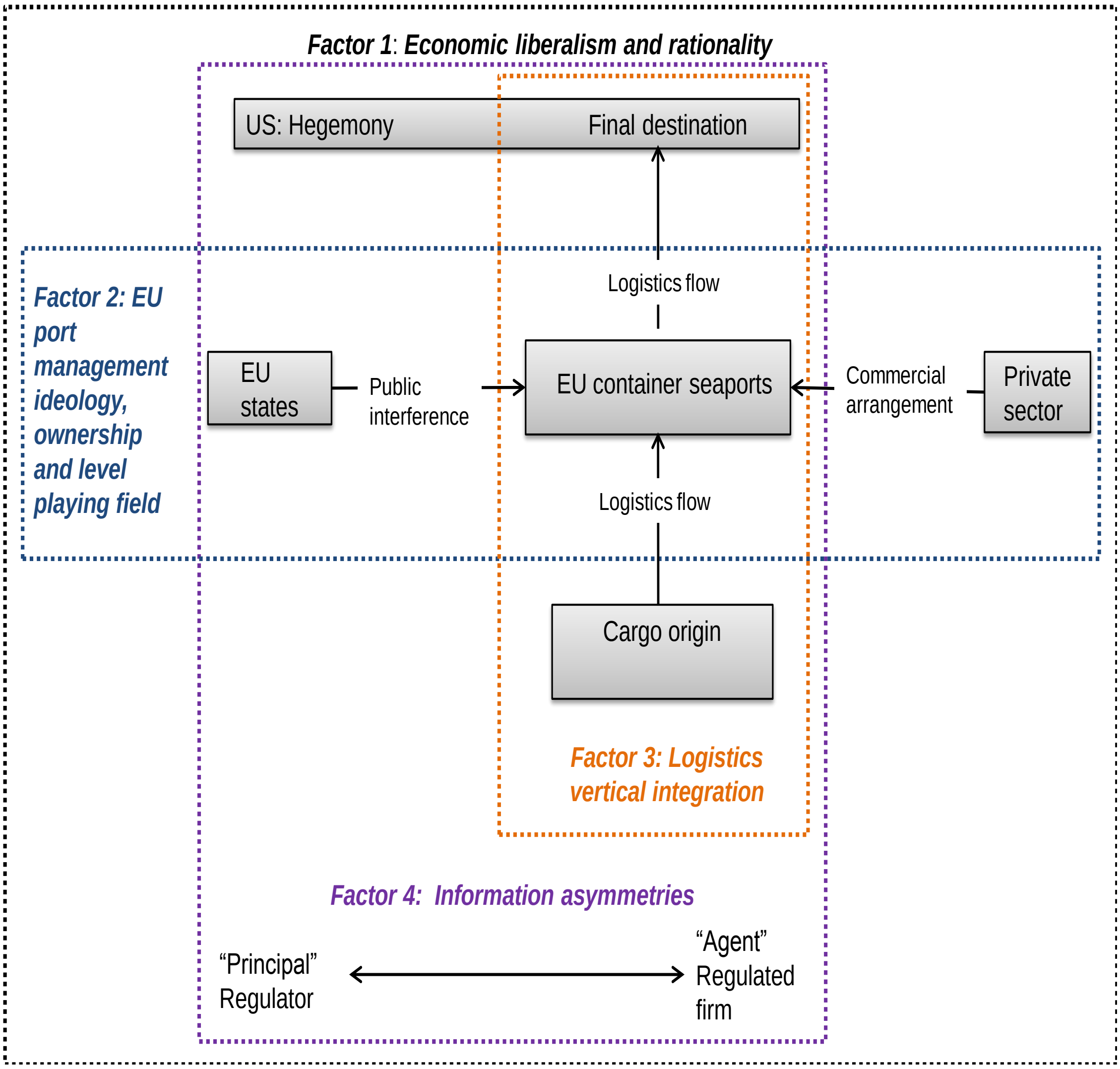


Figure 9.1 Maritime security and EU container seaport system
Source: the author (2017)

As was discussed in Section 5.2, this research follows the abductive approach. Kovács and Spens (2005) reviewed and discussed the adoption of abductive approach in logistics and supply chain field. Abduction was seen by researchers as the systematised creativity to develop new theory or knowledge when an unexpected observation cannot be explained by existing theories (Kovács and Spens, 2005). In terms of this research, the results of the Delphi survey are opposite to what have been argued by many current scholars noted in Chapter 2. The key conclusions from the Delphi in Chapter 8 suggested the industrial stakeholders hold a general active and optimistic view towards CSI implementation; and EU container seaport competition is not distorted unlike the suggestions by the Parliament of Australia (2003), Banomyong (2005), Dallimore (2008) and Donner and Kruk (2009) noted in Chapter 2. These unexpected results and phenomena cannot be fully explained by established theories; therefore, a new conceptual framework is needed for further interpretation. Abduction allows the researcher to examine and interpret existing phenomena from a new perspective, and 'new' knowledge is created in this way (Kovács and Spens, 2005). During this theory building process which was described by Dubois and Gadde (2002) as "theory matching" or "systematic combining", additional data is collected simultaneously. This creates an interactive learning loop that connects theory and empirical study. In most of the cases, the research goes back and forth between established theories, attempting to develop a new conceptual framework. Kirkeby (1990) explained that a 'creative' or 'surprising' element is normally introduced. Kovács and Spens (2005, p.139) summarised abduction as "*to understand the new phenomenon (Alvesson and Sko¨ldberg, 1994) and to suggest new theory (Kirkeby, 1990) in the form of new hypotheses or propositions (Andreewsky and Bourcier, 2000)*".

In terms of this abductive research, the theory matching process follows the interactive learning process described by Kovács and Spens (2005). A framework which seeks the cause of the industrial stakeholders' behaviour and attitudes towards CSI compliance at a deeper level was intended to be built. Danermark *et al.* (2001) interpreted the abduction as the new framework provides supposition to the new phenomena rather than a logically necessary conclusion. Therefore, a researcher can suggest general rules based on one's perception of the phenomena. Regarding this research, the author started with relevant political economic theories as the fundamental presupposition on which the maritime players perceive maritime security regulations and act (Section 3.4). EU port management ideology and ownership is believed to be the second premise as a derivate of the literature review (Section 3.3.3 and Section 3.3.5), Delphi panellists' comments, particularly on Statement 3, 4.1, 4.4, 5, and the discussion in Chapter 8 (Section 8.3.2 and Section 8.6). Logistics integration is developed based on the synthesis of literature review (Section 2.2.5, Section 2.3.2 and Chapter 3), Delphi experts' comments on Statement 4.5 and discussion in Section 8.6.3. The author added information asymmetries as another fundamental precondition of how the maritime practitioners cope with security measures implementation (Section 8.6). The information asymmetries and principal-agent relation exist in modern commercial activities; therefore, it is considered to be applicable to this case. Additional secondary data was collected to examine these four factors, mainly from existing theories in the field of international trade, political economics, maritime governance, logistics and supply chain management and historical port data. The following sections present the synthesis of relevant secondary data in the aforementioned fields and the Delphi results.

9.1 Economic liberalism and rationality

According to the discussion in Section 3.4, maritime activities are closely linked to globalisation. It is the shipping industry that makes global trade possible. Roe (2013) noted that shipping industry portrays a broader globalised world economy. Economic liberalism, on the other hand, is considered as the dominant ideology of globalisation (Usher, 2003) (Section 3.4). Therefore, it is rational to believe that maritime activities and governance can be interpreted from economic liberalism perspective. Section 3.4 also introduced the concept of “rationality”. “Rationality” can be seen as an explanation of human beings’ propensity to maximise their own interest in the economic sphere (Section 3.4). Jeremy Bentham, a 'utilitarian' thinker, believed that people who behave rationally would always act to maximise their own 'utility' and a collective of this behaviour could produce beneficial outcomes to balance between consumers' demand and producers' supply. According to this ideology, all actors within a global trading system act to maximise their own interest and the overall result will create the greatest happiness of the greatest number. In the case of the shipping industry, all stakeholders of the maritime security initiative including both public and private sectors are acting to seek maximisation of their own interest, dominated by the ideology of 'rationality'.

Liberals still acknowledge the role for state in the economy. Public goods such as clean air and security should be provided by governments since the market would not necessarily produce them (Smith, 1910). Moreover, government are necessary in terms of providing a regulatory framework to enforce contracts and protect fair competition. However, classical Liberalism argued that the role of government should be limited to a minimum, although there is some argument about the extent of the state intervention.

9.2 Maritime governance and security measures

In modern society, large public works are still needed and contemporary government must provide a mechanism for the purposes of: resolution of private disputes, specifying the rights and obligations of corporations, imposing taxes or regulations upon externalities, and reducing the gap between rich and poor by progressive income taxation, welfare and other measures (Usher, 2003). Due to the very nature of the shipping industry, administration is necessary not only for industrial competition but also various externalities. The framework of maritime governance is hierarchical model that characterised by formal structures with a set of rules to govern the process by which decision are taken and imposed (Roe, 2013). This hierarchical framework is international, supranational, national, regional and local, comprising of various NGOs (e.g. International Organisation for Standardisation) and inter-governmental organisations (IGO) (e.g. IMO and OECD). The process is shaped with top-down authority, beginning with broad policies developing at higher levels (e.g. IGOs and NGOs) and then pass down the hierarchy to lower jurisdictions (national and regional level) (Roe, 2013). Lower levels then to operate the broad policies derived from upper levels (Roe, 2013). The whole system relies on coordination between jurisdictions and regulatory bodies to minimise conflicts between them (Roe, 2013).

9.2.1 Hegemony in maritime governance and maritime security

The maritime governance and the international trade system illustrate the importance of a hegemon and the phenomenon of hegemony. A hegemon refers to a great power with sufficient political influence and motivation to dominate international affairs in ways that create rules and institutions which serve to further their interests (Hanyes *et al*., 2011). Gilpin (1987) explained that Neo-Realists saw hegemony as a more sophisticated way of understanding how governments could impose power over others by using institutions and rules. Liberal considered hegemony as a means of achieving free trade by overcoming the collective goods problem (Hanyes *et al*., 2011). Dominant trading states such as the US at the end of the Second World War and Great Britain in 19th century liberalisation play an entrepreneurial role in developing and enforcing international rules promote trade (Keohane, 1984).

The US, who relies heavily on global trade, has been a leader in the Liberal International Economic Order (Bove *et al.,* 2014). Security issue has become an important aspect in current international trade system in which a logistics chain connects the cargo origin and destination. As to maritime regulation and policy regarding security and safety, the US plays a leading role in establishing and projecting its power worldwide by developing and conducting various maritime security regimes and measures (see Chapter 2). The CSI can be seen as an example of the US exert their power, owing to the fact that it transfers container inspection from the traditional unloading point at the US boarders to the loading point at the export ports overseas (see Section 8.5.2). Despite the improvement of the total efficiency of the logistics chain, it triggered discussions on costs, operational disruption, information sharing, administrative issue and sovereignty when it was firstly introduced in 2002 (Allen, 2006; Donner and Kruk, 2009; Parliament of Australia, 2003; OECD, 2003; Dekker and Stevens, 2007; Metaparti, 2010). Yet, by January 2003, US Customs had reached bilateral arrangements with 15 foreign customs to place Customs officials at 24 seaports (GAO, 2003). Despite all the negativities suggested by varying scholars (see Chapter 2), as the CSI progressed, more counties started joining it. So far there are 58 foreign ports participating in the CSI, which account for 85% of container traffic destined to the US (CBP, 2014). In fact, due to the hegemon of the US coming from its military and economic power (Metaparti, 2010; Bove *et al.,* 2014), foreign nations and ports joined this programme to maintain their current position and status in the international trade system. According the Delphi results, from the perspective of improving global trade security, the US hegemony has been proved to be effective in spite of the inequity issues in Section 8.5.2. The public entities and private players who are subject to the hegemony have developed their own mechanism to cope with the negativities, dominating by the 'rationality' ideology. The maritime security compliance cost recuperation suggested by the Delphi experts in Section 8.3.2 and Section 8.6.1 can be seen as such a mechanism.

9.2.2 EU Port governance and management

In port industry, according to McConville (1999), there are two most common and extreme managerial ideologies, namely the European or Continental, and the Anglo-Saxon or Peninsular. European philosophies see the ports as a public service and there is a comprehensive port authority instructing the whole operations (Bennathan and Walters, 1979). The Anglo-Saxon approach sees the port as a commercial activity, and management control of the port is a private undertaking (Bennathan and Walters, 1979). Although both approaches are useful, there are no pure examples of these philosophies to be ground. Based on an examination of the position of port services undertaken by the UNCTAD in the mid-1970s, the Anglo-Saxon approach is more found in developed country ports and the ports of developing countries mainly seem to be managed under the European ideologies (McConville, 1999). Within the EU, the Delphi results and the literature review indicated that most ports are managed and operated under the Anglo-Saxon ideology, particularly in the UK and Northern Europe. The primary objective is to earn appropriate profits and avoid unnecessary commercial losses. According to this approach, public intervention needs to be severely curtailed, and limited to general duties such as land planning permission, safety, environmental problems, pilotage and navigation. Furthermore, privatisation, commercialisation, co-operation and some forms of deregulation give ports' management the ability to function in a liberalised environment.

EU port ownership and governance

Public ports in the UK went through asset privatisation, i.e., selling assets (including land) to private sector. Baird and Valentine (2007) stated that the UK port industry was more concentrated than before, and 15 of the 20 largest ports were privately owned, handling 85% of all UK port traffic in 2003. In Greece, the ports of Piraeus and Thessaloniki were listed on the Athens Stock Exchange in 1999 when the Greek government undertook port reform (Talley, 2009). The Greek state still had 75% of their ownership (Talley, 2009). In 2003, they transferred to limited companies to operate as private business, having only one share owned by the state (Talley, 2009). The remaining Greek ports were managed by local authorities. In order to overcome port inefficiencies, Greek port reform was still developing. China's COSCO Shipping took 67% stake in Piraeus Port Authority in August 2016 and became the controlling shareholder (Xinhua News Agency, 2016).

One of the major tasks of contemporary government is providing public services (see Section 9.1), and ports falls into the category (Usher, 2003). A strong and efficient seaport is an important asset for a nation or region that could generate value added and employment. Belgium has a decentralised port governance structure and Belgium ports are publicly owned and managed due to their national economic importance. Hence, port services are ruled by municipal regulation and regional governments provide primary funds for port investments. There is no private port in Belgium (Talley, 2009). The ports of Rotterdam, Amsterdam, and Zeeland that are the three largest ports in the Netherlands are under public management of port authorities. There is no direct involvement of the national government in port management. Rotterdam was a municipal port, but, in 2004, the port authority changed to a public corporation (Talley, 2009). The municipality of Rotterdam became a major shareholder and the national government became the minor shareholder and the financier of port expansion projects (De Langen and van der Lugt, 2007).

Italian Law no.85/94 divided Italy's commercial ports into three categories (Brooks and Cullinane, 2007). These three categories are: Class I are ports of international economic relevance; Class II are ports of national economic relevance; and Class III are ports of regional and interregional economic relevance (Valleri *et al*., 2007). Public port authorities own 24 ports of Class I and Class II and have the legal rights to lease the port or its terminals to private sectors (Talley, 2009). The competitive private operators perform port operations and entrepreneurial activities, and port authorities can only provide ancillary activities (Valleri *et al*., 2007).

Country	**CSI ports**	**Ownership, management and operations**
The Netherlands	Rotterdam	Landlord port(public-private): municipality(major) and national government(minor)+private operators
Italy	La Spezia, Genoa, Naples, Gioia Tauro, and Livorno	Landlord port(public-private): public port authorities and private operators
Germany	Bremerhaven, Hamburg	Landlord port(public-private): local public authority+ private operators
UK	Felixstowe, Liverpool, Thamsport, Tilbury, and Southampton	Fully private ownership
Belgium	Antwerp and Zeebrugge	Landlord port (public-private): national government and regional government+ private operators
Greece	Piraeus	Limited company: National government (major shareholders) and minor shareholders
France	Le Harve and Marseille	Landlord port(public-private): national government+ private operators
Spain	Algeciras, Barcelona, and Valencia	Landlord port (public-private): local port authority+ private operators
Sweden	Gothenburg	Landlord port (public-private): local port authority+ private operators
Portugal	Lisbon	Public-private: local port authority+ publicly owned limited company(management)+ private operators

Table 9.1 EU CSI ports and their ownership
Source: the author 2017 adapted from relevant ports' official websites, Brooks and Cullinane (2007), Valleri *et al*. (2007)

Although early empirical research shows that there was a lack of clear-cut relationships between ownership and port efficiency (see Section 3.2.3), there are some studies argued that decentralisation and privatisation could improve port performance (Estache *et al*., 2002; Song, 2003; Tongzon and Heng, 2005). In the study of Wang *et al*. (2004) (see Section 3.3.5), the government 'hand-off' mode could create an effective commercial operation to achieve better port performance. Table 9.1 shows the ownership of all EU CSI ports. The level of privatisation varies among these CSI ports, ranging from fully privatised UK container ports to partially privatised landlord ports. A Landlord port has the mixed public-private feature and is the mainstream model for larger and medium sized ports, and especially for EU ports. Under this model, port authority is the regulatory body and the landlord, and private companies conduct port operations (Dholakia *et al.,* 2009). The Landlord port model utilises the efficiency and accountability of the private sector and creates competitive market dynamics (Brooks and Cullinane, 2007). Additionally, investment made by the private sector can ensure a strong market leadership and achieve financial stability. On the other hand, a seaport could attract a broad range of industries. In order to avoid impractical investment and strengthen the control over port externalities, public sector retains infrastructural investment and regulatory laws. Legal restraints are instituted. An essential element in economic modelling is that all participants seek the maximisation of something (McConville, 1999). In shipping industry, for instance, a shipping company will operate to achieve profit maximisation or lowest cost possible. Firms or individuals will never deliberately make a decision or take an action knowing in advance it is against self-interest (McConville, 1999). In terms of maritime security, the involvement of both private and public sector could help to maximise the positive effect of security measures and minimise the negative impacts on port operations and financing. The responsibility of ensuring and investing in maritime security and safety falls onto the port authority and government as public goods, while the stakeholders in commercial and private sector such as terminal operators seeks the way of cost recovering, process facilitation and profit maximisation. Therefore, despite the objections and estimated negative influences of the maritime security measures such as the CSI on port operations, in fact, the compliance ports' authorities or other private sectors have seen their solutions to any possible negative effects prior to the implementation.

9.3 Container Security Initiative participation in EU port ranges and level-playing field

The European container port system is one of the busiest container port systems worldwide that features large ports as well as medium-sized to smaller ports and each of them has specific characteristics regarding hinterland markets served and geographic locations (Notteboom, 2012). Port hierarchy and competition in Europe are shaped by different types, sizes and economic hinterland. According to Meersman *et al.* (2010), due to different economic, legal, social and fiscal environment, and the features of liner networking, it is difficult to compare the competition environment across different container port ranges. Although the Delphi survey suggested that the EU container seaport competition is not distorted by the CSI, it is more sensible to analyse the competition within a specific port range that serves the same economic hinterland and foreland.

On one hand, EU container seaports that have regular US-inbound container flows have seen and realised the opportunities and benefits of the CSI, hence joined the programme in different phases to preventing them from being a less preferred choice by port users (Table 9.2). Based on the Lloyd's list (2014), 16 EU container seaports which rank as the busiest European container seaports have joined the CSI. In the Hamburg-Le Havre (HLH) range which handle almost half of the total European container flows, ports are involved in a fierce competitive. Of the 11 major deep-sea ports in HLH-range, 6 ports which are included in Top 20 European container seaports have joined the CSI within 4 years, handling almost 98% of the total TEU flow in HLH-range. In terms of ports within each port range, the total annual TEU throughput (out-going) of non-CSI ports only account for approximately 1%, which means that the non-CSI ports have a small fraction of market share in their range. What is more, for these non-CSI small container seaports, US-related container traffic is not their major business. Therefore, although CSI was introduced to the EU as a voluntary programme to individual ports, the participation of all the major players in one port range at early stage to gain a 'preferred' status implies that the CSI in fact works on major EU container seaports as a ‘must have’ programme. On the other hand, there are a few national and regional authorities that artificially protect their seaports by partially or fully subsiding port infrastructure. Meersman *et al.* (2010) pointed out by doing so, a mutual accusation of distortion of competition arises. Dekker and Stevens (2007) also suggested that subsidies for security measures would affect the price mechanism and in turn on the seaports competitive position. Hence, different ports within the same range have similar investment plans and are competing for the same goods flows. Nijdam *et al.* (2014) stated that the security rules are also defined at the European level and that they are equal for all EU member states. The Delphi survey has confirmed that there have been rare subsidies from government to ports/terminals regarding the CSI compliance besides the occasional loan of portable scanning units which are designed to identify radio-active emissions. So long as there is a level-playing field between these ports regarding security enforcement, which by-and-large there is, there will be no competition distortion caused by CSI-affiliation.

EU Container Seaport range	Phase I (2002-2003)	Phase II (2003-2006)	Phase III (by present)	Non-CSI ports and Total Annual TEU throughput % of total range throughput (outgoing-2013)
Hamburg-Le Havre	**Germany**: Hamburg, Bremerhaven **Netherlands**: Rotterdam **France**: Le Havre **Belgium**: Antwerp	**Belgium**: Zeebrugge	None	Wilhelmshaven Amsterdam Zeeland Seaports Ghent Dunkirk 1.31%
Mediterranean	**Italy**: Genoa, La Spezia **Spain**: Algeciras	**Italy**: Livorno, Gioia Tauro, Naples **Spain**: Barcelona, Valencia **France**: Marseilles **Greece**: Piraeus **Turkey**: Izmir	None	Not available
UK (east and south coast)	Felixstowe	Southampton, Thamesport	Liverpool, Tilbury	Not available
Atlantic	None	**Portugal**: Lisbon	None	Not available
North Sea	None	**Sweden**: Gothenburg	None	Not available
Black Sea	None	None	None	Not available

Table 9.2 CSI ports in different port ranges at different phases
Source: the author 2017 adapted from CBP (2014), Port of Rotterdam (2015) and Notteboom (2012)

Additionally, the security charges of EU container seaports are on a range basis as well (see Section 8.7.1 and Table 8.2 on p.260). The survey conducted by

Drewry (1998) indicated that port tariff diversification was greater among different port ranges/clusters than inside each range. The existence of tariffs diversification on a range basis is not only caused by the different degree of competition existing in the different markets and port management but also by the different monopolistic power of ports regarding their hinterlands (i.e. traffic is less footloose). For instance, the security charges within the EU container seaports vary from US$11 per TEU in Aarhus to US$2.6 per TEU in Gothenburg (Bichou, 2011). In 2011, port of Rotterdam, Antwerp and Le Harve all charge approximately US$11 since they share the same hinterland. This range basis of security charges ensures a fair competition for prices for ports that serves the same economic hinterland.

9.4 Logistics vertical integration and port function

Phenomena such as globalisation and liberalisation have had fostered the international trade. There is a process of mutual influence between international trade and the transport sector. This mutual influence implies a substantial degree of dynamism, especially in maritime sector (Meersman *et al.*, 2009). Competition is no longer seen at the level of individual ports or shipping companies, but at the more complex level of logistical relationships between origins and destinations (Meersman *et al.*, 2010). Port competition would *"shift from the institutional, functional and spatial levels to channel management"* (Bichou and Gray, 2005, p.89) (see Section 4.1.4). The strength of a logistics and supply chain depends on the quality of each individual node and link. The success of the entire chain depends on the competitive strength of incorporated seaports and the success of a seaport depends on the competitive strength of the logistics chain where it is a part (Meersman *et al.*, 2010). In other words, whether a seaport policy or strategy is successful should be aligned with the international logistics context. Therefore, to what extent the trade and commodity flow can be facilitated from cargo origin to destination remains a crucial factor to port policy and strategy. Meersman (2005) suggested that the ability of the port to be one key player of the entire supply chain to minimise the generalised costs would determine the profitability of an investment in port infrastructure.

This research suggested that previous scholars who criticised the negative influences of the CSI on member ports neglected the role of a container seaport in a global logistics chain. As noted in the discussion regarding trade facilitation in Section 7.5.3, routing through a CSI port would lower the risks of containers delay caused by US Custom clearance and shorten the time from its origin to destination, hence, enhancing trade facilitation. The Delphi research also confirmed that the CSI decreases total cargo processing costs and improves port reliability, thus attracting more container volumes. In addition, industrial experts claimed that the provisions of the new security regulations make the security check process more cost-effective and less time-consuming than the traditional random inspections, as Bichou (2008a) suggested. In addition to the direct benefits such as more reliable cargo movement, other benefits include lower insurance costs, fewer penalties and less risk exposure. Advantages that go beyond the security benefits were discussed in Section 8.6.3.

9.5 Principal-Agent relation and Asymmetric information

Cvitanić and Zhang (2013) described a Principal-Agent (PA) problem as a problem of optimal contracting between two parties (principal and agent). The agent could act to influence the value of the outcome process (Cvitanić and

Zhang, 2013). A typical example of a PA problem is in investment that the principal is an investor and the agent is a portfolio manager who manages the investor's money. In finance, a company is the principal and its chief executive is the agent. In broad term, the principal offers a contract to the agent who performs a certain task on behalf of the principal (Cvitanić and Zhang, 2013).

Tirole (1986) developed a model that regarded regulation as a principal-agent problem, with the government or 'regulator' as the principal, and the regulated company as the agent. In the basic Laffont-Tirole model of regulation, the government procures an indivisible public good from a privately-owned firm. In this case, the regulator observes realised production costs without knowing how much effort the company has put into cost-reduction (Tirole, 2014). The regulated company knows more about its cost-reducing technology or means than the regulator. Hence, the regulator encounters hidden information as well as hidden action. The manager of the regulated company can reduce the production cost by working hard. This is caused by the information asymmetries in a PA problem.

As aforementioned, the governance framework in shipping sector is a multilevel governance system which consists of international, supranational, national, regional and local entities. A multilevel governance system has to face the problem of how to ensure policy outcomes are in line with the original objectives when there exist asymmetric information, different capacity and resources of actors, and priorities and values at different levels (Kassim and Menon, 2003; Elgie, 2002; Bauer, 2006). In the context of economic liberalism in which rationality and a seeking for self-interest have become a dominant ideology, "*operating public policy/ regulation in a multilevel governance system requires* *shared understanding and commitment to policy goals, trust and resource interdependence*" (Bachtler and Ferry, 2013, p.1259).

The CSI was introduced as a voluntary initiative between US Customs and overseas exporting container seaports. The US Customs posed the CSI as a regulation on CSI-affiliation ports overseas. Based on the Laffont and Tirole model of regulation, the PA relation can be applied in this case. By joining the CSI, a contractual relationship is formed between the US Customs and CSI-affiliation ports, where the CSI port (the agent) is authorised to act on behalf of the US Customs (the principal) to carry out container inspections at the CSI ports. However, according to the PA problem, the US Customs cannot assume that the CSI ports will always act for the best interest of the principal, particularly if CSI compliance will be costly to the agent. Moreover, the asymmetric information between the principal and the agent will enable the CSI port to use the US Customs' resources to pursue goals that benefit their own business. This is because the agent’s actions are normally unobservable to the principal (Páez-Pérez and Sánchez-Silva, 2016). The CSI ports, as the agent, have the advantage of greater knowledge and specialised abilities in port operation to maximise their own interests and minimise negative effects. Hence, CSI ports recuperate relevant compliance cost by charging the carriers security fees which are ultimately transferred on US importers and final consumers. Under such mechanism, CSI ports and carriers who subjected to the 24-hour rule not only achieve cost recovery, but also create a new revenue stream as discussed in Chapter 8.

Chapter 10. Conclusion

This Chapter will start with a demonstration of the realisation of the research aim and objectives. It is followed by the research contribution and research limitations. This research also revealed several issues under current US maritime security collaborative network, as one of the research objectives, suggestions will be provided and discussed. Recommendations for further research will be explained in the end.

10.1 Realisation of the research aim and objectives

The aim of this research is to analyse the impacts of the CSI programme on EU container seaport competition. In order to achieve this aim, five research objectives were developed in Chapter 1. Research Objective 1, 2 and partial Objectives 3 and 4 were addressed in the literature reviews (Chapter 2, 3) and conceptual model development process (Chapter 4). In order to fully achieve Objectives 3 4 and 5, a Delphi survey was conducted to collect primary data to test the conceptual model and a model was developed based on the Delphi findings and secondary data. The following sections will explain each objective in detail.

10.1.1 Research Objective 1: To review literature on maritime security and EU container seaport competition.

This objective has been addressed in Chapter 2 by reviewing published research regarding maritime security, port competition and the EU port industry. The review of literature reveals the risk factors exposed in maritime transport and the necessity of carrying out maritime security measures, particularly in container shipping due to its high velocity and uniformity. However, the compliance of maritime security measures has been argued to bring negative influences on the port industry considering cost and logistics disruption. Port competitiveness and competitive position would be affected accordingly. This research focused on the EU container seaport, therefore, the characteristics of container port competitiveness, port selection criteria and determinants of port competitiveness have been critically reviewed in Chapter 3. In addition to geographical location and port charge, port efficiency, port service, port performance and port policy were reviewed as key aspects regarding port competitiveness based on the model developed by Yeo (2007).

10.1.2 Research Objective 2: To review the various port security regulations of the US, focusing on the CSI programme and the existing debates over its implications.

Several compulsory and voluntary frameworks have been introduced at international, supranational, national and regional level in order to enhance maritime and port security (Table 2.1 on p.36 and Table 2.2 on p.37). The ISPS code, the IMO/ILO code of practice on security in ports, and the WCO 'SAFE Framework' have been implemented and endorsed at the international level. The US, as the hegemon, has been playing a leading role in establishing and projecting maritime security regimes and measures at national level (Metaparti, 2010). In order to keep terrorism out of the US and ensure supply chain security, the DHS is adopting a multi-layer approach, which includes the 24-hour rule, the C-TPAT, the CSI, the SFI and using of ATS and NII. The voluntary CSI has been criticised as bringing negative effects on port industry in terms of operational efficiency and financing. Transferring container inspection from the US unloading point to the CSI ports overseas has been argued as damaging the interests of the CSI-affiliation ports. Some literature which advocated the CSI argued that its implementation was commercially rewarding and improves productivity of the logistics chain since it was more cost-effective and less time-consuming than conventional inspections. Nevertheless, there is rarely empirical analysis to support both arguments. Moreover, trade and transport operators may operate at a competitive disadvantage without joining in one of those voluntary programmes (Donner and Kruk, 2009). The EC raised their concerns about the possible erosion of fair and genuine competition between the EU ports when the CSI was firstly introduced in 2002 since the CSI is between the US and individual EU ports rather than the EU as a whole. The topic of long-term analysis on the effects of security initiatives on the competitive position of EU seaports has been highlighted as one of three research gaps mentioned in Dekker and Stevens (2007) in the field of maritime security costs and measures implementation. Therefore, this particular research was developed to fill the research gap mentioned by Dekker and Stevens (2007), and Delphi was chosen as a qualitative research method to find out the CSI implications for the EU container seaports.

10.1.3 Research Objective 3: To identify the determinants of EU container port competitiveness.

The Delphi results suggested that the container seaport environment in the EU generally has become increasingly competitive. A multitude of tangible criteria that include efficiency and cost have been identified as the most important competitiveness components (Figure 8.1 in Section 8.4.3 on p.247). Port safety and security, as intangible criteria, are an absolute minimum need to match industry standards and best practices. The implementation of security measures can improve port security and service quality. Security should be closely integrated and incorporated into business practices since the outcomes of security are part of the service that customers seek from ports. Any port or terminal without adequate safety and security would stand at a huge disadvantage against rivals who fully meet standards. It is suggested that security cannot be separated from the overall business. Port security should not be conducted merely as a reaction to legal and social regulations.

10.1.4 Research Objective 4: To investigate the effects of the CSI on EU container seaport competition.

The research aims to analyse the impacts of the CSI programme on EU container seaport competition. In order to fulfil this aim and objectives, Delphi technique was adopted as the qualitative method to collect primary data. The research design, process and implementation were described and discussed in Chapter 5. Data collection and analysis of all three rounds were presented in Chapter 6 and Chapter 7. Thirteen Delphi questions which consisted of twelve Delphi statements and one open-ended question were designed based on the five conceptual assumptions (Chapter 4) under five categories. The five categories were: (1) the necessity of carrying out maritime security initiative; (2) introduction of the CSI and the its controversial influences; (3) determinants of EU container seaport competitiveness; (4) the implications of the CSI for EU port competition; (5) open-ended question for experts to express their comments.

Both the literature and Delphi study advocated the necessity of implementing maritime security measures which need to be integrated into the entire supply chain to be effective. Additional cost and operational obstructions are inevitable due to additional inspections and administration. However, they are very insignificant compared to the overall benefits derived from a secure supply chain. Moreover, utilising production factors and IT systems rationally could minimise the negative influences.

Both the literature review and the Delphi survey confirmed that the CSI has dramatically increased stakeholders' awareness for strengthening global trade security and facilitate global container trade security. On the basis that the container supply chain has not experienced disruption by terrorism, the measures implemented should be considered as successful and appropriate for its purpose.

CSI compliance cost

In terms of CSI financing, the port industry pointed out that the actual investment, procedural costs and operational costs are much less than what have been estimated previously. The Delphi research suggested that the CSI and other security initiatives have been treated by ports and carriers as a business opportunity and security charges have generated additional revenue for ports and shipping lines. None of these CSI ports are suffering uncovered costs or burdens as estimated. There are two reasons behind that. Firstly, the ownership of the EU CSI ports consists of both public and private sectors. The responsibility of providing appropriate security and safety falls into the scope of government. Many security facilitates have already existed prior to the CSI. Secondly, the most important reason is that the CSI ports and related carriers have formed a cost recuperation mechanism such as charging security-related fees. The real cost burden falls to the Beneficial Cargo Owners (BCO) and ultimately to importers/retailers and end consumers. Under such a mechanism, not only the initial cost is recovered, but also a new revenue stream has been created. The additional revenues are used to pay for any additional equipment such as CCTV and sensors. As to non-CSI small ports, the initial investment for security regulations compliance would be corresponding to their business scale and container traffic volume to avoid the unbearable financial situation. From the perspective of Return on Invested Capital (ROIC), ports and terminals still remain the most profitable players within the end-to-end supply chain.

Port productivity and logistics efficiency

Theoretically, security inspection acts against operational and logistical efficiency owing to the fact that additional procedures are acquired. Nevertheless, the Delphi experts confirmed that there has been no evidence to show that the CSI affiliation has caused severe operational obstruction. In fact, the CSI have improved the efficiency and productivity of the entire supply chain from cargo origin to destination. Security regulation compliance could improve port infrastructure which in turn could positively affect efficiency. The investments required by security measures are productive expenditures to attain efficiency improvements. In addition, using NII devices suggested by the CSI have lowered the chance of a container being physically inspected. Very few containers (less than 1%) would undergo a physical check. On the other hand, EU ports rank as one of the most efficient port ranges around the world and EU CSI ports are among the busiest container ports, which implies that the CSI implementation are on an effective and efficient operational basis. With a better IT arrangement and US team assistance, the negative consequences of additional procedures could be minimised.

What is more, competition in the maritime sector is no longer seen at the level of individual ports or carriers, but at a more complex level of logistical relationships between origins and destinations. The CSI could shorten the time from cargo origin to destinations with better procedural arrangements and enhance trade facilitation.

Implications for EU container port competition

The introduction of the CSI has not distorted competition between EU container seaports. According to the key EU port competitiveness determinants identified by the Delphi, it has no significant direct negativities on operational cost and efficiency. Port service, as one of the identified port selection criteria, is levelled up as a result of improving port security and safety. CSI participation also brings other commercial advantages beyond intended security benefits such as increased supply chain reliability. CSI ports obtain a more preferred status than non-CSI ports. Hence, port competitiveness is improved. With regard to the non-CSI small ports, US-related trade only counts for a very small fraction of their total container traffic volume. There are no commercial or operational competitive disadvantages of any significance as a direct result of not joining the CSI. The competitive position among EU container seaports is not altered by CSI implementation since the CSI is implemented at most of the ports that have a level-playing field within a port range. It is the changing market arising from liner network design which aims at lowering the overall transportation cost that would cause the market share to shift from small ports to mega ports.

A model was developed to interpret the findings of this Delphi research. The model contains four factors, namely: (1) economic liberalism and 'rationality'; (2) EU port management ideology, ownership structure and level-playing; (3) logistics vertical integration; and (4) information asymmetries. These four factors underlie the global trade system that affects how the EU container seaport industry manages CSI compliance.

The 'rationality' existing in the current economic liberalism system is the basis of individuals' seeking for profit and interest maximisation. The Anglo-Saxon ideology, as the dominant port management approach within EU, together with port privatisation, directs ports to take action to avoid the loss of self-interests. Regarding maritime security, the involvement of both the private and public sector could help to maximise the positive effect of security measures and minimise the negative implications for port operations and financing. Additionally, so long as there is a level-playing field between these ports regarding security enforcement, which by-and-large there is, there will be no distortion of competition caused by CSI-affiliation. Competition within the transportation industry is seen at a more complex level due to logistical integration. Whether a seaport policy or strategy is successful should be aligned with the international logistics context. From this context, the CSI has been beneficial to trade facilitation. The CSI was introduced as a security initiative between the US Customs and commercial ports overseas and a Principal-Agent relation is formed in this case. Due to the information asymmetries between the principal and the agent, CSI ports are able to pursue goals and approaches that benefit their own business. Therefore, efficiency issues and cost recuperation are managed effectively to make sure their interests are maximised.

10.1.5 Research Objective 5: To propose a sustainable solution to existing issues discovered on maritime security.

The CSI adds additional layers of protection through increasing stakeholders' awareness for security and chances of detection; however, it does not guarantee to prevent terrorists from using sea transportation (Parliament of Australia, 2003). The CSI can be seen as a successful initiative in terms of fitness for purpose owing to the fact that there has been no terrorism-related material discovered so far, however, some issues are revealed by this research.

Issue 1: Substantial liability issue

The substantial liability issue under the CSI in the event of a terrorist attack utilising container shipping remains unaddressed in a fully CSI compliant cooperative work. Container movement involves a large number of actors globally, including business companies, customs authorities, and international organisations. Nonetheless, the transport chain is not fully transparent, and no single authority or industry has the full responsibility for security from origin to destination. With the 100% scanning measures postponed, under current container inspection regimes, the CBP identifies about 5 percent of all seaborne containers entering the US at high risk (Congressional Budget Office, 2016). Moreover, less than 1 percent of containers are inspected physically overseas under the CSI, which has caused its effectiveness to be questioned. The large percentage of uninspected containers and the possibility of tampering a sealed container during transportation pose potential security risks and vulnerability.

Issue 2: Collaboration network under current bilateral regimes

A collaborative working relationship has been fostered between the US government and participating foreign governments to share intelligence and best practice. However, the inequity issue was brought up in by the Delphi experts. First of all, since the US is playing a leading role in establishing a collaborative network based on the bilateral agreement, the partnership between member states and the US government is not balanced. In terms of information sharing and exchange, it has been pointed out that the US takes more information than sharing their own intelligence to others. The second inequity issue originated from the jurisdiction problem and the reciprocal agreement. Under the CSI, the US Customs officers are sent to the host state's ports for assistance and the host states have the opportunities to send their customs officers to major US ports. However, if all countries reciprocated in the CSI by sending their officers to each other’s' ports, an overabundance of officials in container operation would occur, and create chaos. In fact, so far, very few host countries have sent their officials to the US; therefore, the implementation of this reciprocity arrangement has diverged from its original plan. Last but not least, the jurisdiction and administration issue arising from the CSI bilateral agreement has been a major criticism. Generally speaking, a nation's jurisdiction is limited to its sovereign territory (Dallimore, 2008). Nevertheless, the CSI provisions make the host ports in US jurisdiction outreach. Although the objective of the US Customs team is to assess goods entering the US, the port industry revealed that there are extraterritorial control actions by US CSI teams at foreign ports, such as controlling non-US inbound containers inspection process. Both the literature review and the Delphi results revealed that there has been some resentment over the US authorities imposing their will and methods regarding the security issue upon the port industry to solely achieve their goals and aims.

Solution: supply chain security integration and multilateral regimes

Both of the issues revealed in this research indicate that the reason behind the central deficiency in the CSI is a result of the bilateral agreement rather than a global arrangement. A feasible and effective solution to the vulnerability in container movement and the issues discussed above is to form a comprehensive multilateral regime between all supply chain actors and integrate security into the entire supply chain, as suggested by the Delphi panellists (see Section 10.1.3). A multilateral agreement is different from the current bilateral agreement such as the CSI, and a multilateral regime will provide security accountability standards and improve traceability for all elements of container operations. Under a multilateral regime, all supply chain actors will commit themselves into providing a more secured and fair global trade. Moreover, this research pointed out that SCS stakeholders are currently facing a mosaic of measures and regulations that are overlapping and confusing (Figure 2.2 on p.46). A multilateral regime would lead to a harmonisation of security requirements and a collaborative network that is applicable to container transportation operations throughout the supply chain downstream and upstream.

Implementation considerations

Certain issues need to be taken into consideration during planning and implementation of the proposed multilateral regime.

Stakeholder participation and commitment

To make sure all actors are fully committed to such a multilateral regime, all stakeholders and their interests should be considered. As discussed in Section 9.2, maritime governance is formed as a hierarchical model. Various NGOs and IGOs are enforcing regulations at different level. In the case of developing a multilateral security regime, a strong push from the national level is essential to make sure realisation of such a regime is enforced effectively between all parties, especially the private actors and relevant authorities. Furthermore, security, as a public good, should be provided by the government. A strong continuing oversight of a security regime is needed from the government.

Secondly, shipping companies, port authorities and other companies will play a major role in implementing such a regime. Hence, industries should be consulted and brought into the process at a very early stage to gain their support and assure their efforts are effective and realistic. Taking the 100% scanning measure as an example, the industries' self-interest should take a leading role in formulating effective procedures, rather than letting them be imposed by governments since the industries are more concerned about costs, effectiveness, substantial responsibilities and possible competition inequities. This multilateral regime not only should have a full-scale horizontal coverage which includes all public and private stakeholders within a global supply chain, but also forms a vertical integrated cooperation network which includes participations from all governance levels. In a nutshell, two dimensions are needed in this regime, which are vertical and horizontal.

Cost issue

Implementation of a multilateral regime would cause not only monetary cost, but also economic loss due to logistical interruption. Although it is difficult to estimate and measure accurately, the economic cost could be offset by a more secure and reliable supply chain if the revenue loss from theft and smuggling are significantly reduced. Three different levels of costs will occur for establishing and implementing such a multilateral agreement, which are (1) the national cost of establishing and conducting the multilateral agreement; (2) the maritime industrial cost of compliance and operating the regime; (3) the cost of forming and coordinating the multilateral regime at international level. States are suggested to provide suitable equipment at participating transit points such as scanning sensors, and subsidise private sectors as incentives. In addition, installation costs, operation and maintenance of equipment and relevant technical support should be covered by relevant authorities at national and regional level. Moreover, participating private actors should work with public actors to process and recuperate the compliance cost. However, the cooperation of all stakeholders should make sure there is a level-playing field and avoid inequities of competition. The last category of cost is for forming and enhancing an international coordination mechanism. A forum at the international and supranational level should be set up for preliminary negotiation and increase engagement of all parties. A protocol or Memorandum of Understanding (MOU) could be generated from such a forum. The cost should be shared among all member states based on the agreement.

10.2 Research contribution

This research was designed to analyse how the CSI affects EU container seaport competition in the long run. The research design focused on the most important EU container seaport competitiveness determinants, therefore, the results and the findings from this Delphi survey contribute to the research gap brought up by Dekker and Stevens (2007). Moreover, it provides empirical evidence to the controversial port operational and logistical efficiency issues caused by the security initiative compliance. In addition, the results of the Delphi survey also support the arguments by McCalla (1999) (Section 3.3.4), Wang *et al.* (2004) (Section 3.3.5) and Bichou and Gray (2005) (Section 3.3). The literature review revealed that most previous research regarding the implications of maritime security measures for ports are quantitative studies, using methods such as conceptual work, modelling techniques, economic analysis and efficiency measurement. Very limited and abstracted input factors were used and major obstacles occurred when these quantitative data were obtained. This Delphi research is a qualitative approach that enabled a more in-depth response than a quantitative survey in terms of ideological issues as well as obtaining attitudes from various experts in relevant fields. The primary data collected from the Delphi survey provides insights from stakeholders so that it helps policy makers and regulatory bodies to form better policy about developing an effective and efficient maritime multilateral security regime. In addition, this research also interpreted the result of Delphi survey from economic political, logistics, and port management and ideology aspects, and developed a comprehensive model to illustrate the underlying factors. In order to solve the issues discovered in this research, a proposal of developing a multilateral agreement among all stakeholders involved in the entire supply chain was suggested. This multilateral agreement should be more industry-based than administration-based to incentivise all stakeholders' participation to ensure its effectiveness. This solution also fills the research gap brought up by Dekker and Stevens (2007) on whether security measures should be more administration-based than industry-based.

10.3 Research limitations

Although this research has achieved its research aim and objectives and contributes valuable information to maritime security policy and operations, several limitations in the research procedure exist.

10.3.1 Response inconsistency

As shown in Chapter 8, major limitations arise from the nature of the Delphi technique. Bichou (2008a) mentioned that a problem with surveys occurs when the results of a case-specific survey are generalised to all stakeholders. Even when a survey investigates a single security programme, the results could show inconsistency either over time or among participants (Bichou, 2008a). A major drawback of the Delphi technique is that key stakeholders' understanding of statements could be influenced by their varying backgrounds.

Regarding this specific Delphi study, in order to find out whether the CSI is beneficial to the whole logistics community, three groups of experts with different backgrounds were included to analyse the fragmented shipping industry. However, this arrangement has created certain disputes with Delphi statements. For instance, administrative experts emphasised the necessity of security measures more than commercial operational concern for private sectors, while industrial experts believed that commercial goals and interests should be their first priority. Participants were isolated from each other during the process and a strong inclusion of a statement could be lost. Statement 4.1 failed to reach consensus after three rounds since the academic expert insists security initiative compliance brings additional cost and operations disruption regardless of the degree of influence, hence, the dynamics of EU port market would be changed. However, it is incomprehensive to interpret experts' opinions without considering their backgrounds. Industrial experts observe the port market from the angle of commercial operations and traffic flow, while academic experts argue from a conceptual and historical content perspective. Judgment cannot be made on which opinion is correct. There has been no evidence of EU port market distortion so far; nonetheless, port competition is so complex that one change in key factors could lead to an undetected change in the dynamics. One solution to this limitation is to hold an online seminar to discuss the theoretical and practical context while remaining anonymous.

10.3.2 Small panel size

The second limitation comes from the small panel size. There were only 17 out of 83 invited experts who responded and completed the Delphi round one. Fourteen experts stayed and completed all three rounds. It is difficult to maintain the momentum and interest in the survey. Reminders and follow-up emails were sent out; however, the actual procedure was slower than expected. Moreover, as the statements become more specific and in depth, some experts found their knowledge insufficient to contribute valuable and accurate information to the survey. Although the panel size was adjusted in Chapter 8 and acceptable for the research topic, a Delphi panel size range from 20 to 50 is more optimal to generate data. This Delphi survey could be better if more administrative experts joined in.

10.3.3 EU case-specific research

Last but not least, this research only studied EU container seaports, while the CSI is a global initiative that has more compliance ports in Asia and Americas. Ports in those less developed regions face more obstacles in implementing maritime security measures financially and physically. A different standpoint could be generated from studying those ports and their authorities. There are more conflicts in interests among different stakeholders in the logistics chain since developing countries are in a weaker situation when it comes to US-lead supply chain.

10.4 Recommendations for future research

First of all, it would be highly beneficial to consider the implications of the CSI at the global level and form a comparative study between developed country ports and developing country ports. Maritime security is closely linked to politics and less transparent. There will be more government intervention in the shipping industry in less developed regions. Therefore, the action and attitude from public sectors towards maritime security measures implementation should be included as a key factor. However, there could be obstacles in obtaining data since the shipping sector in developing countries is less privatised and relevant stakeholders may be less willing to reveal their true opinions on a political matter.

Secondly, as discussed in Section 10.3.2, although there is no definitive size for a Delphi survey, 20 to 50 participants would be an appropriate size to provide a representative pooling of judgements regarding this research topic (Witkin and Altschuld, 1995). In addition to larger panel size, a wider variety of stakeholders should be taken into consideration as potential participants.

In terms of research method, more than one approach can be adopted to generate more comprehensive data. Interviews or group discussion could be carried out. Moreover, both quantitative (port operational data, financial performances) and qualitative data (comprehensive comments from wider stakeholder range) should be collected to develop a model to have a sound understanding of how maritime security policy affects the port sector.

In summary, future research should be based on a global level and the development of a multilateral security agreement throughout the entire supply chain. Therefore, a wider variety of stakeholders, larger sample size, a mix of quantitative and qualitative data analysis, and adoption of various research methods should be taken into consideration for future research.

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Appendix

Appendix 1: Sample copy of invitation email for Delphi Round One

Dear Mr/Ms xx,

Reference: Request to participate in a PhD study entitled: 'An examination of the US Container Security Initiative (CSI) and exploration of its effects on EU port competition'

My name is Xufan Zhang, I am a research scholar of the Plymouth University Maritime and Logistics faculty. I am currently preparing my thesis in the context of container port security and port competition. The study is of particular interest as it is the first attempt to gather academic and industrial experts' opinions over such a controversial topic and to provide clear qualitative studies for policy makers to make rational decisions.

The purpose of this study is not to test the relationships between the CSI programme and EU port competition, but to identify and describe them. The limited amount of research related to this subject means that this research is exploratory, aiming at identification, classification and description rather than explanation. The following objectives have been set:

- To undertake a critical review of the literature of port security and EU port competition.
- To review the various port security regulations of the U.S.A. and to critically analyse the CSI program based on the existing debate over its implications.
- To identify the EU container seaport competitiveness determinants and investigate the effects of the CSI on EU container seaport competition utilising a combination of literature review and a Delphi technique.
- To conclude the current CSI implementation within the EU and provide a sustainable solution to existing issues discovered on maritime security.

Due to your rich fund of knowledge in the area of maritime, you have been selected as an expert and invited to participate in this Delphi study, which is a confidential survey that will be conducted over two to three rounds. None of your responses will be accessible by the other participants. I would like to invite you to fill the Delphi questionnaire online in FIVE weeks via the link below (the link will expire in five weeks).

A number of assumptions have been developed based on various researches in order to draw analysis upon the original research objectives. I would like to invite you as an expert in the field to participate in the research by considering these assumptions. The research method is based on the Delphi technique, comprising of three rounds of questionnaires in which I ask you to comment upon several statements with 'agree', 'disagree' or 'unable to comment'. In either case of agreement or disagreement, I ask you to give arguments for your answer. There are 13 questions for Delphi round one, the list of statements was developed from the results of a numerical research synthesis. The 13 questions are categorised into 5 topics that help to answer the original research question. They are: (1) the necessity of carrying out maritime security initiative; (2) introduction of the CSI and the its controversial influences; (3) determinants of EU container port competitiveness; (4) the implications of introduction of the CSI on EU port competition; (5) open-ended question for experts to express their comments.

This questionnaire is set up with Qualtrics, using Cookies and allowing “save and continue” function. It allows you to save and continue later if you would like to finish it in several times. However, this function will be invalid if you open the link with other web browser or computer.

Please forgive me for asking such a short period of time for responding since it is quite a complex process to analyse the feedback. The first round contains 13 questions. Once all the responses have been collected through Qualtrics, I as the Delphi Study facilitator can then process the responses and prepare the second round of this study.

I have attached a word document to explain my PhD project. Brief introduction to the project. If at any time you have any concerns about this Delphi Study or you would like to have more information about this research project, please do not hesitate to contact me and I will answer your questions. My email address is xufan.zhang@plymouth.ac.uk.

Your participation in this study is of vital importance to the overall success of my thesis and therefore your help would be very much appreciated.

Thank you very much for your time and cooperation. I am already looking forward to your response.

Best regards
Miss Xufan Zhang
PhD Research Scholar
Maritime Security and Port competition
Plymouth Business School

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Appendix 2: An examination of the US Container Security Initiative (CSI) and exploration of its effects on EU port competition

Xufan Zhang, Michael Roe

Plymouth University

Background

The 9/11 attack has brought safety and security considerations to the forefront of international concerns. Since world trade is largely dependent on maritime transport, the security of maritime transport has received particularly significant attention. Several major international organisations also swiftly reacted to the need for strengthening security measures to enhance maritime transport safety. Different sets of rules and measures have been implemented internationally.

Container Security Initiative (CSI) was established by US in 2002. Participating countries develop as security regime in cooperation with the US Customs and Border Protection (CBP) to ensure all containers that pose a high risk for terrorism are inspected before they are loaded onto vessels destined for US ports. Nevertheless, implications relevant to port competition distortion have emerged. Financial problems have become a major concern. Despite denials from the US, evidence exists that costs related to equipment and personnel can be enormous. The additional cost to US importers of trading with countries adopting such cost-recovery measures may cause importers to consider cheaper alternatives. In addition, although not participating in the CSI does not prevent a country exporting containers to the US, the processing by the US of shipments from non-CSI ports may be less efficient than from CSI-affiliated countries. This will affect the exporting port's efficiency, which will influence the customer decision towards port choice. The European Commission was reportedly concerned that European ports will become divided into those which are approved by US Customs and those not, resulting in the erosion of fair and genuine competition between ports.

Aim and objectives

Much of the available research is based on conceptual work, the economic situation or anecdotal evidence. There is a lack of clear qualitative studies for policy makers to make rational decisions. This project aims to examine the Container Security Initiative (CSI) program which is managed by the US Customs and Border Protection (CBP) intending to improve US border security and protect the global trading system by screening US-bound shipping containers in ports around the world. The aim is to find out the effects of the CSI on EU container seaport competition. Some feasible solutions to the problems discovered will be explored as well.

In order to achieve the aim, the first objective is to offer an overview of the new maritime security environment by presenting several main U.S. initiatives relevant to maritime container security. Accordingly, a critical analysis of the CSI program based on the existing debate over its implications will be presented. The literature review will also cover the theories and conceptual models in terms of port competition. This research will analyse the impacts of the CSI program on relevant characteristics of EU port competition based on the findings from this primary research and research gaps from previous studies.

Initial insights

Based on the current literature review, there could be a distortion of EU port competition reflected in terms of both finance and efficiency. As for the CSI members, some literature advocates productivity gains due to better procedural arrangements. Proponents argue that its implementation is also commercially rewarding. However, some research conclusions pointed out that security programs will have negative impacts on organisational performance. Therefore, this research will offer a confirmatory and qualitative/quantitative study which will not only be useful for ports, but also for governments in terms of setting a better policy.

Appendix 3: Delphi Pilot survey invitation email

Dear Mr/Ms xx,

My name is Xufan Zhang, I am a research scholar of the Plymouth University Maritime and Logistics faculty. I am currently working on my PhD thesis aiming at finding out implications of the Container Security Initiatives on EU port competition through Delphi study.

Due to your rich fund of knowledge in the area of maritime, you have been selected as an expert and invited to participate in this Delphi study, which is a confidential survey that will be conducted over two to three rounds. None of your responses will be accessible by the other participants. I would like to invite you to fill the Delphi questionnaire online in THREE weeks via the link below (the link will expire in three weeks).

This questionnaire is set up with Qualtrics, using Cookies and allowing “save and continue” function. It allows you to save and continue later if you would like to finish it in several times. However, this function will be invalid if you open the link with other web browser or computer.

Please forgive me for asking such a short period of time for responding since it is quite a complex process to analyse the feedback. The first round contains 13 questions. Once all the responses have been collected through Qualtrics, I as the Delphi Study facilitator can then process the responses and prepare the second round of this study.

I have attached a word document to explain my PhD project. Brief introduction to the project. If at any time you have any concerns about this Delphi Study or you would like to have more information about this research project, please do not hesitate to contact me and I will answer your questions.

Your participation in this study is of vital importance to the overall success of my thesis and therefore your help would be very much appreciated.

Thank you very much for your time and cooperation. I am already looking forward to your response.

Best regards

Miss Xufan Zhang

PhD Research Scholar

Maritime Security and Port competition

Plymouth Business School

Appendix 4: Reminder email for Delphi round one

Dear Mr/Ms xx,

Reference: Request to participate in a PhD study entitled: 'An examination of the US Container Security Initiative (CSI) and exploration of its effects on EU port competition'

On 1st September 2015, I sent you an invitation email to request your participation regarding my Delphi survey of the CSI and the EU port competition. As your expertise in the maritime field, I sincerely invite your participation in this survey.

I fully understand your busy schedule. Completing this survey would take 30-45 mins, but the opinions and information you provide is significantly important to the study of maritime security and decision-making process. You are part of a scientifically chosen sample of experts in the area of maritime security, port operation and competition. I hope you would view your effort as important and valuable with regard to the relevant field.

I attach the original invitation email down below to present a full instruction in how to take part in this study. Please allow me to remind you that there are three weeks left till the closure of the Delphi round one.

Original Delphi round one email:

Reference: Request to participate in a PhD study entitled: 'An examination of the US Container Security Initiative (CSI) and exploration of its effects on EU port competition'

My name is Xufan Zhang, I am a research scholar of the Plymouth University Maritime and Logistics faculty. I am currently preparing my thesis in the context of container port security and port competition. The study is of particular interest as it is the first attempt to gather academic and industrial experts' opinions over such a controversial topic and to provide clear qualitative studies for policy makers to make rational decisions.

The purpose of this study is not to test the relationships between the CSI programme and EU port competition, but to identify and describe them. The limited amount of research related to this subject means that this research is exploratory, aiming at identification, classification and description rather than explanation. The following objectives have been set:

- To undertake a critical review of the literature of port security and EU port competition.

- To review the various port security regulations of the U.S.A. and to critically analyse the CSI program based on the existing debate over its implications.

- To identify the EU container seaport competitiveness determinants and investigate the effects of the CSI on EU container seaport competition utilising a combination of literature review and a Delphi technique.

• To conclude the current CSI implementation within the EU and provide a sustainable solution to existing issues discovered on maritime security.

Due to your rich fund of knowledge in the area of maritime, you have been selected as an expert and invited to participate in this Delphi study, which is a confidential survey that will be conducted over two to three rounds. None of your responses will be accessible by the other participants. I would like to invite you to fill the Delphi questionnaire online in FIVE weeks via the link below (the link will expire in five weeks).

A number of assumptions have been developed based on various researches in order to draw analysis upon the original research objectives. I would like to invite you as an expert in the field to participate in the research by considering these hypotheses. The research method is based on the Delphi technique, comprising of three rounds of questionnaires in which I ask you to comment upon several statements with 'agree', 'disagree' or 'unable to comment'. In either case of agreement or disagreement, I ask you to give arguments for your answer. There are 13 questions for Delphi round one, the list of statements was developed from the results of a numerical research synthesis. The 13 questions are categorised into 5 topics that help to answer the original research question. They are: (1) the necessity of carrying out maritime security initiative; (2) introduction of the CSI and the its controversial influences; (3) determinants of EU container port competitiveness; (4) the implications of introduction of the CSI on EU port competition; (5) open-ended question for experts to express their comments.

This questionnaire is set up with Qualtrics, using Cookies and allowing “save and continue” function. It allows you to save and continue later if you would like to finish it in several times. However, this function will be invalid if you open the link with other web browser or computer.

Please forgive me for asking such a short period of time for responding since it is quite a complex process to analyse the feedback. The first round contains 13 questions. Once all the responses have been collected through Qualtrics, I as the Delphi Study facilitator can then process the responses and prepare the second round of this study.

I have attached a word document to explain my PhD project. Brief introduction to the project. If at any time you have any concerns about this Delphi Study or you would like to have more information about this research project, please do not hesitate to contact me and I will answer your questions. My email address is xufan.zhang@plymouth.ac.uk.
Your participation in this study is of vital importance to the overall success of my thesis and therefore your help would be very much appreciated.

Thank you very much for your time and cooperation. I am already looking forward to your response.

Best regards
Miss Xufan Zhang

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Appendix 5: Sample copy of invitation email for Delphi Round Two

Dear ${m://LastName}:

Reference: Delphi round two - participation in a PhD study entitled: 'An examination of the US Container Security Initiative (CSI) and exploration of its effects on EU port competition'.

Thank you for agreeing to participate in the study of container port security. The Delphi panel of which you are a member has been carefully and rigorously put together based on their experience and knowledge of maritime security and EU container port operation.

As previously stated, by design the Delphi study is an iterative process comprising of a series of three consecutive questionnaires. The purpose of this study is not to test the relationships between the CSI programme and EU port competition, but to identify and describe them. The limited amount of research related to this subject means that this research is exploratory, aiming at identification, classification and description rather than explanation. The study is of particular interest as it is the first attempt to gather academic and industrial experts' opinions over such a controversial topic and to provide clear qualitative studies for policy makers to make rational decisions. There are 14 questions for Delphi round one, the list of statements was developed from the results of a numerical research synthesis. The 14 questions are categorised into 5 topics that help to answer the original research question. They are: (1) the necessity of carrying out maritime security initiative; (2) introduction of the CSI and the its controversial influences; (3) determinants of EU container port competitiveness; (4) the implications of introduction of the CSI on EU port competition; (5) open-ended question for experts to express their comments.

Delphi round two is now enclosed. I have attached a word document to show you the Delphi Round one results. If at any time you have any concerns about this Delphi Study or you would like to have more information about this research project, please do not hesitate to contact me and I will answer your questions. This round allows you to reconsider your opinion on any statement which has not previously reached group consensus. You are at liberty to change your opinion completely, or stick to your original argument if you feel it is appropriate. Please indicate your opinion on each statement by selecting one of the following: "agree‟, "disagree‟, or "neither agree nor disagree‟. Once again there is an opportunity to comment should you wish to do so. All the questions in each section must be answered. It should not take longer than 40 minutes to complete this questionnaire. If you have any questions regarding the study please do not hesitate to contact me using the above contact details.

All information will be treated confidentially. Responses are given anonymously, (the identity of the respondents is not known to the other experts in the study) and will only be known by the researcher. As a candidate, I would like to invite you to fill the Delphi questionnaire online in EIGHT weeks via the link down below (the link will be expired in EIGHT weeks), considering the winter break. This questionnaire is set up with Qualtrics, using Cookies and allowing "save and continue" function. It allows you to save and continue later if you would like to finish it in several times. However, this function will be invalid if you open the link with other web browser or computer.

Your participation in this study is of vital importance to the overall success of my thesis and therefore your help would be very much appreciated.

Thank you very much for your time and cooperation. I am already looking forward to your response.

Follow this link to the Survey: ${l://SurveyLink?d=Take the Survey}

Or copy and paste the URL below into your internet browser:
${l://SurveyURL}

${l://OptOutLink?d=follow%20this%20link%20if%20you%20wish%20to%20unsubscribe%20the%20emails}

Best regards
Miss Xufan Zhang
PhD Research Scholar
Maritime Security and Port competition
Plymouth Business School

Appendix 6: Summary of Delphi Round One result

Background - How would you describe your current background?

#	Answer	%	Count
1	Academic	52.94%	9
2	Industrial	17.65%	3
3	Administrative	11.76%	2
4	Other	17.65%	3
	Total	100%	17

Other

Other
Government
Transportation Advisor
academic

Adjusted size and structure of panel

Category	Response	Percentage
Academic	10	56%
Industrial	4	25%
Administrative	3	19%
Total	17	100%

S 1.1 - Maritime security has become a great concern worldwide. The increasing volume of container movements, their relatively high velocity in the international trade and their uniformity have posed formidable security challenges. As the loading and unloading points of a sea transport process, container ports are the most important nodes for maritime safety. However, only around 2% to 10% of containers are actually inspected. U.S. ports normally inspect roughly 5% of the 17 million containers arriving at the border every year. A great concern about container security emerged from this low inspection rate. Container security is far more important than efficiency and profit for the port. Therefore, security should be seen as the first priority.

#	Answer	%	Count
1	Agree	58.82%	10
2	Neither Agree nor Disagree	23.53%	4
3	Disagree	17.65%	3
	Total	100%	17

S1.2 - As the world's largest national economy, United States plays a vital role in global trade. After 9/11, US has reacted to the needs for strengthening security measures to enhance maritime transport safety. Some of the maritime security initiatives have influence on some export ports in terms of logistics efficiency and financing. Nevertheless, those export ports should be prepared to comply with the US container port security initiatives for maritime safety.

#	Answer	%	Count
1	Agree	64.71%	11
2	Neither Agree nor Disagree	23.53%	4
3	Disagree	11.76%	2
	Total	100%	17

S 2.1 - The Container Security Initiative (CSI) program managed by the U.S. Customs and Border Protection (CBP) is an influential voluntary initiative. CSI was proposed to ensure all containers that pose a potential risk for terrorism are identified and inspected at foreign ports before they are loaded on to vessels imported to the U.S. Without a doubt, CSI has increased the level of awareness for the need to secure global trade.

#	Answer	%	Count
1	Agree	88.24%	15
2	Neither Agree nor Disagree	11.76%	2

3	Disagree	0.00%	0
	Total	100%	17

S 2.2 - Unlike the 24 Hour Rule, CSI is a voluntary initiative. However, in order to keep the market share for US inbound trade, the major exporters have to join the programme. Not joining the programme could make the exports lose competitiveness over their rivals.

#	Answer	%	Count
1	Agree	58.82%	10
2	Neither Agree nor Disagree	35.29%	6
3	Disagree	5.88%	1
	Total	100%	17

S 3 - The port environment has become increasingly competitive, it varies among regions depending upon the extent to which influential factors affect the nature of the port environment. According to prior studies, the components of port competitiveness are: port location, port facilities, overall efficiency, hinterland networks, value added logistics; and port services, safety handling of cargoes, confidence in port schedules, simplification of procedures, operational transparency, and port labour and skills. Among these factors, for the EU ports, since port location is static, port efficiency, service and cost related elements are still the most important competitiveness components. Port safety and security is not an incentive for port selection.

#	Answer	%	Count
1	Agree	52.94%	9
2	Neither Agree nor Disagree	5.88%	1
3	Disagree	41.18%	7
	Total	100%	17

S 4.1 - To obtain the minimum required level of compliance, ports need to implement technical and organisational measures that will bring additional costs to maritime industries. Enhancing the technical measures due to security regulations, such as the ISPS Code, has brought additional costs to European maritime industries. Smaller ports in the EU may stop their US-inbound business since they cannot bear the financial costs. Larger ports may "steal" new business from smaller ports which are financially strained to meet the scanning requirements. A distortion of the EU container port market share will arise.

#	Answer	%	Count
1	Agree	29.41%	5
2	Neither Agree nor Disagree	47.06%	8
3	Disagree	23.53%	4
	Total	100%	17

S 4.2 - While port security measures enhance port security, procedural requirements of the new security regime act against operational and logistical efficiency. The proponents of this view list a number of operational inefficiencies ranging from direct functional redundancies such as additional inspections and lengthy procedures to indirect supply chain disruptions stemming from longer lead times and less reliable demand and supply scenarios.

#	Answer	%	Count
1	Agree	41.18%	7
2	Neither Agree nor Disagree	23.53%	4
3	Disagree	35.29%	6
	Total	100%	17

S 4.3 - Productivity could improve due to better procedural arrangements. With the reinforcement of security, there is reduced likelihood of security incidents, a probability of fewer incidents being recorded and higher port reliability. Increased reliability which leads to higher trust between a port and its upstream and downstream partners in a container supply chain, contributes to the reduction of cargo processing time and results in reduction of cargo processing cost. Decreased cargo processing cost has a positive effect on port selection, thus attracting more container volume. Consequently, from the viewpoint of the above analysis, improving security level and increasing port reliability can attract more containers. Compliant participants would benefit from access certification and fast-lane treatment as well as reduced insurance costs and risk exposure.

#	Answer	%	Count
1	Agree	58.82%	10
2	Neither Agree nor Disagree	23.53%	4
3	Disagree	17.65%	3
	Total	100%	17

S 4.4 - Although the US Customs and Border Protection stated that the CSI can bring benefits to member ports, those benefits are still controversial. The CSI has negative effects on port profit. In addition to the significant initial investment in new equipment, the CSI makes cargo inspection process more complicated, creating an increase in cargo processing time and cargo processing cost. That can change important performance characteristics of the port such as the port efficiency and price. On the perspective of a long-term economic model, these consequences produce the negative impacts on relative attractiveness of ports for various stakeholders, namely exporters, and cargo carriers. The reduced attractiveness will decrease the competitiveness of a port. Moreover, the deepening cost and time may initiate a vicious circle of decreasing port competitiveness. CSI is actually a heavy burden for those ports that have joined.

#	Answer	%	Count
1	Agree	23.53%	4
2	Neither Agree nor Disagree	35.29%	6
3	Disagree	41.18%	7
	Total	100%	17

S 4.5 - The CSI could improve the capabilities and the overall effectiveness of the targeting process. However, this programme transfers the container examinations from unloading ports in the US to the loading ports overseas. On the other hand, all the checks are carried out in the host countries which bear the equipment cost. In case of unloading and emptying of any potential threat posed by a dangerous container, the costs are borne by the importer to a US port. The US Customs sacrifices the export ports to save the US unloading port’s time and cost. The CSI is a unilateral and unfair programme without considering the host ports.

#	Answer	%	Count
1	Agree	23.53%	4
2	Neither Agree nor Disagree	29.41%	5
3	Disagree	47.06%	8
	Total	100%	17

S 4.6- CSI bilateral system of information exchange requires a host country to offer to conduct a security check on containers shipping to a US port. In return, the host country can send its officers to any US port to target ocean –going containerised cargo being exported to their country. Under this system, there can be sensitive information exchange, according to the US government, which may be deemed necessary to ensure safety of any ports involved. However, the host countries are not willing to offer any confidential information.

#	Answer	%	Count
1	Agree	29.41%	5
2	Neither Agree nor Disagree	47.06%	8
3	Disagree	23.53%	4
	Total	100%	17

S 5 - There are many ports in Europe. However, there are 'only' about 130 seaports handling containers of which around 40 accommodate intercontinental container services. About 70% of the total container throughput in the EU port system passes through the top 17 load centres. 14 of those have joined the CSI programme. In the short term, small container ports have to stop their US inbound business and large EU container ports will gain new market share. In the long run, with further CSI implementation, the EU host countries will absorb the extra cost through transferring them to customers. However, the distortion in the competitiveness of large EU container ports will be minor.

#	Answer	%	Count
1	Agree	47.06%	8
2	Neither Agree nor Disagree	35.29%	6
3	Disagree	17.65%	3
	Total	100%	17

Open-question: Are there any further comments you would like to make on these statements and how do you think the CSI will change the EU container port competition? In addition to cost, efficiency and port charges, what other aspect do you think the CSI will/have affected in short/long-term?

#	Answer	%	Count
1	Agree	33.33%	5
2	Neither Agree nor Disagree	53.33%	8
3	Disagree	13.33%	2
	Total	100%	15

Appendix 7: Reminder email for Delphi round two

Dear Mr/Ms xx,

Reference: Request to participate in a PhD study entitled: 'An examination of the US Container Security Initiative (CSI) and exploration of its effects on EU port competition'

On 1stDecember 2015, I sent you an invitation email to request your participation regarding my Delphi survey of the CSI and the EU port competition. As your expertise in the maritime field, I sincerely invite your participation in this survey.

I fully understand your busy schedule. Completing this survey would take 30-45 mins, but the opinions and information you provide is significantly important to the study of maritime security and decision-making process. You are part of a scientifically chosen sample of experts in the area of maritime security, port operation and competition. I hope you would view your effort as important and valuable with regard to the relevant field.

I attach the original invitation email down below to present a full instruction in how to take part in this study. Please allow me to remind you that there are three weeks left till the closure of the Delphi round two.

Original Delphi round two email:

Reference: Delphi round two - participation in a PhD study entitled: 'An examination of the US Container Security Initiative (CSI) and exploration of its effects on EU port competition'.

Thank you for agreeing to participate in the study of container port security. The Delphi panel of which you are a member has been carefully and rigorously put together based on their experience and knowledge of maritime security and EU container port operation.

As previously stated, by design the Delphi study is an iterative process comprising of a series of three consecutive questionnaires. The purpose of this study is not to test the relationships between the CSI programme and EU port competition, but to identify and describe them. The limited amount of research related to this subject means that this research is exploratory, aiming at identification, classification and description rather than explanation. The study is of particular interest as it is the first attempt to gather academic and industrial experts' opinions over such a controversial topic and to provide clear qualitative studies for policy makers to make rational decisions. There are 14 questions for Delphi round one, the list of statements was developed from the results of a numerical research synthesis. The 14 questions are categorised into 5 topics that help to answer the original research question. They are: (1) the necessity of carrying out maritime security initiative; (2) introduction of the CSI and the its controversial influences; (3) determinants of EU container port competitiveness; (4) the implications of introduction of the CSI on EU port competition; (5) open-ended question for experts to express their comments.

Delphi round two is now enclosed. I have attached a word document to show you the Delphi Round one results. If at any time you have any concerns about this Delphi Study or you would like to have more information about this research project, please do not hesitate to contact me and I will answer your questions. This round allows you to reconsider your opinion on any statement which has not previously reached group consensus. You are at liberty to change your opinion completely, or stick to your original argument if you feel it is appropriate. Please indicate your opinion on each statement by selecting one of the following: "agree‟, "disagree‟, or "neither agree nor disagree‟. Once again there is an opportunity to comment should you wish to do so. All the questions in each section must be answered. It should not take longer than 40 minutes to complete this questionnaire. If you have any questions regarding the study please do not hesitate to contact me using the above contact details.

All information will be treated confidentially. Responses are given anonymously, (the identity of the respondents is not known to the other experts in the study) and will only be known by the researcher. As a candidate, I would like to invite you to fill the Delphi questionnaire online in EIGHT weeks via the link down below (the link will be expired in EIGHT weeks), considering the winter break. This questionnaire is set up with Qualtrics, using Cookies and allowing “save and continue” function. It allows you to save and continue later if you would like to finish it in several times. However, this function will be invalid if you open the link with other web browser or computer.

Your participation in this study is of vital importance to the overall success of my thesis and therefore your help would be very much appreciated.

Thank you very much for your time and cooperation. I am already looking forward to your response.

Follow this link to the Survey: ${l://SurveyLink?d=Take the Survey}

Or copy and paste the URL below into your internet browser:
${l://SurveyURL}${l://OptOutLink?d=follow%20this%20link%20if%20you%20wish%20to%20unsubscribe%20the%20emails}

Best regards
Miss Xufan Zhang
PhD Research Scholar
Maritime Security and Port competition
Plymouth Business School

Appendix 8: Sample copy of invitation email for Delphi Round Three

Dear ${m://FirstName}

Reference: Delphi round three - participation in a PhD study entitled: 'An examination of the US Container Security Initiative (CSI) and exploration of its effects on EU port competition'.

Thank you for agreeing to participate in the study of container port security. The Delphi panel of which you are a member has been carefully and rigorously put together based on their experience and knowledge of maritime security and EU container port operation.

As previously stated, by design the Delphi study is an iterative process comprising of a series of three consecutive questionnaires. The purpose of this study is not to test the relationships between the CSI programme and EU port competition, but to identify and describe them. The limited amount of research related to this subject means that this research is exploratory, aiming at identification, classification and description rather than explanation. The study is of particular interest as it is the first attempt to gather academic and industrial experts' opinions over such a controversial topic and to provide clear qualitative studies for policy makers to make rational decisions. There are 14 questions for Delphi round one, the list of statements was developed from the results of a numerical research synthesis. The 14 questions are categorised into 5 topics that help to answer the original research question. They are: (1) the necessity of carrying out maritime security initiative; (2) introduction of the CSI and the its controversial influences; (3) determinants of EU container port competitiveness; (4) the implications of introduction of the CSI on EU port competition; (5) open-ended question for experts to express their comments.

Delphi round three is now enclosed. This round only consists of three statements which have not reached consensus during last round. If at any time you have any concerns about this Delphi Study or you would like to have more information about this research project, please do not hesitate to contact me and I will answer your questions. This round allows you to reconsider your opinion on any statement which has not previously reached group consensus. You are at liberty to change your opinion completely, or stick to your original argument if you feel it is appropriate. Please indicate your opinion on each statement by selecting one of the following: "agree‟, "disagree‟, or "neither agree nor disagree‟. Once again there is an opportunity to comment should you wish to do so. All the questions in each section must be answered. It should not take longer than 20 minutes to complete this questionnaire. If you have any questions regarding the study please do not hesitate to contact me using the above contact details. **Since it is the last round of this research, could I kindly ask you to comment as much as you like regarding the topic? Your professional opinion would be extremely valuable for my research.**

All information will be treated confidentially. Responses are given anonymously, (the identity of the respondents is not known to the other experts in the study) and will only be known by the researcher. As a candidate, I would like to invite you to fill the Delphi questionnaire online in THREE weeks via the link down below (the link will be expired in three weeks). This questionnaire is set up with Qualtrics, using Cookies and allowing “save and continue” function. It allows you to save and continue later if you would like to finish it in several times. However, this function will be invalid if you open the link with other web browser or computer.

Your participation in this study is of vital importance to the overall success of my thesis and therefore your help would be very much appreciated.

Thank you very much for your time and cooperation. I am already looking forward to your response.

Follow this link to the Survey: ${l://SurveyLink?d=Take the Survey}

Or copy and paste the URL below into your internet browser:
${l://SurveyURL}

Follow the link to opt out of future emails:
${l://OptOutLink?d=Click here to unsubscribe}

Best regards
Miss Xufan Zhang
PhD Research Scholar
Maritime Security and Port competition
Plymouth Business School

Appendix 9: Reminder email for Delphi Round Three

Dear Mr/Ms xx,

Reference: Request to participate in a PhD study entitled: 'An examination of the US Container Security Initiative (CSI) and exploration of its effects on EU port competition'

On 20th April 2015, I sent you an invitation email to request your participation regarding my Delphi survey of the CSI and the EU port competition. As your expertise in the maritime field, I sincerely invite your participation in this survey.

I fully understand your busy schedule. Completing this survey would take 20-30 mins, but the opinions and information you provide is significantly important to the study of maritime security and decision-making process. You are part of a scientifically chosen sample of experts in the area of maritime security, port operation and competition. I hope you would view your effort as important and valuable with regard to the relevant field.

I attach the original invitation email down below to present a full instruction in how to take part in this study. Please allow me to remind you that there are two weeks left till the closure of the Delphi round three.

Original Delphi round three email:

Dear ${m://FirstName}

Reference: Delphi round three - participation in a PhD study entitled: 'An examination of the US Container Security Initiative (CSI) and exploration of its effects on EU port competition'.

Thank you for agreeing to participate in the study of container port security. The Delphi panel of which you are a member has been carefully and rigorously put together based on their experience and knowledge of maritime security and EU container port operation.

As previously stated, by design the Delphi study is an iterative process comprising of a series of three consecutive questionnaires. The purpose of this study is not to test the relationships between the CSI programme and EU port competition, but to identify and describe them. The limited amount of research related to this subject means that this research is exploratory, aiming at identification, classification and description rather than explanation. The study is of particular interest as it is the first attempt to gather academic and industrial experts' opinions over such a controversial topic and to provide clear qualitative studies for policy makers to make rational decisions. There are 14 questions for Delphi round one, the list of statements was developed from the results of a numerical research synthesis. The 14 questions are categorised into 5 topics that help to answer the original research question. They are: (1) the necessity of carrying out maritime security initiative; (2) introduction of the CSI and the its controversial influences; (3) determinants of EU container port competitiveness; (4) the implications of introduction of the CSI on EU port competition; (5) open-ended question for experts to express their comments.

Delphi round three is now enclosed. This round only consists of three statements which have not reached consensus during last round. If at any time you have any concerns about this Delphi Study or you would like to have more information about this research project, please do not hesitate to contact me and I will answer your questions. This round allows you to reconsider your opinion on any statement which has not previously reached group consensus. You are at liberty to change your opinion completely, or stick to your original argument if you feel it is appropriate. Please indicate your opinion on each statement by selecting one of the following: "agree‟, "disagree‟, or "neither agree nor disagree‟. Once again there is an opportunity to comment should you wish to do so. All the questions in each section must be answered. It should not take longer than 20 minutes to complete this questionnaire. If you have any questions regarding the study please do not hesitate to contact me using the above contact details. **Since it is the last round of this research, could I kindly ask you to comment as much as you like regarding the topic? Your professional opinion would be extremely valuable for my research.**

All information will be treated confidentially. Responses are given anonymously, (the identity of the respondents is not known to the other experts in the study) and will only be known by the researcher. As a candidate, I would like to invite you to fill the Delphi questionnaire online in THREE weeks via the link down below (the link will be expired in three weeks). This questionnaire is set up with Qualtrics, using Cookies and allowing “save and continue” function. It allows you to save and continue later if you would like to finish it in several times. However, this function will be invalid if you open the link with other web browser or computer.

Your participation in this study is of vital importance to the overall success of my thesis and therefore your help would be very much appreciated.

Thank you very much for your time and cooperation. I am already looking forward to your response.

Follow this link to the Survey: ${l://SurveyLink?d=Take the Survey}
Or copy and paste the URL below into your internet browser:
${l://SurveyURL}

Follow the link to opt out of future emails:
${l://OptOutLink?d=Click here to unsubscribe}

Best regards
Miss Xufan Zhang
PhD Research Scholar
Maritime Security and Port competition
Plymouth Business School

Appendix 10: Application for ethical approval form

RESEARCH WITH PLYMOUTH UNIVERSITY	**Faculty of Business** **Academic Partnerships** **Faculty Research Ethics Committee** **APPLICATION FOR ETHICAL APPROVAL OF RESEARCH**	**(For FREC use only)** **Application No:**	
		Chairs action (expedited)	Yes/ No
		Risk level -if high refer to UREC chair immediately **Cont. Review Date**	High/ low / /
		Outcome (delete)	Approved/ Declined/ Amend/ Withdrawn

1.	**Investigator/student** **Note:1* Xufan Zhang	Student –*Professor Michael Roe* and Course/Programme: MPhil/PhD International Logistics, Supply Chain and Shipping Management
	Contact Address: Flat23 46Ebrington Street Plymouth PL4 9AD	
	Tel:07427611977	Email: xufan.zhang@plymouth.ac.uk
2.	**Title of Research:** An examination of the US Container Security Initiative (CSI) and exploration of its implications for EU container seaport competition	
3.	**Nature of approval sought** (Please tick relevant boxes) **Note:2* a) PROJECT: [x] b) PROGRAMME [ ] (max 3 years) *If a) then please indicate which category:* Funded/unfunded Research (*staff*) [ ] MPhil/PhD, ResM, BClinSci [x] Masters [ ] Undergraduate [ ] Or Other *(please state)* [ ]	
4.	**Funding:** a) Funding body (if any): b) If funded, please state any ethical implications of the source of funding, including any reputational risks for the university and how they have been addressed. **Note: 3*	
5.	a) Duration of project/programme: **Note:* 44years b) Dates:04/2013-04/2017	
6.	Has this project received ethical approval from another Ethics Committee? N a) Please write committee name: b) Are you therefore only applying for Chair's action now? N	
7.	**Attachments** (if required) a) Application/Clearance Form Yes b) Information sheets for participants No c) Consent forms No d) Continuing review approval (if requested) No e) Other, please state:	

**1. Principal Investigators are responsible for ensuring that all staff employed on projects (including research assistants, technicians and clerical staff) act in accordance with the University's ethical principles, the design of the research described in this proposal and any conditions attached to its approval.*

**2. In most cases, approval should be sought individually for each project. Programme approval is granted for research which comprises an ongoing set of studies or investigations utilising the same methods and methodology and where the precise number and timing of such studies cannot be specified in advance. Such approval is normally appropriate only for ongoing, and typically unfunded, scholarly* *research activity.*

**3. If there is a difference in ethical standards between the University's policy and those of the relevant professional body or research sponsor, Committees shall apply whichever is considered the highest standard of ethical practice.*

**4. Approval is granted for the duration of projects or for a maximum of three years in the case of programmes. Further approval is necessary for any extension of programmes.*

8. **Aims and Objectives of Research Project/Programme:**

The events of September 11th, 2001 have caused international concerns in terms of safety and security. World commerce depends heavily on maritime transport, so the security of maritime transport has received significant attention (UNCTAD, 2004). Several major international organisations also swiftly reacted to the need for strengthening security measures to enhance maritime transport safety. Varying sets of rules and measures have been implemented internationally. The main programs can be categorised as compulsory and voluntary.

CSI was established in 2002 by CBP to address the threat to border security and global trade posed by the potential terrorist use of a maritime container (World Bank, 2009). Participating countries develop a security regime in cooperation with the US CBP to ensure all containers that pose a high risk for terrorism are inspected before they are loaded onto vessels destined for US ports. Currently, CSI has been operated in 58 ports worldwide. It is labelled as voluntary since the regulations are not imposed by a law or international convention.

Theoretically, trade and transport operators can still operate possibly at a competitive disadvantage-with or without participating in those programmes (World Bank, 2009). However, implications relevant to port competition distortion have emerged. Financial problems have become a major concern since the CSI was introduced. The additional cost to US importers may cause importers to consider cheaper alternatives. In addition, although not participating in the CSI does not prevent a country exporting containers to the US, the processing by the US of shipments from non-CSI ports may be less efficient than the processing of shipments from CSI-affiliated countries. Longer processing time from a non- CSI port will affect the port's efficiency, which will influence the customer decision towards port choice.

This project aims to examine the Container Security Initiative (CSI) program which is managed by the U.S. Customs and Border Protection (CBP) intending to improve US border security and protect the global trading system by screening US-bound shipping containers in ports around the world. The aim is to and find out the potential implications of the introduction of CSI for EU port competition. In the academic field, there has been a large amount of research on maritime safety and security. Roach (2004) studied security management of terrorism threats in shipping companies. Håvold (2005) discussed safety culture in a Norwegian shipping company and classified the risks into 11 factors. Thai (2007) examined the effects of security improvements in maritime transport with an empirical study of Vietnam. Lun *et al*. (2008) discussed how technology could enhance container transportation security. The implications of different maritime security measures for ports in terms of financing and efficiency have been widely discussed. Based on the current literature review, there could be a distortion of EU port competition which will be reflected mainly from the aspects of finance and efficiency. According to Bichou (2011), there exist two major debates over port efficiency due to security initiatives: port security measures enhance port security; procedural requirements of the new security regime harm operational and logistical efficiency (Bichou, 2011).

Nevertheless, there is rarely empirical analysis to support both arguments. Much of the available research is based on conceptual work, the economic situation or anecdotal evidence. There is a lack of clear qualitative studies for policy makers to make rational decisions. Therefore, this research will offer a confirmatory and qualitative study which will not only be useful for ports, but also for governments in terms of setting a better policy. Some feasible solutions to the problems discovered will be explored as well.

In order to achieve the research aim, the following research objectives are developed:

	•To undertake a critical review of the literature of port security and EU port competition. •To review the various port security regulations of the U.S.A. and to critically analyse the CSI program based on the existing debate over its implications. • To analyse the potential impacts of the CSI program on relevant characteristics of EU port competition based on the findings form this primary research and research gaps from previous studies • To provide some feasible solutions to the problems discovered
9.	**Brief Description of Research Methods and Procedures:** The purpose of this study is not to test the relationship between the CSI programme and EU port competition, but to identify, describe and understand them. According to the literature review, there is a lack of empirical data in the case of how maritime security measures affect port competition. In order to find out how the CSI changes EU port competition, Delphi can help to get comprehensive opinions and judgements in terms of the past, present and future need to be collected. Additionally, Delphi can be applied to a wide range of subjects, such as policy-making and industry predictions. A broader spectrum of responses can be gathered since Delphi enables the participation of stakeholders with a variety of backgrounds. Also, participants can explore the original hypothesis and subsequent developments to offer a range of inclusive indicators for the final research. Furthermore, Delphi questionnaires can be facilitated through post or email, which makes it very efficient. Efficiency is vital for experts who are very busy. Cost can be saved since Delphi does not involve physical contact like interviews to collect the required data. The Delphi process for this research is: 1. Selection of panel to participate in the exercise. Customarily, the panellists are experts in the area to be investigated. 2. Development of the first round Delphi questionnaire. 3. Testing the questionnaire for proper wording (e.g. ambiguities). Transmission of the first questionnaire to the panellists. 4. Analysis of the first round responses and preparation of the second round questionnaire (and possible testing). Transmission of the second round questionnaire to the panellists. 5. Analysis of the second round responses and preparation of the third round questionnaire (and possible testing). Transmission of the third round questionnaire to the panellists. 6. Preparation of a report to present the conclusions of the exercise. Figure 1 Illustrates this study's Delphi process.

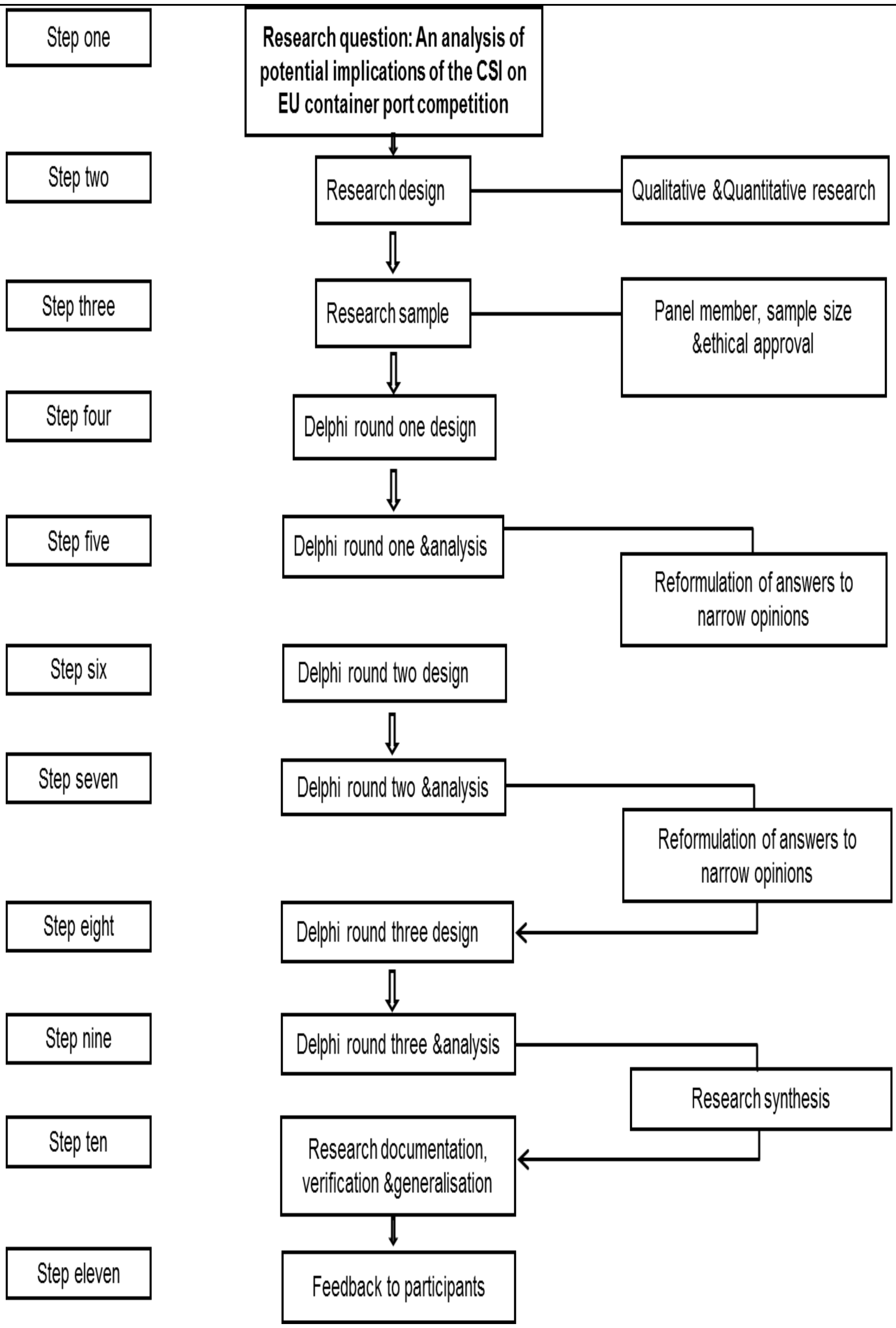

Figure 1 The Delphi process

Source: the author 2014 adapted from Fowles (1978) and Linstone and Turoff (2002)

The first step is to formulate research conceptual assumptions, which include the definition of variables and the rationale for relating the variables to one another. The assumptions of this research endeavors to direct the research to find out the potential implications of the CSI on EU container port competition. The variables identified in this study are significantly influenced by the conceptual model discussed above and its various elements. Four variables have been selected to categorise the main assumptions of the study. They are: (1) maritime transport risk;(2) maritime security regimes;(3) implementation of the CSI;(4) EU container seaport competition. Based on the four variables and conceptual model, five conceptual hypotheses are constructed under four categories. The four categorises are: (1) the necessity of pursuing maritime security initiative;(2) implementation of the CSI and its controversial influences;(3) determinants of EU container seaport competitiveness;(4) the implications of introduction of the CSI for EU container seaport competition.In terms of the Delphi study, the objectives are: to gain consensus about the necessity of maritime security initiatives; to gain consensus about the positive effects of the CSI on maritime industry; to gain consensus about the EU container port competitiveness components; and to gain consensus about the potential implications of the CSI implementation on EU container ports through affecting the competitiveness components identified.

Thus, this study develops the following research conceptual assumptions:

Assumption 1

It is necessary to carry out maritime security initiative despite the fact that additional inspections may cause supply chain disruption and financial burden.

Assumption 2

The Container Security Initiative (CSI) can facilitate global container seaborne trade safety and security, adding competitiveness to CSI-affiliated ports.

Assumption 3

The EU container port industry is highly competitive. Port efficiency, service and cost related elements are still the most important competitiveness components.

Assumption 4

CSI compliance does not cause global supply chain disruption or financial problems for the EU container ports.

Assumption 5

The introduction of the CSI does not cause small ports to lose market share. EU container port marker competition is not disrupted by the CSI introduction.

The conceptualised assumptions form the 13 questions for Delphi round one, including 12 statements and one open-ended question. The list of statements was developed from the results of a numerical research synthesis. The 13 questions are categorised into five topics that help to answer the original research question. They are: (1) the necessity of carrying out maritime security initiative; (2) introduction of the CSI and the its controversial influences; (3) determinants of EU container port competitiveness; (4) the implications of introduction of the CSI on EU port competition; (5) open-ended question for experts to express their comments.

After developing feasible assumptions, the next step is to begin designing the research at the micro level. Selecting Delphi panel members is the next critical step since it is the experts' opinions on which the output of the Delphi is based.

The key to a successful Delphi study is the selection of participants. The results of a Delphi study depend on the knowledge and cooperation of the experts. Therefore, it is essential to include people who are likely to contribute valuable ideas. The selection of the panellist is never a random sample. In Delphi, non-representative, knowledgeable persons are needed (Linstone and Turoff, 2002). This means that each respondent is an expert who also has an incentive and is motivated to participate in the area of the research (Day and Bobeva ,2005). An expert has been defined as a group of `informed individuals' (McKenna, 1994) and as `specialists' in their field (Goodman, 1987) or someone who has knowledge about a specific subject (Davidson et al., 1997). In this research, there are four main requirements for expertise: (i) knowledge and experience with the issues under investigation; (ii) capacity and willingness to participate;(iii) sufficient time to participate in the survey and (iv) effective communication skills (Campbell *et al*, 2004; Matthews and Ross,2010;

	Mckenna,1994; Zeedick,2011). The research comprises experts with three different backgrounds. They are: (i) academics who encompassing the opinions and expertise of scholars researching maritime security and container port competition; (ii) industry-users, specifically encompassing the opinions and industry experience of EU container port management and the CSI implementation; (iii) administrators, embracing the positions and experience of major organisations involved in maritime security regulation and maritime governance on international, supranational and national levels. All participants will remain anonymous, with careful attention to protect their identity and the integrity of the companies and organisations involved. There is no agreement on the Delphi panel size (Keeney *et al.*, 2001) or precise approach for identifying it in any individual research, and it is impossible to recognise a positive relationship between Delphi group size and Delphi group performance (Rowe and Wright, 2011). Keeney *et al.* (2001) suggested that the panel size should depend on the research aim, design selected and time frame for data collection. In addition, the nature of the different viewpoints included and the resources available can help to determine the panel size (Landeta *et al*., 2011; Sharkey and Sharples, 2003). Previous Delphi research used different techniques for panel formation. van Zolingen and Klassen (2003) formed one panel with four different stakeholder groups. Wang *et al*. (2003) included two panels differentiated by location. Therefore, the panel size varies and ultimately depends upon the nature of the research (Nowack *et al.*, 2011). Delbecq *et al.* (1975) recommended a panel with 10–15 similar panellists as the ideal number. Warner (2014) suggested that at least 13 experts should be included to achieve a reliable (reliability of 0.9) sample. Kapoor (1987) included 39 experts in his Delphi. Delbecq *et al.* (1975) argued that using too many panellists would lead to extreme difficulty in data analysis. However, Whitman (1990) had a study with 75 experts, and Campbell *et al*. (2000) included more than 300 experts. Therefore, there is no optimum number for panels or participants (Lai *et al*., 2002). Nowack *et al.* (2011) commented that the panel size can be much larger in a Real Time Delphi, whereas for a Delphi which relies on interviews, the panel size would be much smaller for practical reasons. In the context of this study, a single panel of experts with different backgrounds, naming academics, industrial users and administrators was chosen for the research enquiry. The reasons for the single panel choice included the simplicity of single panel administration (Nowack *et al.*, 2011) and the opportunity to share their ideas across all panel members through feedback between rounds (Nowack *et al.*, 2011; Goluchowicz and Blind, 2011). However, experts are required to state their background in the questionnaire in order to compare the different viewpoints held by different experts. Also, experts may have overlap between the three backgrounds. Therefore, it is essential for them to identify themselves for this research. The Delphi will utilise Qualtrics web-based survey software for data collection and analysis. In relation to this study, each selected panel member is to be sent an invitation email, stating:(1) that the nominee would be personally written to inviting them to participate in the Delphi study; (2) the reasons why they have been chosen; (3) a concise description and justification of the research project; (4) a time expectation; (5) confidentiality assurances; (6) importance and contribution of their views; (7) contact details for further information about the research study; and (8) the survey link and the instruction of participation. Once the primary data has been collected, analytical techniques will be applied to provide an insight into the data collected. In particular, Average Percentage of Majority Opinion (APMO) will be used to establish consensus (Cottam, 2012). *Specify subject populations and recruitment method. Please indicate also any ethically sensitive aspects of the methods. Continue on attached sheets if required*.
10.	**Ethical Protocol:** Please indicate how you will ensure this research conforms with each clause of the University of Plymouth's *Principles for Research Involving Human Participants.* Please attach a statement which addresses each of the ethical principles set out below.
	(a) Informed Consent: When recruiting for the Delphi survey, all potential participants will be informed from the beginning

about the nature and purpose of the research, the expected duration of the subject's participation, and a description of the three round Delphi methodology (Israel and Hay 2006). Potential participants will be informed that the Delphi survey is entirely voluntary. A statement will be included about confidentiality of sensitive personal or company data. Participants will not be required to give details on their: gender, age, ethnicity, disability or sexual orientation, and will at all times have anonymity (Oliver 2003). All potential participants will be informed of the expected benefits to industry, policy and research. Contact details for answers to questions about the research and research subjects rights will also be included in the invitation email. Potential participants will be given this information in plain English.

(b) Openness and Honesty:
The researcher will be open and honest about the research about its aim and application. Participants will be informed about the purpose, methods and intended possible uses of the research. Potential participants will be informed fully about what their participation in the research entails and what risks, if any, are involved. The researcher will ensure that any sensitive company information (data that may harm company integrity or strategic positioning), or personal information (which may lead to the identification of the participant) will not be used in any capacity.

Note that deception is permissible only where it can be shown that all three conditions specified in Section 2 of the University of Plymouth's Ethical Principles have been made in full. Proposers are required to provide a detailed justification and to supply the names of two independent assessors whom the Sub-Committee can approach for advice.

(c) Right to Withdraw:
All potential participants will be informed at the outset of the study that they have the right to refuse to participate or withdraw from the Delphi investigation whenever and for whatever reason they wish. An explanation of whom to contact for answers to questions about the research and the right to withdraw will also be included in writing before the Delphi survey commences.

Note that this section should also clarify that participant's data will be destroyed should they withdraw, in accordance with best practice.

(d) Protection From Harm:
The principle of "protection from harm" requires that social science research should be conducted in such a way that minimises harm or risk to social groups or individuals (ESRC 2009). Thus, the researcher will endeavour to protect participants from physical and psychological harm at all times during the project. The research design will also consider potential harm to participants organisations or businesses as a result of the work. The researcher recognises three areas of potential risk: *"(1) company/organisation, whereby the researcher will at all times seek to preserve the integrity of the company and not disseminate information deemed sensitive in terms of competitive positioning; (2) participant, whereby the researcher will at all times seek to preserve the anonymity of the individual and any personal details which may lead to the identification of the participant; (3) non-participant colleagues, whereby the researcher will at all times seek to preserve the anonymity of any other individuals named in the data collection and any personal details, which may lead to the identification of non-participants"* (Cottam, 2012).

(e) Debriefing:
The researcher will provide a link of the purpose and procedures of the study. The researcher will ensure a final debriefing of the research outcome to make sure that participants are fully informed about, and not harmed in any way by their participation in the Delphi survey (Israel and Hay 2006). At the end of the study, once data has been analysed and collated, all participants will be sent the research findings, potential dissemination route (academic journals) and thanked for their commitment and time to the research (Abdel-Fattah 1997).

(f) Confidentiality:
Confidentiality requires that researcher to ensure that research data and its sources remain confidential, unless participants have consented to their disclosure (Oliver 2003). Hence, this research *"seeks to only use data/information that participants have consented to disclose, and at all times prioritise the non-disclosure of any information deemed to be sensitive and consequently should remain confidential"* (Cottam, 2012). In particular, the researcher will ensure confidentiality

of the participant's identity (Israel and Hay 2006), and confidentiality of sensitive company (business) data. All information deemed confidential will remain private throughout the research. As records and information gained from the survey will be held electronically, the Data Protection Act will also be applied.

(g) Professional Bodies Whose Ethical Policies Apply to this Research:
(1) University of Plymouth: “Ethical Principles for Research Involving Human Participants“

(2) Economic and Social Research Council (ESRC): “Research Ethics Framework“ (REF)

(3) The Social Research Association (SRA) (http://www.the-sra.org.uk/ethical.htm).

*The committee strongly recommends that prior to application, applicants consult an appropriate professional code of ethics regardless of whether or not they are members of that body (for example, Social Research Association . http://www.the-sra.org.uk/ethical.htm Market Research Society http://www.mrs.org.uk/standards/codeconduct.htm British Sociological Association http://www.britsoc.co.uk/equality/). Applicants **MAY** choose to write "not applicable" in the "Relevant Professional Bodies" section of the Ethical Application Form. However, it is very rare that there would be no professional/academic code of ethics relevant to a given research project. If based on the information written in other sections of the form, FREC considers a particular professional code to be of relevance, then the Committee may make its consultation and adherence a condition of acceptance.*

11. **Declaration*:**

To the best of our knowledge and belief, this research conforms to the ethical principles laid down by Plymouth University and by the professional body specified in 6 (g).

	Name	E-mail (s)	Date
Principal Investigator:	Xufan Zhang	Xufan.zhang@plymouth.ac.uk	9th May 2016
Other Staff Investigators:			
Director of Studies (only where Principal Investigator is a postgraduate student):	Professor Michael Roe	m.roe@plymouth.ac.uk	9th May 2016

*You will be notified by the Research Ethical Approval Committee once your application is approved.
This process normally takes around 3-4 weeks.

RESEARCH WITH PLYMOUTH UNIVERSITY

Please Answer Either YES or NO to <u>ALL</u> Questions Below.

If you answer YES, please provide further details.

Do You Plan To Do:

- Research involving vulnerable groups – for example, children and young people, those with a learning disability or cognitive impairment, or individuals in a dependent or unequal relationship

Answer:

No vulnerable group involved

■ Research involving sensitive topics – for example participants' sexual behaviour, their illegal or political behaviour, their experience of violence, their abuse or exploitation, their mental health, or their gender or ethnic status

Answer:

No sensitive topics involved. This research focus on maritime business world regarding operations.

■ Research involving groups where permission of a gatekeeper is normally required for initial access to members – for example, ethnic or cultural groups, native peoples or indigenous communities

Answer:

No permission of a gatekeeper is involved

■ Research involving deception or which is conducted without participants' full and informed consent at the time the study is carried out

Answer:

This research will be completely honest to participants.

■ Research involving access to records of personal or confidential information, including genetic or other biological information, concerning identifiable individuals

Answer:

No personal or confidential information is involved

■ Research which would induce psychological stress, anxiety or humiliation or cause more than minimal pain

Answer:

No psychological stress or anxiety or humiliation will be induced

■ Research involving intrusive interventions – for example, the administration of drugs or other substances, vigorous physical exercise, or techniques such as hypnotherapy. Participants would not encounter such interventions, which may cause them to reveal information which causes concern, in the course of their everyday life.

Answer:

No intrusive intervention is involved

Completed Forms should be forwarded BY E-MAIL to Cher Cressey, Secretary of the FREC at:

UNIVERSITY OF PLYMOUTH FACULTY OF BUSINESS

ETHICAL APPROVAL OF ALL BUSINESS PLACEMENT REPORTS

AND RESEARCH-BASED DISSERTATIONS INVOLVING HUMAN SUBJECTS AND

MATERIAL COVERED BY CONFIDENTIALITY AT TAUGHT MASTERS LEVEL AND BELOW

Please read the attached extract from the University of Plymouth's Research Policies and Procedures relating to Ethical Principles for Research involving human participants before completing and signing below.

Ethical Protection & Declaration

To the best of my knowledge and belief, the proposed research conforms to the ethical principles for research involving human participants contained in the University of Plymouth's Research Policies and Procedures with regard to the following (please tick appropriate box).

(a)	Openness and honesty	Yes	x	No	
(b)	Protection from harm	Yes	x	No	
(c)	Right to withdraw	Yes	x	No	
(d)	Debriefing	Yes	x	No	
(e)	Confidentiality	Yes	x	No	
(f)	Informed consent	Yes	x	No	

Note: I agree to abide by the ethical protocol. The Supervisor signs to state that he/she has read and is satisfied with the content of this application.

Sign below where appropriate:

Principal

Investigator: Name Signature
Date

September 2004

ETHICAL PRINCIPLES FOR RESEARCH INVOLVING HUMAN PARTICIPANTS

1. Informed Consent

The researcher should, where possible, inform potential participants in advance of any features of the research that might reasonably be expected to influence their willingness to take part in the study.

Where the research topic is sensitive, the ethical protocol should include verbatim instructions for the informed consent procedure and consent should be obtained in writing.

Where children are concerned, informed consent may be obtained from parents or teachers acting in loco parent is, or from the children themselves if they are of sufficient understanding. However, where the topic of research is sensitive, written informed consent should be obtained from individual parents.

2. Openness and Honesty

So far as possible, researchers should be open and honest about the research, its purpose and application.

Some types of research appear to require deception in order to achieve their scientific purpose. Deception will be approved in experimental procedures only if the following conditions are met:

(a) Deception is completely unavoidable if the purpose of the research is to be achieved.

(b) The research objective has strong scientific merit.

(c) Any potential harm arising from the proposed deception can be effectively neutralised or reversed by the proposed debriefing procedures (see Section 5).

Failing to inform participants of the specific purposes of the study at the outset is not normally considered to be deception, provided that adequate informed consent and debriefing procedures are proposed.

Covert observation should be resorted to only where it is impossible to use other methods to obtain essential data. Ideally, where informed consent has not been obtained prior to the research, it should be obtained post hoc.

3. Right to withdraw

Where possible, participants should be informed at the outset of the study that they have the right to withdraw at any time without penalty.

In the case of children, those acting in loco parent is or the children themselves, if of sufficient understanding, shall be informed of the right to withdraw from participation in the study.

4. Protection from Harm

Researchers must endeavour to protect participants from physical and psychological harm at all times during the investigation.

Note that where stressful or hazardous procedures are concerned, obtaining informed consent (1) whilst essential, does not absolve the researcher from responsibility for protecting the participant. In such cases, the ethical protocol must specify the means by which the participant will be protected e.g. by the availability of qualified medical assistance.

Where physical or mental harm nevertheless does result from research procedure, investigators are obliged to take action to remedy the problems created.

5. Debriefing

Researchers should, where possible, provide an account of the purpose of the study as well as its procedures. If this is not possible at the outset, then ideally it should be provided on completion of the study.

6. Confidentiality

Except with the consent of the participant, researchers are required to ensure confidentiality of the participant's identity and data through the conduct and reporting of the research.

Ethical protocols may need to specify procedures for how this will be achieved. For example, transcriptions of the interviews may be encoded by the secretary so that no written record of the participant's name and data exist side by side. Where records are held on computer, data protection legislation also applies.

7. Ethical principles of professional bodies

This set of principles is generic and not exhaustive of considerations which apply in all disciplines. Where relevant professional bodies have published their own guidelines and principles, these must be followed and the current principles interpreted and extended as necessary in this context.

September 2004
ccressey@plymouth.ac.uk

Please forward any questions/comments or complaints to:
Cher Cressey, DTC Administrator
Graduate School (Link Building), Plymouth University, Drake Circus, Plymouth, PL4 8AA
Tel: 01752 585540 *Updated: 03/07/14*