2016

An Analysis of Policy Making for Dry Port Location and Capacity: A Case study on Alexandria

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PHD

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Award date:
2016

Awarding institution:
University of Plymouth

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An Analysis of Policy Making for Dry Port Location and Capacity: A Case study on Alexandria

by

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A thesis submitted to the University of Plymouth in partial fulfillment for the degree of

DOCTOR OF PHILOSOPHY

School of Management, Business School

University of Plymouth

February 2016

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.

This study was financed with the aid of a studentship form the Arab Academy for Science & Technology & Maritime Transport.

Relevant scientific seminars and conferences were regularly attended at which work was often presented and several papers prepared for publication.

Publications (or presentation of other forms of creative and performing work):

- Elgarhy, A. (2012) "Decision Support Tool for Inland Container Depot Location and Capacity with Multiple Objectives" In: *conference proceedings from the seventh Plymouth Postgraduate Symposium, Plymouth, 31 May 2012. Plymouth:* University of Plymouth.

- Elgarhy, A. and Roe, M. (2014) "An Analysis of Policy Making for Inland Container Depot Location and Capacity; A Case study on Alexandria Port" *In: conference proceedings from The 19th Annual Conference of The Chartered Institute of Logistics & Transport, "Logistics Research Network", Huddersfield, 3rd -5th September 2014.* Huddersfield: Huddersfield University.

External Contacts: Alexandria International Container Terminal (a branch of Hutchison Port Holdings Limited (HPH) Company).

Word count of main body of thesis: 43,624

Signed: Aya elgarhy

Date: 4/ 2/ 2016

Acknowledgements

First and foremost, I would like to express my utmost gratitude to God the Almighty for giving me the strength and stamina to accomplish this work.

The first person that I would like to express my extreme gratitude to and acknowledge his efforts is my supervisor, Prof. Michael Roe. I do thank him for the years of supervision, guidance and encouragement, academically and personally. I believe I could not have accomplished or survived this process without his support along the way. Thank you for being you and being there. After years of supervision, patience, caring, guidance and knowledge, I believe at this point that without your support and your giving me the chance to be one of your PhD students, I would not have been able to reach this stage.

My sincerest gratitude to my university, the Arab Academy for Science, Technology & Maritime Transport – College of International Transport and Logistics in Alexandria, Egypt for supporting me and offering me the opportunity to pursue my study in the United Kingdom.

I would like to express my deep appreciation to the case study company involved for the help given during the application phase of this research. My deep gratitude goes to the person who made this work possible and eases the company's accessibility.

My heartfelt gratitude goes to my parents; Dad has always been supporting me and Mom was standing by me from day one, and all my family members - my three brothers and my step mother - were always encouraging me with their best wishes and so lovingly cared for my newly-born daughters, Aya and Reem, to let me focus on my research, the only thing that kept me going on over the last few months. I am glad and grateful to you all.

Last but not least, I am greatly indebted to my devoted husband, Mohamed, who provided me with love, understanding and support to complete this PhD project.

Abstract

Aya Elgarhy

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Container terminal capacity is a crucial issue for port and terminal operators nowadays as it is one of the key points for their success and increasing their competitive market position in the maritime industry. Therefore, researchers have tried to find solutions for the over capacity problem that faces many terminal operators. This research suggests dry ports as one of the most suitable solution for this problem through proposing a structured framework to adopt the right policy decisions for Dry Port location and capacity.

To achieve the presented framework some areas were addressed in detail to have the full picture clear. The current status of the global container sector was assessed, also, the main capacity problems of container terminals with a view to reviewing the suggested solutions was investigated, hence the need for dry ports. In addition, policies for providing optimal location and capacity decisions for container terminals were identified. A technique that supports assessing container terminal location and capacity policy decisions with particular reference to dry ports were developed. Moreover, a case study on Alexandria International Container Terminal for validating the results was conducted.

The current research was facilitated by experts from the maritime transport industry, through the application of the Delphi Technique. Applying such a technique enables collaborating experts to share experience modify statements and re-asking to reach a final exact answer that could be generalized. The consensus achieved will help build knowledge and understanding of potential Dry Ports' policies of the maritime transport sector.

This research seeks to make an original contribution to knowledge by developing a structured framework to identify policy decisions for location and capacity of Dry Ports using a Delphi technique as a support tool for terminal managers and operators, port

planners, policy makers, and investors in deciding decisions relevant to Dry Port investment.

Key words: Dry Port (Inland Container Depot), Container terminals, Capacity Problem, Port policies, Delphi.

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LIST OF ABBREVIATIONS

ACT	Automated container terminal
AGVs	Automated guidance vehicles
AHP	Analytic Hierarchy Process
AICT	Alexandria International Container Terminal
AICT DKH	Alexandria international container terminal Dekheila
ANP	Analytic Network Process
AS/RS	An automated storage and retrieval system
BSR	Baltic Sea Region
CFS	Container Freight Station
CO2	Carbon dioxide
CTC	Container Terminal Capacity
CTMS	Container Terminal Management System
DEA	Data Envelopment Analysis
DFLPs	Dynamic facility location problems
EDI	Electronic Data Interchange
ELECTRE	Elimination Et Choice Translating Reality
ERP	Enterprise Resource Planning
ESCAP	The Economic and Social Commission for Asia and the Pacific
FCL	Full Container Load
FCM	Fuzzy c-means
FLRP-U	Facility Location and Relocation Problem – Uncertainty
GA	Genetic Algorithm
GAFI	General Authority for Investment
GDR	Greater Dublin Region
GIS	Geographical information system
GR	Overhead grid rail system
GRT	Gross Registered Tons
HHT	Hand Held Terminals
HPH	Hutchison Port Holdings
ICA	Imperialist Competitive Algorithm
ICD	Inland Container Depot
IMO	International Maritime Organization
IOM	International Organization for Migration
IT	Information Technology
KPIs	key performance indicators
LCL	less than a container load

LMCS	Linear motor conveyance system
LRP	Location Routing Problem
TEU	Twenty Equivalent Unit
TGS	Terminal ground slots
MPB	Multi-period binomial model
MILP	Mixed integer linear program
NECB	New Eurasia Continental Bridges
NRT	Net Registered Tons
PPP	Public Private Partnerships
RFID	Radio Frequency Identification
SCM	Supply Chain Management
SFA	Stochastic Frontier Analysis
UNCTAD	United Nations Conference on Trade and Development
UNECE	United Nations Economic Commission for Europe
VMT	Vehicle Mounted Terminals

Chapter 1

Introduction

1.1 Background

Container Terminal Capacity (CTC) has become a major problem nowadays in many ports around the world due to the remarkable growth of globalisation and container transportation. Henesey (2006) believed that in order to have efficient container terminal management, new solutions should be established such as applying novel methods and technologies. Niswari (2005) has specified that the major weakness point considered in container terminal operation is insufficient capacity. Since the number of containers and dimensions of vessels are growing, this puts a higher pressure on seaports to increase the capacity of their container terminals either by building new terminals or adding more infrastructure facilities (Islam and Olsen, 2013).

However, Lee et al. (2008) discussed the impact of increasing demand from shipping lines on ports which leads ports to seek to increase hinterland areas and build inland terminals such as dry ports in order to overcome the capacity problem and maintain their competitive position.

Woxenius et al. (2004) stated, “The dry port concept is based on a seaport directly connected by rail with inland intermodal terminals where shippers can leave and/or collect their goods in intermodal loading units as if directly at the seaport.”

Furthermore, Chandrakant (2011) indicated that one of the key components, as it has a major effect on other parameters of the whole supply chain network, is in locating dry ports (e.g. transport cost, connectivity, transport modes, etc.). Also,

KA (2011) added that the selection of optimal dry port locations is essentially a multi-objective decision making process.

Islam and Olsen (2011) indicated that decision makers in today's maritime ports face a very important dynamic problem which is where and how to improve the existing capacity in order to cope with the increasing demands and continuous growth in the number of containers. Consequently, capital investments in developing ports and/or expanding port capacity are costly ventures, similarly as the global Port of Hong Kong as it faces increasing competition from the fast-growing newer competitors within mainland China's Pearl River Delta region as stated by Ho et al. (2008).

Thus, this research into policies for Dry Ports will be valuable since it helps port operators to take appropriate decisions in relation to location and capacity policy decision making processes. Techniques need to be developed to help port policy makers to make rational judgments upon their inland network as well as the location and capacity of each depot.

1.2 Research objectives

The research aims to provide port planners, policy makers, and investors with a structured framework to adopt the right policy decisions for dry port(s) location and capacity. Specific objectives include:

- To assess the current status of the global container sector.
- To investigate and identify the main capacity problems of container terminals with a view to reviewing the suggested solutions. Hence, the need for dry ports.
- To identify policies for providing optimal location and capacity decisions for container terminals.
- To develop a technique that supports assessing container terminal location and capacity policy decisions with particular reference to dry

ports.

- To apply the results arises from the established technique using a case study on Alexandria International Container terminal for validation purpose.

To achieve the above research objectives, the following research questions should be answered:

1. Why could a terminal need a dry port?
2. How can capacity problem be solved by investing in a dry port?
3. How can terminal operators (managers) be supported in taking a decision to invest in a dry port?
    a. How many dry ports are needed;
    b. Where to locate dry port's; and
    c. How large the dry ports should be in terms of capacity.
4. What are the key factors (indicators) that have the greatest impact on supporting this decision?
5. Could a Delphi technique be applicable for policy decisions for most of the container terminals?

Before the application of the case study on the chosen port, a brief summary of the research context should be reviewed first to the reader as a background to this study. This will include a clarification on the major ports in Egypt, the types of port ownership, port administration, operation of Terminals and other port infrastructure in Egypt with especial reference to the container port industry.

As referred to the last major study of port policy in Egypt was in 1996 prepared by Nathan Associates Inc., and the objective of the report was to recommend an action plan to ensure greater competition in maritime transportation services for the purpose of increasing Egyptian exports through the development of recommendations for policy reforms in Egypt. It therefore has direct relevance to the research. Its main sections include the following:

Port Administration

In Egypt a port authority, which administers and supervises commercial ports, can take the form of either a single national port authority for all the commercial ports in the country, ensuring that national port policies are unified throughout all ports, or a separate port authority for each port, encouraging competition among ports. The local government or commercial interests could exercise control over the port authority, depending on the composition of the Board of Directors. Operating each port can aim at either increasing the natural or economic advantages of the port or pursuing new opportunities. Port authorities in Egypt are usually local public sector entities and can also be joint stock companies that can help the public sector to administer the port effectively and profitably. In either case, the Board of Directors supervising the operation of the port authority can have representatives from the private sector, the local government, and from the central government (Ministry of Transport, Economy, Industry, Commerce or Foreign Trade).

The goals of any given port in Egypt determine who controls the port authority and the extent of its activities in the port. If the main goal of the port authority is to ensure that the operators in the port adhere to all aspects of the Government's port policy, laws and regulations, the port authority should probably be under some supervision by the central government. But if the main goal is for the port to benefit the local economy around the port, the port authority should probably be under the control of the local government and the local business interests. If the main goal is for the port authority to adopt efficient business practices in the port administration and to actively promote major private investments and more shipping lines to the port, strong private sector participation in the port authority can be beneficial. If the port authority acts as the "landlord" representing the Government's ownership and long-term planning interests in the port, government control of the port authority is usually exercised. The port authority exercises jurisdiction over the land area of the port, surrounding water and breakwater, and all fixed installations are owned by the Government.

If the function of port administration and the functions of port operators and service providers in Egypt are mixed up, a conflict of interest takes place and decreases the efficiency of port operations. What prevents competition and effective deregulation of port services to a great extent is the practice of interlocking directorship with Board representation by port authorities in the state monopolies carrying out cargo handling operations and vice versa. It may even limit the Egyptian Government's ability to pursue port policies in the best national interest free from effective interference by the special interests of managements of the state operating companies.

Operation of Terminals and Other Port Infrastructure

There are various approaches through which governments retain some measure of control over the ports, which are viewed as important elements in any country's foreign trade strategy. The fixed port installations can be operated by (1) the government companies for total government control over the ports and financing all port investments, (2) private operators under management contracts for improving the ports' operating efficiency with the government making its own investments, (3) private operators under long term concession arrangements to maintain and expand the port facilities by private operators, or (4) private companies operating under short-term leases, in order for the government to participate in market opportunities. Storage facilities are sometimes leased for short terms to private users, but berths are usually available to all vessels. A Government monopoly is maintained over all aspects of port operations, including the operation of terminals, as in the case of Egypt, when port operations are viewed as a public service.

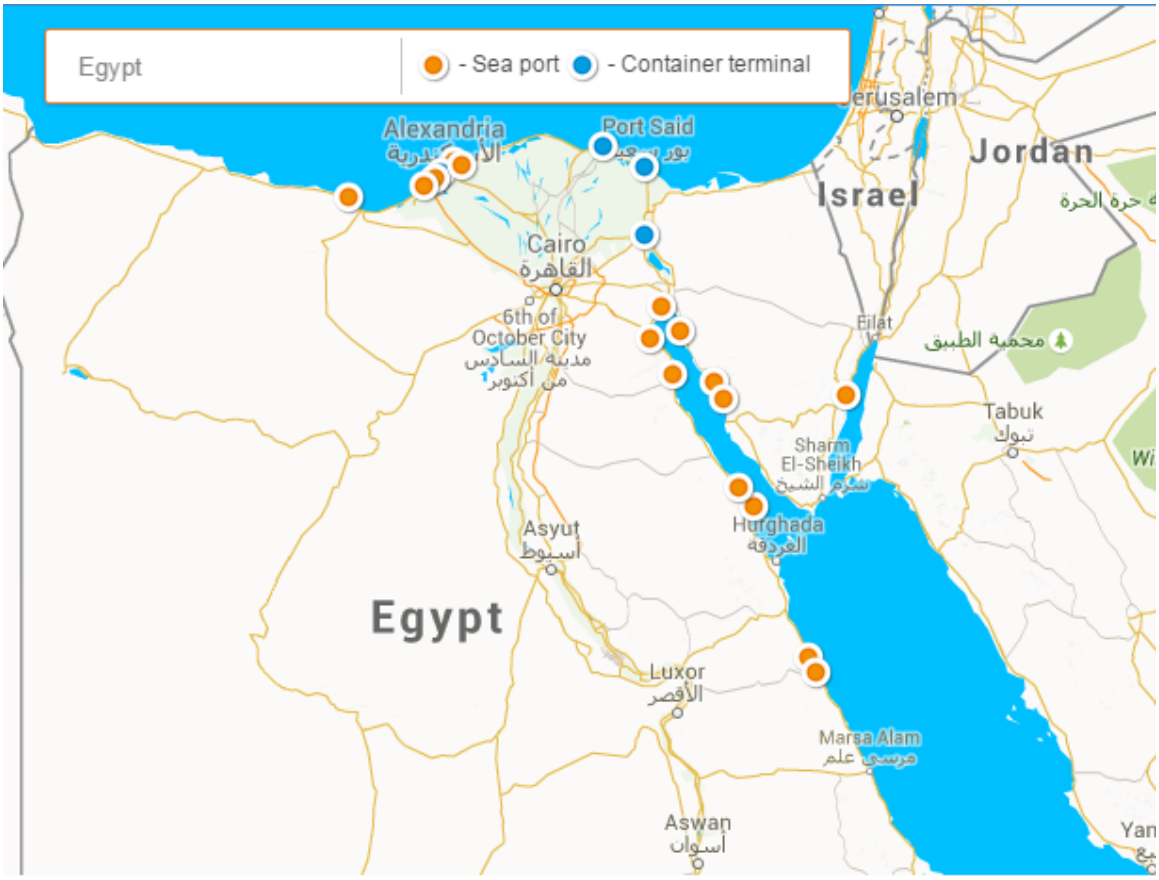
In the hands of private operators – national or foreign investors- the ports are operated as a business for profit rather than a public service. Only foreign investors may be in a position to make major investments in upgrading the port equipment and infrastructure and expanding capacity or build transhipment terminals as is the case in Egypt.

Major shipping lines are often interested in bidding for concessions to operate container terminals and are willing to organize major investments for improving port operations. Vessels of different lines should be allowed to use the berths and other port facilities and to contract independent stevedoring services. Contracts for port operations usually include fixed or minimum guaranteed payments to the Port Authority from the private operator.

It is some years since this report making this research even more worthwhile as it updates the current position particularly in the light of under-capacity evident in Egyptian ports and changes in the world container market.

Since the application will be on Egypt, the following map enlightens the major ports in Egypt.

Figure 1.1 Egypt map



(Source: Searates, 2015)

Egypt includes 15 commercial marine ports of the Republic distributed as follows:

- Alexandria port
- El-Dekheila port
- Damietta Port
- Port Said port
- East Port Said Port
- Arish Port
- Suez port
- Petroleum Dock port
- Adabiya port
- Sokhna Port
- Nuwaiba port
- AL-Tour port
- Sharm El Sheikh Port
- Hurghada port
- Safaga Port (MTS, 2015).

The following table shows the recent Port Traffic situation in Egypt from 01-01-2014 to 30-09-2014:

1.1 Port Traffic in Egypt from 01-01-2014 to 30-09-2014

Port Traffic	
Total Volume of Imported Cargo to Egyptian Ports	74,636 thousand tons
Total Volume of exported Cargo from Egyptian Ports	36,259 thousand tons
Total number of imported Containers to Egyptian Ports	2,049,718 containers
Total number of exported Containers from Egyptian Ports	2,084,149 containers
Total number of Passenger arrivals to Egyptian Ports	339,261 arrivals
Total number of Departing passengers from Egyptian Ports	420,846 passengers

Source: (MTS, 2015)

Ports and Dry Ports in Egypt

The Egyptian Maritime Transport Sector (EMTS) is one of the organizational divisions of the Ministry of Transport and the competent oversees all maritime transport affairs, in coordination with all concerned parties (MTS, 2015). It completely manages the Egyptian ports, and Alexandria Port Authority directly manages Alexandria Port which is Egypt's main port and as such is very essential to the Egyptian economy (Fady & Beeson, 2009).

Egyptian ports enjoy many maritime facilities, located on both the Mediterranean and Red Sea coasts. Alexandria Port is the largest port in Egypt as the port accounted for the largest share of goods handled in Egyptian ports in 2011, at 35.4%, compared to 21.2% for the Damietta Port Authority, 30.6% for the Port Said Port Authority and 12.8% for the Red Sea Ports Authority. Egypt has 15 commercial ports- six on the Mediterranean and nine on the Red Sea - and 51 specialized ports – 6 tourism, 15petroleum, 9 mining and 21 fishing and 17 berths.

In order to accommodate larger ships and increase capacity and handling for a larger volume of trade, the Egyptian government has been giving special concern to develop and upgrade ports; the number of containers handled in Egyptian ports increased up from 6.2 million in 2009 to 6.6 million TEUs (Twenty Foot Equivalent) in 2011. Dry ports as an alternative to 'conventional' wet ports offer storage, cargo handling, customs clearance and other import/export services, thus providing an extra approach in order to cross the anticipated gap between port capacity and demand, which is probably arising from a projected 4.8% increase in import/export volume over the next 20 years. To become integrated logistics centres with effective and less costly operations, the six strategically located dry ports in Egypt (AL Obour – 6th of October – 10th of Ramadan - Sosdi – Zahraa – Sakr) are all accessible by road and one is to be accessible by both road and rail but require enhancements and development to their service portfolios to become integrated logistics centres with efficient operations at lower costs (GAFI, 2012).

1.3 Research Methodology

The existing literature related to container port capacity and location problems and their suggested solutions and Dry Ports will be reviewed extensively to address the research objectives. In addition, qualitative methods will be employed in this research. First: the use of the Delphi Technique which is the most promising method(s) that helps in answering this research question. When there is insufficient knowledge about phenomena, the Delphi method is preferred as a flexible research technique as specified by Skulmoski et al. (2007). Researchers would prefer choosing the Delphi method particularly when gathering the judgments of experts in a group decision making setting. They also added that Delphi has been used in research in order to create, recognize, predict and validate in a wide variety of research areas. The Delphi approach holds many benefits for the anticipated results, as it involves multi-step interviews with experts in a particular field, along with possible feedback incorporation in order to be able to evaluate results and pinpoint the most significant decision criteria as identified within the research questions (Grammerstorf, 2012). In addition, Linstone et al. (2002) indicated that the Delphi technique offers an advantage of permitting people scattered everywhere to contribute at any time without the difficulty of travelling. This technique will be discussed in detail in section 3.

Finally, a case study will be conducted on a container terminal for validity purposes which should assist port operators (policy makers) in deciding the location and the capacity when investing in Dry Ports. According to Baxter and Jack (2008) a qualitative case study methodology provides tools for researchers to study complex phenomena within their contexts. It will become a valuable method to develop theory, evaluate programs, and develop appropriate interventions. Also, it was acknowledged by Kothari (2004) that one of the most important advantages of case study techniques is that they are essential for administrative purposes as they aid taking decisions concerning numerous management problems. The required data will be collected through multiple methods, e.g. interviews, questionnaires, observations, and archive data.

1.4 Research structure

This dissertation comprises the following chapters:

Chapter 1- Introduction: This chapter presents an overview of the research aim, objectives, and methodology. In addition, it outlines the dissertation structure.

Chapter 2- Literature review: This chapter starts with reviewing the container terminal capacity and overcapacity problem followed by some suggested solutions for this problem. This research discusses one of the suggested solutions which is the Dry Port (sometimes referred to as an inland container depot). Hence, a brief overview of the Dry Port including its definition, functions, benefits and objectives will be provided. Three types of dry ports will be examined briefly followed by a discussion of the previous studies about implementing dry ports. Then, dry port location and capacity problems have been specified in detail including problem description and the mathematical models related to this issue with regard to the important factors affecting this problem. Finally, a brief discussion on the key performance indicators is presented.

Chapter 3- Research Methodology: Chapter three identifies the research scope, approach and strategy, on which the framework is formulated and the methods and techniques used in creating it are discussed.

Chapter 4- Dry-Port Location and Capacity policies the Delphi approach: This chapter displays Delphi technique design. It shows the formulation of the statements for both rounds.

Chapter 5- Dry-Port Location and Capacity policies Delphi Results: This chapter focuses on analysing results for each round.

Chapter 6- Case study: This chapter presents the case study of Alexandria International container terminal to validate the research method used.

Chapter 7- Conclusion and recommendations for future work: Chapter seven presents the research conclusions, policy suggestions, limitations and recommendations for further research.

In summary, this chapter introduced the research topic and based on this the research aim and objectives have been defined. The chapter also presented the research methodology and processes by which the research aim and objectives

will be achieved. Finally, the outline of the research structure and design was presented.

The next chapter will synthesize published literature in the related research areas in order to illustrate how this study would differ from, support, add to or even derive from previous studies.

Based on a literature review, the research gap will be identified in a way that clarifies how this research will contribute to knowledge. Also, based on this review, the foundation of the research framework will be created and the best suited data collection techniques for this research will be selected.

CHAPTER TWO - LITERATURE REVIEW

2.1 Introduction

Recent development in world container transportation has increased the demand for more terminal capacity to accommodate bigger numbers of containers and to attract more traffic. Cullinane et al. (2012) considered the 'dry port' concept to be a potential solution to the multifaceted conflicts that may exist between the need for capacity expansion, environmental considerations, community restrictions, and the continual attachment of freight transport and logistics functions to integrated supply chains. This solution, emerging more often both in practice and as a field of research in the relevant literature, is needed to facilitate the future evolution of container ports and therefore cause the international freight industry to thrive based on continuous change and development, as reflected in managerial, regulatory and technological innovations within the sector.

As a consequence, usage of the term 'dry port' has numerous different definitions appearing in the literature (see, for example, UNCTAD, 1991; UN ECE, 1998; United Nations, 1992; Woxenius *et al*., 2004). As concluded, a dry port shall refer to a secure inland location for temporary storage, handling, inspection and customs clearance of cargo moving in international trade. Mwemezi and Huang (2012) indicated that ports have started the application of the capacity enhancement strategy of dry ports as a result of increasing container volumes, congestion and constraints of capacity. Many ports today face the challenge of determining the optimal routing of containers, depot location and the number of depots to insert in the logistics network.

The remainder of this chapter is organised as follows. The next section reviews the literature on container terminal capacity emphasising the capacity problem, followed by a section presenting the suggested solutions to cope with congestion in container terminals and associated capacity problems. Section 2.4 provides an

extensive literature review of the Dry Port concept. Section 2.5 provides an insight into the problem of selecting the optimal location for a Dry Port. This section reviews published studies of some mathematical models used in choosing dry ports locations and capacity problems. Section 2.6 summarises the factors affecting location/capacity decisions. Section 2.7 presents key performance indicators used by ports and section 2.8 concludes this chapter.

2.2 Container Terminal Capacity

Container Terminal Capacity (CTC) has become a major problem nowadays in many ports around the world. Many researchers have defined CTC and almost all of them reached the same definition. For example, Henesey (2006) defined the CTC as the maximum output generated from the production factors input. According to the Tioga Group, Inc. (2010), capacity measures are usually in units of output per time period and should represent the maximum throughput possible unconstrained by demand or other systems: maximum TEU per hour/day/year, maximum crane moves per hour/day, and yard storage TEU/acre (p. 22). The capacity problem occurs when the input is bigger than the possible output that can be generated by a terminal. Liu (2010) explained that due to the “negative technique change” in the infrastructure efficiency, this excess or overcapacity has become a serious problem. Liu (2010) explained what he meant by “negative technique change” when he mentioned that both investment and traffic growth should be considered as interactive factors. On the one hand, the container port capacity should be able to cope with the accelerating pace of demand in emerging economies. Hence, it is the traffic growth that drives the expansion of ports' capacity. On the other hand, in developing economies, such as the North Mediterranean Sea Area, it is the investment in port capacity that leads to traffic growth. However, taking this into consideration, it becomes clear that to attract new traffic to ports, more capacity must exist. Therefore, the negative annual percentage change in the output of container ports because of technological development is understandable in the North Mediterranean Sea area.

Some researchers showed a deep concern about how to cope with the capacity problem. For example, Liu (2010) claimed that container ports and terminals must cope with overcapacity because it is a significant feature that indicates how reliable and important the port is to users, and therefore it is significant in determining traffic. He also added that overcapacity is a necessary characteristic of key players in the port industry given the overwhelming increase in the trading volume and the volatile market, which necessitate having bigger capacity reservation.

Maloni and Jackson (2005) classified container capacity influences into internal and external port capacity factors. The internal port capacity factors include capital, facilities, equipment, waterways, labour, technology, and efficiency while the external port capacity factors include railroad capacity and efficiency, truck capacity and efficiency, steamship line efficiency, road congestion, shipper efficiency, and OTI (Ocean Transportation Intermediaries) efficiency. Security regulations, terrorism activity, military deployments, labour strikes, and weather represent other capacity influences.

Ilmer (2006) suggested that the CTC problem some ports face lies not only in the terminal capacity, but also in the way it is utilised. He defined utilization as “the ratio between the actual throughput and the designed capacity of a terminal” (p.1). He then explained that congestion of a container terminal occurs when its utilisation exceeds 70%. The Tioga Group, Inc. (2010) defined utilization as the current throughput divided by throughput capacity, expressed as a percentage: berth utilization or occupancy, crane utilization, and terminal utilization (p.22).

Based on the above definitions, utilization can be defined as the relation between the current throughput and the planned throughput of a terminal. However, despite the increase of container transport, many container terminals have successfully coped with congestion and capacity problems. This is reflected in the increasing number of Twenty-foot Equivalent Unit containers (TEUs) shipped world-wide. In 1980, this number of containers was 39 million and this number witnessed a dramatic rise in the year 2004 when it reached 356 million. A 10 per

cent rate of growth is expected annually until 2020 (Davidsson, 2005). For the other ports which still face capacity problems, several solutions have been suggested. The following section discusses some of these solutions.

2.3 Solutions to the Container Terminal Capacity issue

Liu (2010) discussed the issue of inefficient overcapacity and stated that, as a result, different policy consequences vary because of the various maritime stakeholders. As far as the port and terminal management is concerned, enhancing operational flexibility should be given more attention to face the increasing demand. Consequently, the levels of inefficiency resulting from the capacity problem will drop. As regards governments, some measures should be put in place to help port operators deal with the fluctuations of trade. Moreover, should there be an economic downturn with ports keeping their idle productive capacity, inefficiency will be evident and this necessitates setting a policy that can divert trade volumes to other seaborne routes.

2.3.1 Solution: 1 Physical expansion:

Niswari (2005) discussed in his research terminal expansion as an option to increase capacity and improve terminal productivity. He tried to answer in his research what could be the optimal expansion design that leads to capacity enlargement with the most suitable financial solutions.

However, Loke *et* al. (2010) stated that the purpose of physical expansion is to meet the continuous increase in terminal capacity and, they presented a critical review about container terminal expansion models to compare the existing approaches, advantages and disadvantages and specify the best area for these approaches.

Other researchers proposed other solutions to face the ever-growing capacity problem. Henesey (2006) argued that one of the creative methods to solve the congestion problem that hinders terminals from performing in a better way is increasing capacity. There are two methods to increase capacity, namely, physical expansion and improving the utilisation of available resources. Physical

expansion poses a problem to many seaports in Europe, for instance, as they do not have enough space to put this solution in action and the funds required to build the new infrastructure are also not available. On the other hand, other projects can be implemented such as introducing new IT systems, terminal equipment, land expansion and training labour. The following table shows the biggest port projects in Europe in recent years to increase CT capacity. The additional capacity provided by these projects is estimated at 31.2 million TEU, with over €5 billion budgeted.

Table 2.1 Largest Port Projects for Container Terminal in Europe 2005:

Port/Country	Cost of Approval (million €)	Total Project Cost (million €)	Increased capacity (m teu/ p.a.)	Proposed Project Start Date	Earliest Actual Operation Date
Bathside Bay/ UK	20	438	107	2004	2008
Cuxhaven/ Germany	5	400	2.0	2006	Never?
Dibden Bay/ UK	98	876	201	2000	Never?
Felixstowe South/ UK	5	365	1.6	2006	2007
Hull Quay 2000/2005	10	51	.6	2000	2007
Le Havre Project 2000/ France	25	550	4.2	2003	2006
London Gateway/ UK	36	876	3.5	2006	2008
Rotterdam Euromax/ Netherlands	25	225	2.4	2004	2008
Rotterdam Maasvlakte II/ Netherlands	150	1100+	6.0	2002	2012
Westerschelde/ Netherlands	50	400	3.0	2003	2008?
Wilhelmshaven/Jade/ Germany	25	800	4.1	2006	2010
Totals	**€ 449**	**€ 5081**	**31.2**		

(Source: Compiled from Drewry Consultants presentation and documentation)

The idea of physical expansion has proved impractical for many US ports, for example, Ioannou *et* al. (2000) highlighted that most US ports cannot expand due to the scarcity of land. Not only that but also as Niswari (2005) argued, terminal expansion requires a lot of funds and in case the terminal operator takes a wrong

decision, the outcome could be catastrophic. In this case, both costs and benefits must be calculated before taking any decision concerning expansion on to land in the proximity of the existing port.

However, according to Drewry (2015) reported by 2020, completion of the main expansion projects within the largest ports in West Africa could increase terminal capacity by over 12 million TEU, allowing larger vessels to serve the region.

Table 2.2 Key capacity expansion projects in West Africa

Project	Capacity/ TEU	Water depth, m	Quay length, m	Terminal operator	Shipping line affiliation
Dakar	1.6 million	15.0m	1,200m	DP World	None
Tema	1 million	17.0m	700m	MPS (Bollore, APMT, GPHA)	Maersk
Abidjan II	1.4 million	18.0m	1,100m	Bollore / APMT / Bouygues	Maersk/ CMA CGM
Lome LCT	1.9 million	15.5m	2,400m	TIL-MSC/ China Merchants	MSC
Lome TTL	0.25 million	15.0m	450m	Bollore	None
Lagos-Badagry	2.0 million	16.0m	2,600m	APMT / TIL-MSC / Macquarie	Maersk / MSC
Lagos-Lekki	2.5 million	16.5m	1,250m	ICTSI / CMA CGM	CMA CGM
Kribi	0.8 million	15.0m	700m	Bolloré / CMACGM	CMA CGM
Pointe Noire	0.6 million	15.0m	800m	Bollore/APMT/Socotrans	Maersk
Total	12.05 million		11,200m		

(Source: Drewry, 2015)

The expected growth (for the nine projects) in total capacity by over 12 million TEU could be done through: first, increasing water depths of at least 15 metres, allowing vessels up to size 14-18,000 TEU to call at the ports. Second, encourage larger vessels to sail in the Asian trades and possibly reduce the number of ports with direct calls. Whether vessel sizes will increase in the European trade remains to be seen. In the European trade, vessel sizes have so far increased more slowly. Conversely, the planned capacity expansions to 2020 will shift from 385.000 TEU in 2015 to reach 7.685.000 TEU.

2.3.2 Solution 2: Using automation and new technologies:

Another solution is suggested by other researchers. Abbate *et* al. (2009), Liu *et* al. (2002), Liu *et al*. (2004), and Ioannou *et al*. (2000) mentioned that, in the logistics area, using automated procedures and advanced solutions/technologies can increase a terminal's ability to meet excessive traffic by speeding up terminal operations. Ioannou *et al*. (2000) explained that this trend already exists in Europe and Asia. However, according to labour agreements, automation will harm the labour force if applied, though it is assumed that this trend will prevail in the near future to overcome the obstacle of land usage saturation and to confront world competition. Customers expect low cost as well as rapid and dependable cargo shipping. This constitutes a pressure on port authorities and terminal operators to utilize their existing port facilities efficiently. Due to the problem of land usage saturation and the competition for higher capacity and efficiency the only way out for ports, as Ioannou *et al*. suggested, is the use of advanced technology. Terminal operations can be improved by means of automated, high-tech loading/unloading equipment and associated cargo handling and tracking technologies.

Furthermore, Ioannou *et* al. (2000) also explained that when taking into consideration the increasing demand for more capacity, the trend for using advanced technologies emerged to boost the efficiency of terminal facilities. Moreover, Henesey (2006) perceived the negative effect that port congestion can have on stakeholders such as the shipping lines, terminals, trucking and

shippers. Therefore, he conceived that the solution to overcome inefficient container terminal management is to adopt creative methods and apply new technologies.

2.3.3 Solution 3: Improving the utilization of available resources:

Le-Griffin and Murphy (2006) gave an example of Los Angeles and Long Beach ports in the USA. They argued that since it is fundamentally significant to improve the physical capacity and the operational efficiency to store greater volumes of containerized cargo at these ports, and given the fact that physical expansion to land in close proximity to urban centre ports is absolutely impossible in addition to the growing environmental and community concerns regarding port development, port authorities and terminal operators realized that improving operations productivity is the only way out.

In addition, some researchers call for improving the utilization of available resources. Hui and Junqing (2009) wrote that it is no longer possible for some container terminals to expand their surrounding land to cope with the ever-growing world trade. They argued that the solution is in a “multi-agent theory based system” concerned with resource allocation and operation scheduling problems, aiming at improving productivity. The method they proposed is simulation.

Kho (2005) suggested three measures to increase existing terminal capacity:

1. Influence demand, i.e. prioritize vessel calls and reschedule certain calls to the off-peak period,
2. Improve productivity, i.e. increase equipment productivity and explore flexible manpower arrangements, and
3. Enhance capacity, i.e. increase container handling equipment and increase yard capacity and space.

However, Niswari (2005) claimed that to measure yard capacity, the total TEU visits that the terminal can accommodate must be counted according to the terminal ground slots (TGS) in addition to the average dwell time (the number of days the containers are stored in the terminal), peak factor (the maximum number of container moves that can be carried out at the terminal), stacking height (how high containers can be stacked depending on the container type), and finally the stacking density (how many containers can be stacked at the yard).

He also drew the following equation to explain his point of view:

$$\text{TEU visits} = \frac{\text{TGS} \times \text{Stacking Density} \times \text{Stacking Height} \times 365 \text{ (days)}}{\text{Dwell Time (days)} \times \text{Peak Factor}}$$

Niswari (2005) then highlighted that the TEU visits do not mean the number of containers the terminal handles, because containers are not necessarily 20 feet long. Hence the TEU factor, which is the ratio between the number of boxes and the number of TEU, should be measured as follows:

Container visits = TEU visits / TEU factor.

2.3.4 Solution 4: Floating and dry docks:

On the other hand, the solutions of utilising floating and dry docks were not ruled out. Koh et *al*. (2011) focused, in their study on the spatial scheduling for shape-changing mega-blocks in shipbuilding companies, based on a very interesting solution to overcome the problem of space restriction and to increase productivity. Some of the shipbuilding companies started to use docks floating on the sea rather than dry docks on the land. A floating crane capable of lifting up to 3600 ton objects was used to handle the blocks, the basic units in the processes of shipbuilding. However, it was difficult to handle huge or mega blocks that

could also be used to build ships due to the positional restrictions in the mega blocks assembly yard. This leads again to the problem of scarcity of space.

2.3.5 Solution 5: Investing in Dry port:

Murphy and Le-Griffin (2006) explicitly mentioned that pure physical expansion is commonly constrained due to the limited space/land available. They also raised the issue that terminal operators need to enhance their capacity and at the same time reduce the handling costs. One of the methods to achieve this aim was to move some of the containers to holding sites outside the terminal area should there be more land to store such containers. However, this solution entails more costs for transporting the containers to the storage yard outside the port. Also, Foster and Briceno-Garmendia (2010) discussed the need for planning and developing inland ports (dry ports), particularly in the landlocked countries which need more than one alternative to achieve the maximum benefit of traffic growth. Then, it becomes the role of governments as well as coastal and landlocked countries to choose the transit corridors that must be developed.

Furthermore, Roso *et* al. (2009) indicated that dry ports aim at improving the situation resulting from the container terminal capacity problem, through a focus on security and control by the use of information and communication systems. So, dry ports are a suggested solution for crowded terminals, congestion and prolonged dwell times for containers by using rail shuttles for connecting a seaport with its hinterland.

The specific role of an Dry Port will be discussed in detail in section 2.3. (its importance , benefits, functions, etc.). Meanwhile the following table summarizes the literature reviewed in this section by mentioning the author(s), the objectives explained, the methodology adopted in each research and solutions for building capacity.

Table 2.3 - Suggested Solutions for Building Capacity

Solution number	Author/s	Solution focus	Methodology	Suggested solution
1	Niswari (2005)	To investigate some expansion options that might be feasible when one is to expand an existing manual-operated container terminal.	A case study that assesses the operational and financial impacts of five possible expansion projects is conducted.	Physical expansion by changing terminal layout and equipment.
1	Loke et al. (2010)	To investigate the alternative ways of container terminal's expansion model.	A generic container terminal expansion model is developed.	Physical expansion
2	Ioannou et al. (2000)	To select and evaluate cargo handling technologies for both commercial and military operations.	Using simulation and the performance is compared with a base scenario of manual operations at the Norfolk International Terminal.	Using advanced technologies by means of Automated container yard using: a) AGVs. b) Linear Motor Conveyance Systems. c) AS/RS.
2	Lui et al. (2002)	To design, analyse, and evaluate four different automated container terminal (ACT) concepts.	A microscopic simulation model is developed.	Using advanced technologies and automation based on the use of automated guidance vehicles (AGVs), a linear motor conveyance system (LMCS), an overhead grid rail system (GR), and a high-rise automated (AS/RS).
2	Liu et al. (2004)	To demonstrate the impact of deploying automated guided vehicle systems (AGVS) and terminal layout on terminal performance.	Developing simulation models.	Applying advanced technologies, and in particular automated guided vehicle systems (AGVS).
2	Abbate et	To provide a	They proposed a	Using automated

	al. (2009)	method that enables the discovery of the relative positions of a group of adjacent containers.	non-conventional approach by means of a wireless sensor network.	procedures and advanced solutions in the area of logistics.
2	Henesey (2006)	To evaluate the performance of container terminal management operations using agent-based technologies.	Multi-agent based simulation was applied. Also, a simulation tool called SimPort, was developed. Qualitative and quantitative interviews were conducted.	Applying novel methods and technologies.
3	Le-Griffin and Murphy (2006)	To assess the productivity of Los Angeles and Long Beach.	Analysing the productivity factors and measures both quantitative and qualitative of the ports of Los Angeles and Long Beach has been conducted.	Improve ports operational and managerial efficiencies and overall productivity.
3	Ilmer (2006)	How container terminal investments in Northern Europe are developing and how the balance between the supply of and demand for terminal capacity in this geographical area will look like in 2010.	Quantitative approach based on statistics.	Improving utilization of the available resources.
3	Hui and Junqing (2009)	To presents a multi-agent theory based system for resource allocation and operation scheduling problems in container terminal to improve productivity.	A simulation system of this multi-agent system was developed. The system was developed under the platform of JavaEE.	Improving utilization of the available resources.

3	Liu (2010)	To evaluate the efficiency of container ports and terminals and improve the scale efficiency of any particular port/terminal.	Reviewing the stochastic frontier analysis (SFA) literature applied in container port and terminal studies.	Focusing on improving operational flexibility to meet peaks in carrying demand.
4	Koh et al. (2011)	To develop an efficient spatial schedule for the mega-block assembly yard in a shipbuilding company.	A GA-based heuristic algorithm using computational geometry theory was proposed.	Using floating-docks on the sea instead of dry-docks on the land.
5	Roso et al. (2009)	To extend the idea of the dry port concept.	Reviewing literature.	Dry port implementation

All of the above mentioned solutions have been taken into consideration when thinking about the appropriate solution to overcome the container terminal capacity problem. Most of the solutions concentrated on using automation and the optimal use of the available resources; others suggested expanding the land space. The question is: if there was a maximum utilization of the available resources but there was not enough space to expand land space, especially in land locked countries, what will the solution be? This is central to the question that the present research attempts to answer and one potential solution the researcher conceives to increase capacity and efficiency of container terminals is to invest in building Dry Ports.

Due to the increasing demand from shipping lines, some ports have no other option for the capacity problem than to increase the hinterland areas and build inland terminals such as dry ports, with a view to maintaining their competitive position (Lee *et al*., 2008). However, Roso (2009b) explained the importance of the accessibility of seaports' hinterland as it may become a resistant point for port development as there should be different means of transportation to link the seaport with the hinterland as well as intermodal loading units for goods. This was illustrated by Woxenius *et al*. (2004) when they stated, "The dry port concept

is based on a seaport directly connected by rail with inland intermodal terminals where shippers can leave and/or collect their goods in intermodal loading units as if directly at the seaport."

Roso and Lumsden (2009) demonstrated that transport systems are characterized by transfers of goods between points of origin and destinations through the transport network that is made of links and nodes, where links represent transport and transfer activities connecting nodes. These activities such as consolidation, sorting, storage, and trans-shipment between vehicles and traffic modes are carried out in nodes. Based on this point of view, a node is equivalent to a stop in the flow or to a point where the flow can be stopped. They added that in order to ensure that the network will function when it comes to exchanging goods between different links, it is essential that the links converge in a specific node at certain times or within certain time intervals. They concluded that the main problems seaports face today, as a result of growing containerized transport, are lack of space at seaport terminals and increased bottlenecks in the land-side transport system serving the seaports.

Cullinane and Wilmsmeier (2011) stated that limitations on port capacity still plague the container handling industry despite the temporary respite afforded by worldwide recession. At the same time, competitive pressures continue to mount on container ports. In recent years, the dry port concept has increasingly been applied, not only as a means to overcome capacity problems but also a deliberate attempt to expand or reinforce the hinterlands of container ports.

2.4 Dry port

2.4.1. Definition

ICD or an inland container depot is used to refer to a dry port. According to the United Nations Conference on Trade and Development (UNCTAD, 1991), an ICD performs the same function as a port. Both UNCTAD (1991) and the United Nations Economic Commission for Europe (UN ECE, 1998) defined ICD as, "A

common user facility with public authority status equipped with fixed installation and offering services for landing and temporary storage of export, laden and empty containers carried under customs control and with customs and other agencies competent to clear goods for home use, warehousing, and export, temporary storage for onward transit and outright export."

Another ICD definition was proposed in 1992 by the United Nations (1992a) as follows:

"Inland Container Depots (ICDs) may be generally defined as facilities located inland or remote from port(s) which offer services for the handling, temporary storage and customs clearance of containers and general cargo that enters or leaves the ICD in containers. The definition also highlighted the main purpose of ICD *as "to allow the benefits of containerization to be realized on the inland transport leg of international cargo movements".* The definition added that ICDs may contribute to the cost-effective containerization of domestic cargoes as well, but this is less common.

2.4.2 Dry Ports Functions

Many researchers discussed the functions of dry ports, which are various. Gujar and Ng (2009) stated some of these functions included consolidation and distribution, temporary storage, custom clearance, connection between transport modes, allowing agglomeration of institutions (both private and public), which facilitates the interactions between different stakeholders along the supply chain. They concluded that though dry port functions are similar to modern seaports, they do not perform stevedoring operations from ships.

2.4.3 Benefits

Having all the above functions, Dry ports have several benefits, most important of which are increasing seaport capacity and productivity and reducing congestion. Roso (2009) identified some of the benefits of dry ports. She focused on increasing seaport capacity and productivity, reducing congestion in seaport cities and at ports, lowering the environmental impact, decreasing risk for road

accidents as well as road maintenance cost, and improving a seaport's access to areas outside their traditional hinterland. She added that they may also serve as a depot. Roso and Lumsden (2009) suggested that building dry ports in the hinterland of the seaport will help this seaport enhance its terminal capacity and as a result solve the problem of lack of space.

According to Notteboom and Rodrigue (2009) inland fright distribution can be significantly improved by simple coordination. This will lead to benefits for all the involved parties. Some of the key benefits involved with more cooperation with inland locations include increasing regional productivity by a more efficient connection with inland locations and stronger support for the cargo handling function of the port because of better use of space and increased possibilities for a successful modal shift. In addition, there is an expansion of the hinterland, and a possibility to capture a market share of competitor ports as well as retention of customers in the hinterland. Other advantages are a better insight and level of service in the local markets; an increased potential for intermodal services, even on shorter distances; more attractive hinterland services because of an increased flexibility, reliability and frequency; further strengthening of the geographic concentration of logistics companies, including advantages for both seaports and inland ports; and simplified customs procedures. They concluded that the growing focus on inland ports is indicative of transport development strategies, gradually shifting inland to address capacity and efficiency issues in light of global supply chains. They added that the main drivers for the complexity of modern freight distribution are the increased focus on intermodal transport solutions and capacity issues.

Jaržemskis and Vasiliauskas (2007) expressed their positive opinions on the dry port advantages as shown by the respondents in Figure 2.1 It shows that the dry port is feasible because it helps both to avoid traffic bottlenecks and to connect cargo handling from the port with other types of cargo at one common transport centre. Also, it strengthens multi-modal solutions.

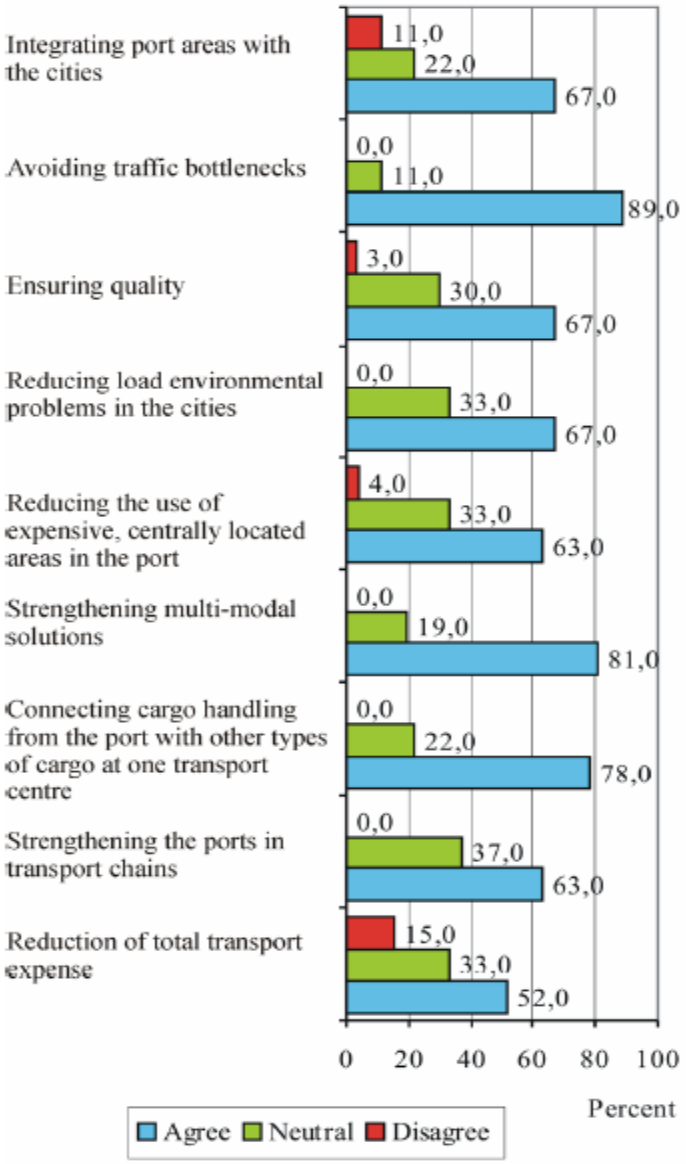


Figure 2.1 - The Average Opinion of Dry Port Advantages

(Source: Jaržemskis, and Vasiliauskas (2007))

They added that the dry port should concentrate on offering both more specialized and extra services and customs clearance services as well as on ensuring intensification of the transport chain effectiveness.

Benefits for the actors of the system include less congestion, increased capacity, and extended hinterland for seaports; less road congestion and land use

opportunities in seaport cities; improved services for shipping lines and forwarders; economies of scale and more market share for rail and intermodal operators; less time on congested roads and terminals for road operators; improved seaport access and greener marketing for shippers; lower environmental impact and more job opportunities for society (Roso, 2009 and Roso and Lumsden, 2009).

Woxenius *et* al. (2004) discussed the benefits of dry ports from a different perspective concerned with environmental aspects. They elaborated on the benefits of shifting flows from road to rail on the ecological environment and the quality of life. They also referred to the high possibility of enlarging the port throughput without physical expansion and consequently the enhanced service for both shippers and transport operators. Henttu and Hilmola (2011) also referred to the environmental impacts of dry ports as using a dry port network reduces the environmental impacts of the transportation network.

Roso (2007) also explained the benefits of dry port implementation but from an environmental perspective. She calculated CO_2 emissions that become approximately 25% lower with an implemented dry port for the chosen case, and she proposed having dry ports as a solution for the reduction in seaport terminal congestion and truck waiting times.

It is evident therefore that the dry port can certainly develop a seaport's hinterland economically, increase cargo capacity as well as the services provided by ports and as a result promote their competitiveness. This in turn can enhance the regional economy and improve the supply chain as concluded by Wang and Wang (2010).

Also, Rosa and Roscelli (2009) viewed that the relationship between the seaport and dry port is a crucial element and that its role is to make the two sections of the port work as a single system, as if they were close to one another.

2.4.4 Importance of dry port implementation

Roso and Lumsden (2009) contend that implementation of a dry port into a seaport transport system, which serves the seaport's hinterland, should create a seamless transport chain, a smooth transport flow with one interface, or node in the form of dry port instead of two interfaces, or nodes, one at the seaport and the other at the inland destination. However, significant time and financial savings could be made only by avoiding the queues at seaport gates and by moving container storage inland.

Other authors indicated the importance of having rail transport to serve the dry ports. Woxenius *et al. (*2004) said that regardless of the reason for implementing dry ports, rail transport has to play as an intermediate traffic mode between sea and road. However, costs and benefits should be evaluated carefully. However, Henttu and Hilmola (2011) suggested that the implementation of dry port solutions and increasing the use of rail transport decreases the total relative costs of transport. Kenya Ports Authority (2009) stated that the major objectives of Dry ports is to bring port services closer to hinterland customers (shippers) through specialized rail transport service as well as decongesting the port area.

Jaržemskis, and Vasiliauskas (2007) asserted that in order to ensure an effective dry port, there are two general objectives. First, consolidation of maritime goods in intermodal short and long-distance transport flows. Second, the collection and distribution of international transport - whether local, regional or international. They added that in order to achieve these two objectives, it is necessary for the terminal to carry out the following functions: hinterland warehousing; management of container flows to different ports based on consolidation of individual container flows; reduction of pre-and end haulage with road transport and expansion of rail transport; offering special and extra services; reduction of transport costs; and an increase in the firms of ship owners and the port's influence to ensure intensification of the transport chains effectiveness.

In their final report published in December 2006, the IBI group reviewed the key success factors of inland container terminals by saying that these terminals should be near the centre of production/population and there should be availability of suitable land use. Moreover, efficient rail connectivity should be installed with a direct connection to a major highway network and a phased development approach, which can limit initial capital requirements, should be applied.

Based on different case studies, the most vital structural and functional characteristics of a sample dry port in developing countries are: inland intermodal terminal (at least 2 different modes of transportation) and different distances from seaport(s); shuttle rail connection with seaport(s) (at least once per day); appropriate access to origins and destinations of main nodes of freight; handling equipment for different types of containers; customs clearance and control; intermodal container transportation services with required bills of lading; and lowering transportation time and cost (even for very short distances (Roso 2008)); in addition, ownership and management are usually assigned to seaports, public and private rail companies, municipalities of adjacent cities, some other value-added services, and adequate marketing in its region as stated by Dadvar *et* al. (2011).

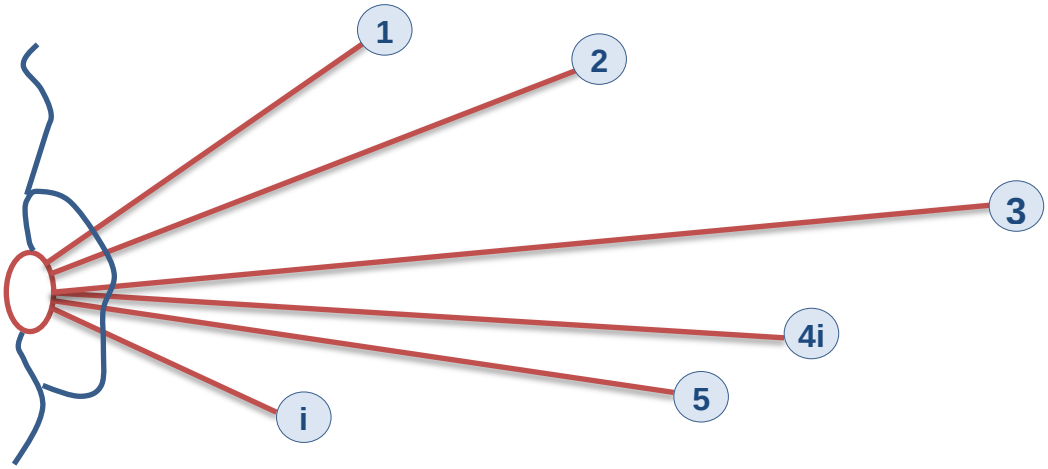
Some countries have already started investing in inland container depots In Vietnam, for example, the Prime Minister signed a decision concerning the country's inland clearance depot (ICD) system development until the year 2020 aiming to reach 2030, thus encouraging investment in this system. By 2020, Vietnam is expected to have 13 ICDs and the annual throughput of the national ICD system will be six million TEUs, having 1.2, 0.6 and 4.2 million capacity in the north, central and south respectively. By 2030, these figures are expected to rise to 14.2 million TEUs across the country as reported in *The Saigon Times Daily.* by Tan (2011).

Another related term is Container Freight Station (CFS), which offers similar activities to an ICD or Dry Port. Both act as transit facilities that could be served

by rail and/road transport, however, they are differently located. The CFSs deal with break-bulk cargo originating/terminating in the intermediate hinterland. They are located near the port as off dock facilities that help in decongesting the port, shifting cargo and custom related activities outside port area. On the other hand, ICDs are located in the interior away from the servicing ports (Government of India Ministry of Commerce and Industry, 2006).

According to a feasibility study on the network operation of hinterland hubs (2007), the consolidation of maritime goods in intermodal short- and long distance transport flows; and collection and distribution of local, regional and international transports are two general objectives of a dry port.

As shown in Figure 2.2, Roso (2008) illustrated how dry ports reduce road transport to/from seaports by shifting the flows from road to rail transport in the transport system.



a)

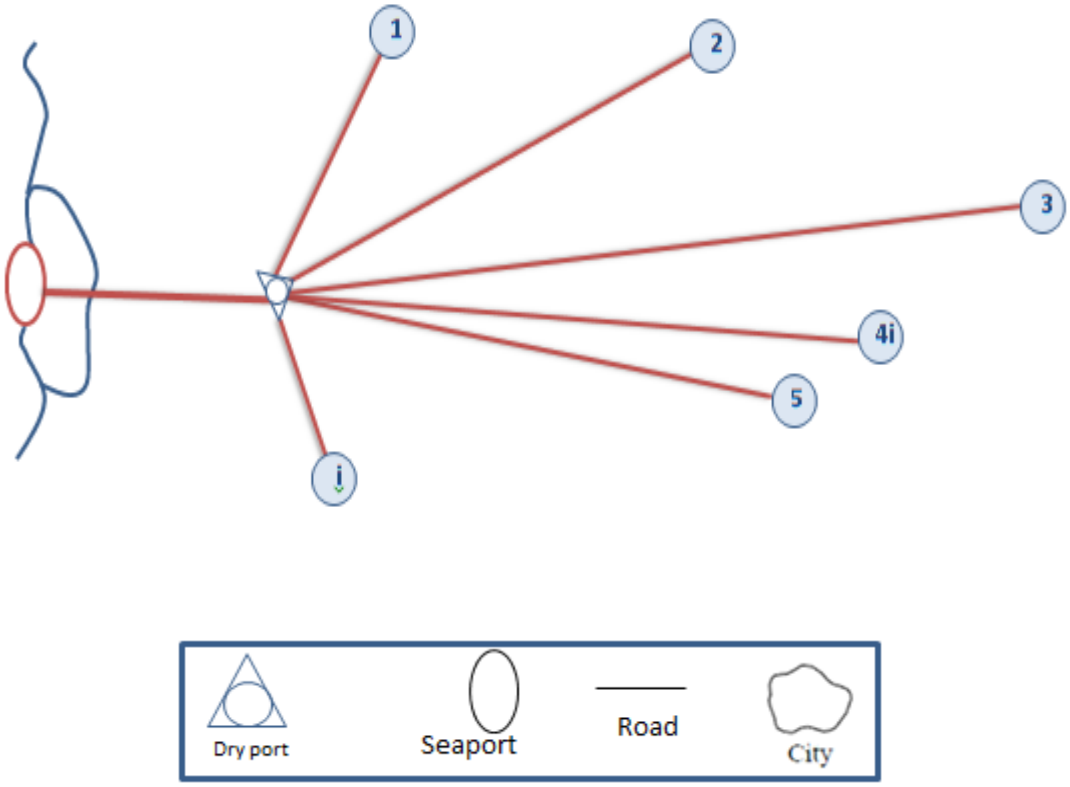


Figure 2.2. Seaport's Inland Access (a) without Dry Port, (b) with Dry Port

(Source: Roso, 2008)

Also, De Langen and Chouly (2004) ensured that the performance of the dry port will greatly depend on the quality of access to a dry port and rail-road interface. Though the behaviour of many players like freight forwarders, terminal and transport operators, and port authorities, this will determine the quality of inland access. Therefore, the inter-organizational arrangement of the actors in the transport system should be considered.

Roso (2007) demonstrated the impact of implementing a dry port on increasing a seaport's terminal capacity. Thus, the potential of receiving bigger container ships will increase which also increases the productivity of the seaport. She also mentioned dry ports as a good solution for countries that did not allow long trailers to move through cities for safety reasons. However, rail will substitute for

the road transport. So, congestion made by a large number of Lorries in seaport gates and surrounding areas will be reduced and the number of accidents, road maintenance costs and local pollution will definitely reduce. In addition, dry ports can serve as a depot for storing empty containers.

The importance of selecting dry port location was one major issue in the study conducted by Ng and Gujar (2009) because it affects tremendously all the elements contributing to the entire supply chain efficiency such as transport cost, connectivity, and transport modes.

They highlighted that geographical considerations are of great importance when deciding upon the suitable locations for transport hubs. The main reason they mentioned is that economic activities are carried out in certain areas and the processes involved lead to creation of spatial patterns.

Xu (1999) argued that the operations of transporting containers have been spreading inland, with more complicated services across the shipping network. Therefore, installing inland container depot networks requires extensive capital investments from container transport operators. Hence, it is important for both capital and operating efficiencies to optimize the location of such depots financially. In addition, goods should move from shipper to consignee in a continuous flow without any interruption in order to have an efficient and reliable freight transport system.

Magala and Sammons (2008) proposed a new approach that models port choice and how shippers choose ports. Ports are chosen not only because of their location but also due to their reliability and quality of the whole supply chain network performance. Dry port ownership adds a new element to the supply chain that connects seaports to rail, road and freight consolidation networks.

Vandervoort and Morgan (1999) reasoned that the failure of dry ports in developing countries was because of the system and regulations. However, the necessary supporting infrastructure (railways and roads) should be available in place with assured maintenance in order to have a dry port successfully

implemented. Furthermore, the involvement of both the public and the private sector should be optimized by the legislative and institutional systems.

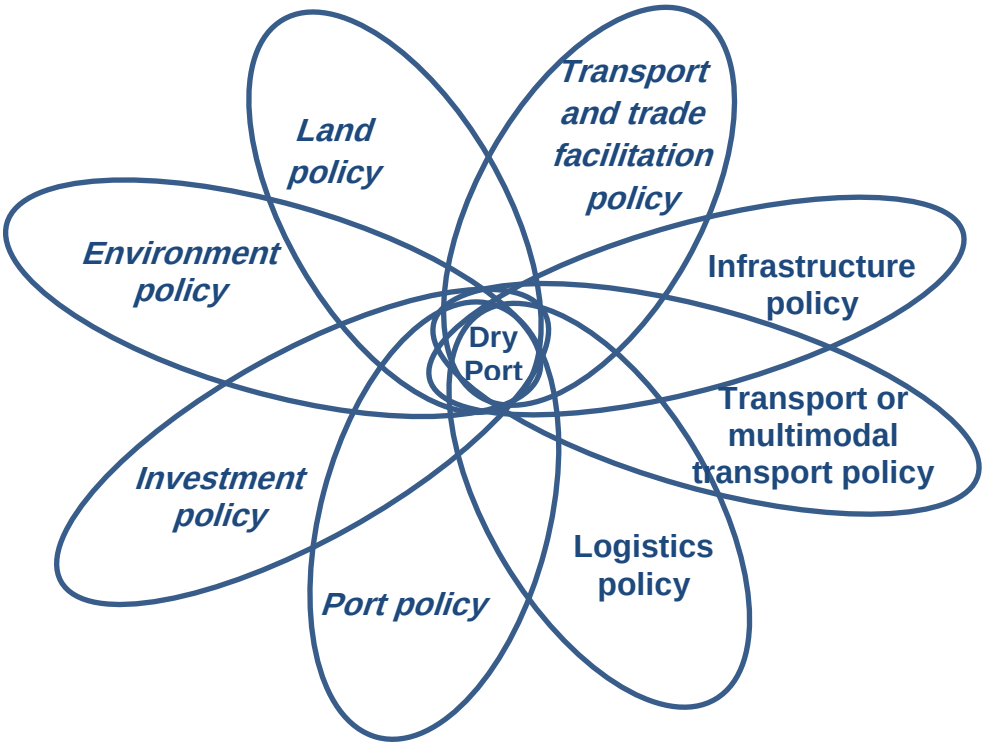


Figure 2.3 Policies and Regulations Relevant to Dry Ports

Coordination among the various sectors and different levels of government is essential.

(Source: ESCAP, 2010)

Figure 2.3 shows that the development of dry ports involves numerous governmental agencies concerned with transport, trade, commerce, finance, the environment, customs, ports, and logistics in addition to private sector organizations, financing companies and banks. Thus, the planning, development, and operation of dry ports demands significant coordination and cooperation as indicated by ESCAP, Institutional and Regulatory Issues for the Development and Operation of Dry Ports (2010).

Furthermore, Cullinane and Wilmsmeier (2011) supported the application of the Product Life Cycle to ports and stressed both the relationship between dry port development and the prolongation of the growth and/or maturity phases of a Port's Life Cycle and the specific relationship between the Product Life Cycle and container port development. Moreover, they evaluated the prospect of a dry ports' effect on the Product Life Cycle of container ports. Finally, they identified the conditions that are likely to characterize the successful implementation of the dry port concept in order to achieve the desired effect of prolonging a port's growth and/or achieving maturity phases.

Cezar-Gabriel, 2010; Cullinane and Wilmsmeier (2011) also indicated that the dry port concept was recently reborn due to the growing attention towards the environmental issues related to growing volume in containerized maritime transport.

Henttu *et* al. (2010) debated that the EU will focus on decreasing the external costs of transport as it is the only sector with increasing external cost. The interest on environmental problems and issues has increased lately due to the higher external costs such as congestion, CO2 emission, noise and accidents. Moreover, they decided that rail transport is a cost effective and environmentally friendlier mode of transport than road transport. Therefore, they supported dry port implementation.

However, Cezar-Gabriel (2010) talked about the positive environmental advantages which resulted from implementation of dry ports and how CO2 emissions will be reduced by transport of freight through an electrified railway network instead of road transport. In addition to application of the "last mile" principle; which will reduce the congestion of trucks queued at seaport gates and the risk of road accidents, it will improve security, customs and government control.

Hanaoka and Regmi (2011) argued that the dry ports established near manufacturing and distribution facilities can offer positive environmental benefits

due to the reduced travel distance for manufactured goods that are distributed through dry ports and raw materials that are transported to factories. Thus, they concluded that through a modal shift that reduces the number of long-haul trucks plying on roads, railway connections to dry ports can also decrease freight emissions of CO2 and local air pollution.

Although it is clearly understood that inland intermodal freight transport cannot be made emission-free, efforts should be directed toward making it more sustainable in order to decrease both the noise and the emission of pollutants, volatile organic compounds, and hydrocarbons that pollute the local air. In addition, utilizing cleaner and greener forms of fuel/energy in transport and improving the transport services' operational efficiencies should be considered; therefore, an environmental impact assessment undertaken for the development and operation of dry ports should consider all potential impacts and should also develop a mitigation plan for likely impacts, including noise, vibration, and emissions of pollutants.

The concept of a dry port is investigated by Henttu and Hilmola (2011) and they argued that a rail transport share model can be increased through making use of the dry port concept that is applicable to general cargo. The evidence for the success of this concept is highlighted in the Port of Gothenburg in Sweden where applying the concept along with rail transport has brought about decreasing CO_2 emissions as well as lower transport energy costs. The researchers investigated, through analytical models; how the same concept could be implemented in the Finnish transportation network and what the benefits are that can be gained.

Davar *et al.* (2011) concluded that the idea of dry ports provides feasible solutions to the problems of seaport congestion and inland collection and distribution of goods. They added that dry ports develop both the rail transportation and the environmental situation.

2.4.5. Categories

Roso *et al.* (2009) defined the three categories of dry ports based upon their function and their location; they can be categorized as distant, midrange and close dry ports.

The first and the most popular type is the distant dry port. The main purpose behind implementing this type is that the distance and the size of the flow will be more economical when transported by rail and obviously, this will result in reducing the congestion at seaport gates as well as the surrounding area.

The second type is the midrange port which is situated within a distance from the port that is normally covered by road transport and works as a consolidation point for different rail services. Also, the administration and technical equipment needed could be installed in one terminal. So, this type of dry port works as a buffer for a seaport's stacking areas.

Finally, close dry ports are situated on the border of the city where road transport is consolidated to and from shippers outside the city area. The dry port offers rail shuttle services far away from port gates and city streets and thus it offers greater possibilities for buffering containers compared to the other types of dry ports. However, keen tracking and very reliable rail services are required to avoid the danger of increasing the dwell times.

The following table summarizes the literature on Dry Ports and shows the methodology used by each author:

Table 2.4 – Dry Ports in Transport Literature

Author/s	Aim/Objective	Methodology
Gao (1997)	Assisting intermodal carriers in determining their inland depot selection problem.	Multi-period model (MPB) was applied.
Xu (1999)	To formulate the ICD location problem at network level.	The formulation combines the multinomial logit model of discrete choice analysis to quantitatively describe the

		shipper's behaviours and preferences.
Ahadi (2002)	To demonstrate how the carrier should dispatch empty container to meet shipper's demand to relocate empty containers among depots and warehouses and to lease on/off vehicles in preparation for future demand.	Developing a decision support tool to assist transportation carriers in determining their inland network, the location and capacity of each depot and warehouse.
Woxenius *et al.* (2004)	To illustrate that a consciously applied dry port concept can shift freight volumes from road to more energy efficient traffic modes that are less harmful to the environment.	Existing applications of the dry port concept are presented regardless of whether these are officially denoted dry ports.
Roso (2007)	To evaluate the dry port concept from an environmental perspective using modelling and simulation.	A model of a transport system, with and without a dry port, is created and the results of the simulations compared.
Jaržemskis and Vasiliauskas (2007)	To present the concept of the dry port.	A research was conducted within The BSR Interreg III B NP Inloc (Integrating logistics centre networks in the Baltic Sea Region) project was carried out by the 35 partner organisations from nine Baltic Sea countries.
Magala and Sammons (2008)	To suggest a new and more effective analytical framework within which the modelling of port choice can be conducted and shipper choice decisions well understood.	A discrete choice modelling to handle both the system and the port choice is suggested.
Roso (2008)	To investigate and define impediments to a close advanced intermodal terminal – dry port implementation.	Comparative case studies through face-to-face interviews and a literature review have been carried out.
Lee *et* al. (2008)	To introduce evidence from an Asian perspective,	A conceptual model of port–city relationships in the case of Asian

	focusing on the particular case of global hub port cities such as Hong Kong and Singapore.	hub port cities was developed.
Wang and Wei (2008)	To evaluate the priorities on location selection of the dry port in regards to the new dry port location problems of Tianjin Port.	Analytic Network Process is used for the analysis.
Roso *et al.* (2009)	To extend the idea of the dry port concept and to define dry port categories.	Literature review on dry ports concept.
Gujar and Ng (2009)	To investigate the spatial characteristics of inland transport hubs in Southern India.	Semi-structured, in-depth interviews with 15 carefully-chosen senior industrial stakeholders within the region, including dry port operators, government officials and shippers, had been conducted.
Roso and Lumsden (2009)	To develop the dry port concept and to analyse the transport system with and without a dry port.	Literature review and interviews with relevant actors in the transport system.
Lv and Li (2009)	Discussion on the location selection of the dry port and takes Tianjin Port as an example.	Analytic Network Process (ANP) method has been introduced.
Wang and Wang (2010)	To optimize the location of dry port, and the results are helpful for accelerate the development of both seaports and dry ports.	A case study was conducted on the hinterland of Western Side of the Taiwan Straits Port Group, Fuzzy Clustering Analysis is used.
Wei *et* al. (2010)	To study the selection of Dry port location bases on the index system in view of the factors.	A fuzzy Analytic Network Process (ANP) method is used and evaluation model was built.
Cezar-Gabriel(2010)	To present an approach for defining accurate performance to evaluate the effectiveness and efficiency of processes in dry ports (inland intermodal hubs).	Extended literature review, interviews and case studies, with external validation regarding dry ports implementation.

Henttu *et* al. (2010)	To find out if a dry port solution could decrease costs of transport, especially external costs.	Literature review about dry port concept and costs of transport was conducted. Financial and environmental impacts of the dry port concept are studied using a simulation model.
Hanaoka and Regmi (2011)	To review the status of intermodal freight transport in Asia from an environmental perspective.	Case studies of operations in Asia are provided.
Chang *et* al. (2011)	To review the problem of optimally locating dry ports for seaport.	FCM is applied to solve the problem.
Dadvar *et* al. (2011)	To evaluate potential benefits and impacts of Dry ports for different kinds of stakeholders, which may lead to establish “Dry ports”.	A methodological approach was designed as follows: a) Comprehensive literature review, b) Definition of “Base Case” for Dry ports with required features, c) Comparative study and analysis, d) Questionnaires, e) Analysis of answered questionnaires, and f) SWOT matrix. Iran is chosen as a case study, as a developing country.
Cullinane and Wilmsmeier (2011)	To apply the Product Life Cycle to ports and to relate dry port development to the prolongation of the growth of a port’s Life Cycle.	The dry port concept is explained by reference to both the literature and industry examples.
Henttu and Hilmola(2011)	To examine how dry port concept could be implemented in the Finnish transportation network.	Macro gravitational models of distribution applying linear integer programming.

2.5 Dry Port location and capacity problem

The problem of selecting the optimal location for a Dry Port was investigated by some researchers but the problem was described from different points of view and different perspectives. The following sections will review this issue in detail. The literature review in the following section will be classified according to authors that describe the location / capacity problem of a dry port and the models

applied to solve this problem since, this research focuses on the dry port location/ capacity problem and the development of policies to address these issues. These approaches to dry port location and capacity modelling provide a useful background to the policy studies which will be adopted.

2.5.1 Problem description

Nowadays, a primary part of operational research and management science is location decisions, which can be referred to as facility location, location science, or location models. Farahani *et* al. (2010) added that location science has no limitation, from an application perspective.

Moreover, the locating facility problem is not new to the community of operational research and the challenge of finding the facilities' best site has prompted a rich and ever growing body of literature. They added that an ever growing family of models has developed to adjust to the multitude of applications found in both the business world and the public sector. Furthermore, location-allocation models extend over formulations ranging in complexity from simple linear, single-stage, single product, and powerless, deterministic models to non-linear probabilistic models. They added that mathematical programming based approaches and local searches are parts of algorithms. Klose and Drexl (2005) reviewed some of the work that has aided the current state of-the- art, focusing on the basic assumptions, mathematical models and certain references to solution approaches.

Additionally, Farahani *et* al. (2010) indicated that the multi-criteria facility location problems have been addressed increasingly in the literature due to the recognition of the need to regard more criteria in order to attain more real solutions.

However, Daskin *et* al. (2005) comprehensively examined facility location problems through both indicating the significance of facility location decisions in supply chain design and assessing the classical models including the conventional problem of fixed charge facility location.

Arabani and Farahani (2012) introduced a complete review on dynamic facility location problems (DFLPs). They also proposed their mathematical formulations and case studies from the literature.

2.5.2 Mathematical Models

Many researchers propose different mathematical models for the facility location problem but with different aims and perspective. The following section will review some of the more significant mathematical models that have been used in different cases with a view to solving the location problem.

Canel *et* al. (2001) considered the potential of minimizing the costs of both the total transportation and facility opening, especially effective when the costs of reopening and closing are relatively vital to the multi-period problem, by developing an algorithm for the capacitated, multi-commodity, multi-period, multi-stage facility location problem.

Melo *et* al. (2005) discussed facility dynamic location and relocation through proposing a mathematical modelling framework that includes capacity expansion and reduction scenarios. Thanh et al. (2008) propose a mixed integer linear program (MILP) for designing and planning a production-distribution system, which was to back up dynamic decisions concerned with designing and modifying a supply chain over a multi-period horizon.

However, Yu *et* al. (2010) proposed a simulated annealing based heuristic that holds a unique solution taking into consideration aspects of vehicle routing through a representation scheme for the Location Routing Problem (LRP), which is considered a relatively new research direction within the field of location analysis.

Bozkaya *et* al. (2010) addressed a multi-facility location problem, offering both a model of an integrated location-routing and a methodology of a hybrid heuristic solution. They also offered a GIS-based framework accompanied by an

algorithmic solution approach, potentially offering location analysts with an effective decision support system.

Moreover, Sonmez and Lim (2012) addressed two long-term facility location problem challenges that happen immediately: future demand change and an indefinite number of future facilities named the Facility Location and Relocation Problem – Uncertainty (FLRP-U). Presenting an integer programming formulation of the problem and performing sensitivity analysis they introduced a mathematical model that lessens the commencing and anticipated future weighted travel distance of customers.

Finally, Shiripour *et* al*.* (2012) proposed a model using the LINGO 9.0 software package, the global solver and the two meta-heuristic algorithms (GA and ICA) in order to find new facilities' optimal locations, lessening the total weighted anticipated rectilinear barrier distances from the new facilities to the existing ones.

2.6 Factors affecting location/capacity decisions

Some researchers highlighted factors, indicators or variables that highly affect siting dry ports; the following literature reviews different analytical methods used by different researchers and their selected factors which have been taken into consideration when determining the location of dry ports.

Both Wang and Wei (2008) suggest that the ANP (Analytic Network Process) can be used to decide the best city that can be selected as a location for the dry port. They also highlighted the most important factors involved in such selection. These factors include: 1) the natural environment (weather conditions, geological conditions, hydrological conditions, and terrain conditions), 2) the operating environment (labour conditions, characteristics of goods, level service, customer conditions), 3) the infrastructure (status traffic, state of public facilities, information infrastructure), and finally 4) the costs (transport costs, the local labour wage level, use of land resources, environment protection).

In addition, Lv and Li (2009) discussed the selection of dry ports and used Tianjin Port as an example. They mentioned some indicators for the evaluation of dry ports including: 1) the development status of the city involved as well as the nearby cities and if there is any potential for city development; 2) the traffic convenience between the dry ports and the port, the city traffic radiation area and the traffic capacity; 3) the labour resources and technology are also emphasized to understand the capacity of the local labour market and the level of hi-tech industry and labour; and finally 4) the cost that includes costs of transportation, level of local labour wages, use of land resources and environment protection.

They elaborated that the development status of selected cities is significant in the process of decision making since this status identifies the dry port environment and whether any goods are imported or exported. Their second indicator, traffic convenience, explains the possibility of transporting goods from the seaport to the dry ports and from the dry port to the places which may produce process or consume these goods. The third factor, which is technology and labour, is essential to be able to handle the goods entering and exiting the port. It is a very significant factor that has to be fulfilled to establish a dry port. Finally, the location of dry ports cannot be taken into consideration without bearing the costs in mind. Also, building dry ports should entail gaining financial profits.

Wang and Wang (2010) illustrated that selecting the perfect location of a dry port is a practical problem. They attempted to set the characteristics of the optimal location of dry ports. This was carried out by taking the hinterland of the Western Side of the Taiwan Straits Port Group as a case study and they used Fuzzy Clustering to rank the alternatives in order. They provided a way for optimizing the location of dry ports and the results they reached proved fundamental for the development of both seaports and dry ports. Also, Chang and Notteboom (2012) used the same quantitative method of Fuzzy c-means (FCM) clustering that focuses on seeking optimal locations for dry ports. However, they discussed the factors influencing dry port location decisions and established an evaluation index system.

Table 2.5 Evaluation Index of Development of Dry Port

Primary indicator	Secondary indicator	index
Development of logistics industry	Carrier service	Value-added of Transport Storage and Post (100 million Yuan)
Execution	Customer satisfaction	
Efficiency of dry port	Equipment	Value-added of tertiary Industry (100 million Yuan)
Equipment and Service	Conditions	
Conditions of dry port		Total Investment in fixed Assets (100 million Yuan)
	The overall level of the national economy	
Regional economic environments	Industrial foundation in hinterland	Gross Domestic Product (100 million Yuan)
	Foreign trade in hinterland	Gross Industrial output value (100 million yuan)
		Total Imports And Exports (USD 10000)
	Highway in hinterland	Number of highway linked to ports in Economic Zone on the western Side of the Taiwan Straits (unit)
Transport infrastructure	Railway in hinterland	Number of railway linked to ports in Economic Zone on the Western Side of the Taiwan Straits (unit)
	Volume of regional freight transportation	Freight Traffic (10000 tons)

Factors Affecting the Development of Dry Port

(Source: Wang and Wang, 2010)

It becomes clear that various factors affect the site selection, construction and development of a dry port. These factors can be either internal or external according to participants, executive power, facilities and equipment (see table 2.5).

Moreover, Wei *et al*. (2010) indicated that while the usage of maritime containers increases, the functionality of a seaport's inland access becomes fundamental for the efficiency of the transportation chain as a whole. For them, selection of dry ports is based on an index system concerning the factors involved. They also analysed the factors that influence dry port facilities in a systematic way and built an evaluation model. They concluded that decision makers may find it difficult to

come up with exact numerical values for the factors due to the complexity of assessing dry port selection performance. Finally, they found out that the fuzzy ANP method is feasible to solve the problems in uncertain conditions.

The factors that affect dry port location are summarized in this paper. It aims at deciding indicator systems related to the function of a dry port and logistics centre location. The following evaluation indicator system (Table 2.6) was created:

Table 2.6 - Dry port location evaluation indices system

Criteria	Sub-criteria
Infrastructure status	Traffic Information State of public facilities
Costs	Transport costs The environment protection Local labor wage level
Operating environment	Labor conditions The distribution and quantity of goods Customer conditions

(Source: Wei *et* al., 2010)

Table 2.6 illustrates the most important factors and the sub-factors that have an impact on them.

Lv and Li (2009) explained that infrastructure status determines how hard is it to shift goods from the seaport to dry ports and from dry ports to other places that produce process or consume goods. Costs are the essential things to be considered about location selection of dry ports. To pursue more profits is one of the most important purposes to build dry ports. Operating environment mentioned labor conditions, distribution and quantity of goods to be fulfilled to become a dry port. They are necessary to manage the goods to be transport in and out.

The problem of choosing the optimal location for dry ports was also addressed by Chang *et al*. (2011). They established an evaluation system to decide upon dry port location and they also applied Fuzzy c-Means (FCM) to find a solution to the problem. Tianjin Port is taken as an example and they concluded that Beijing is

the appropriate location for operating a dry port that can be selected from eight hinterland cities. When they compared the results, they suggested that both industry transfer and relevant policy tendency are to be considered when taking the dry port location decision.

Ka (2011) also listed six important factors that have influence upon dry port location selection in China: transportation, economic level, infrastructure facilities, trade level, political environment, and cost. Then, he combined two optimal selection models of dry port construction projects--Fuzzy-AHP and ELECTRE (Elimination Et Choice Translating Reality) in the New Eurasia Continental Bridges (NECB) of China region. On the other hand, Chang and Notteboom (2012) applied a quantitative method using Fuzzy C Means Clustering (FCM) for the selection of dry port location with a view to providing guidance for an optimal and reasonable dry port layout for the port of Dalian in China. They also, established factors affecting dry port location decisions such as transportation condition, regional economy, and policy environment.

Regmi (2012) tried to analyze and address the issues of adaptation and mitigation in the transport sector in Asia. With this regard his research considered the potential of freight modal shift through the development of dry ports. The four suggested alternative locations were analyzed using an analytic hierarchy process and goal programming using evaluation criteria such as transportation time, cost, intermodal connectivity, environmental impact and regional economic development.

Chandrakant (2011) discussed dry ports in India. He focused on certain factors that affect establishing dry ports. These factors are location analysis, government role in developing dry ports, the need for Public Private Partnerships (PPP), and regulating dry port competition by regulatory authorities. He also emphasized the efficiency of dry ports, the factors influencing dry port performance and the security of containers at dry ports. A GIS technique was used to analyse the dry ports' location.

A variety of authors focused on the factors that affect dry port location decision making using different analytical tools; some authors classified these factors or criteria into two levels: first and second level criteria. However, the first level contains the most significant factors while the second level is the sub-factor that should be weighted in the model and gives the indicators for the researcher to reach decisions. Table 2.7 summarizes the first and second level criteria and also the method used in solving this problem. I.e. where (F) refers to the first level, (S) refers to the second level.

Table 2.7 Summary on criteria in location problem

Author(s)	First and second level variables	Problem	Approach
Farahani *et* al. (2010)	• Cost (F) • Environmental risks(F) • Value and benefits(F) • Resource accessibility and utilization(F) • Public facility accessibility (F) • Political matters and regulations(F) • Competition(F) • Economical (besides costs and benefits)(F) • Population(F) • Capacity(F) • Distance(F) • Suitability(F)	Reviewing the recent efforts and development in multi-criteria location problems and their solution methods.	Literature review
Wei *et* al. (2010)	• infrastructure status(F) ○ traffic (S) ○ information infrastructure(S) ○ state of public facilities(S) • Cost (F) ○ transport costs(S) ○ the environment protection(S) ○ local labor wage level(S) • Operating environment(F) ○ labor conditions(S) ○ the distribution and quantity of goods(S) ○ customer conditions(S)	Selecting Dry port location bases on the index system in view of the factors.	fuzzy ANP method
Wang and Wang (2010)	• Development of logistics industry(F) ○ Carrier service(S)	To layout the optimal location of dry port	fuzzy cluster analysis

	• Execution efficiency of dry port (F) ○ Customer satisfaction(S) • Equipment and Service Conditions of dry port (F) ○ Equipment conditions(S) • Regional economic environments(F) ○ The overall level of the national economy(S) ○ Industrial foundation in hinterland (S) ○ Foreign trade in hinterland (S) • Transport Infrastructure(F) ○ Highway in hinterland(S) ○ Railway in hinterland(S) ○ Volume of regional freight transportation(S)		
Wang and Wei (2008)	• Natural environment(F) ○ weather conditions(S) ○ geological conditions(S) ○ hydrological conditions(S) ○ terrain conditions(S) • Operating environment(F) ○ labour conditions(S) ○ characteristics of goods(S) ○ level service(S) ○ customer conditions(S) • Infrastructure status(F) ○ Traffic(S) ○ state of public facilities(S) ○ information infrastructure(S) • Costs (F) ○ transport costs (S) ○ the local labour wage level (S) ○ use of land resources (S) ○ environment protection(S)	To evaluate the priorities on location selection of the dry port.	Analytic Network Process
Lv and Li (2009)	• development status (F) ○ development level of the city(S) ○ development level of nearby	Discussing the location selection of the dry port.	Analytic Network Process (ANP)

	cities(S) ○ potential of the city development(S) • traffic convenience(F) ○ traffic between dry ports and the port(S) ○ traffic radiation area of the city(S) ○ traffic capacity universities and colleges(S) • labour resources and technology(F) ○ the capacity of local labour market(S) ○ the status of hi -tech industry and labour(S) • Costs(F) ○ transport costs(S) ○ the local labour wage level(S) ○ use of land resources(S) ○ environment protection(S)		method
Chang and Notteboom (2012)	• Transportation condition(F) ○ Traffic Capacity(S) ○ Development status(S) • Regional economy(F) ○ Industrial level(S) ○ Commercial level(S) ○ Logistics level(S) ○ Foreign trade(S) ○ Development potential(S) ○ Social reproduction conditions(S) • Policy environment(F) ○ Policy orientation(S)	Providing guidance for an optimal dry port layout for the port of Dalian in China (dry port location selection)	Fuzzy c - Means (FCM) clustering
KA (2011)	• Transportation(F) ○ Transport distance(S) ○ Region scale of freight volume(S) • Economic level(F) ○ GDP(S) ○ Commercial and industrial output value(S) • Infrastructure facilities(F)	Research on Dry Ports Location of the NECB in China region	Fuzzy-AHP and ELECTRE (Elimination Et Choice Translating Reality)

	○ Security of infrastructure facilities (S) ○ Logistics centre(S) ○ Mutual complimentary of resource(S) • Trade level(F) ○ Import and export trade(S) • Policy environment(F) ○ Policy-oriented(S) ○ Regional cooperation environment(S) • Cost(F) ○ Transportation cost(S) ○ Land cost(S)		
Regmi (2012)	• Development and operation costs(F) ○ Land acquisition costs(S) ○ Construction costs(S) ○ Transport costs(S) • Transport time(F) ○ Total transport time from seaports(S) • Intermodal transport connectivity(F) ○ Highways(S) ○ Railways (S) ○ Inland waterways(S) ○ Seaports(S) • Environmental impacts(F) ○ Impact from construction(S) ○ Impact from transport operation(S) • Regional economic development(F) ○ Proximity to market, production centres and consumers(S) ○ Government polices to develop special economic zone or free trade area nearby(S) ○ Freight demand(S)	Assessing the impact of climate change on transport and mitigation potential of the dry port development.	Analytic hierarchy process (AHP) and Goal Programmi ng (GP).

Earlier researchers used different methods in evaluating the dry port location problem such as fuzzy ANP, fuzzy cluster analysis, ANP, fuzzy c-means clustering and Fuzzy –AHP an ELECTRE ; in addition, Chang and Notteboom (2012) indicated that many researchers gave substantial attention towards dry ports location analysis. Location analysis using mathematical methods has been successfully applied to dry ports for certain situations. Some of the well-used methods in solving the location problem are integer programming and linear programming, as well as multi-criteria decision models such as Analytical Hierarchy Process (AHP), Fuzzy Analytical Hierarchy Process (F-AHP), and Data Envelopment Analysis (DEA).

Each researcher choses the analytical tool that suits their case, and they also selected the factors or the variables that highly affect the location decision. So, based on the previously reviewed factors and early academic research, common variables were selected. The following table (2.8) summarizes the most common variables affecting dry port location decision.

2.8 -Table summarizing the most common factors "Variables" affecting Dry port location:

First level variables	Second level variables
• Operating environment	• labour conditions • level service • customer conditions
• Transportation Time	• Total transport time from seaport
• Infrastructure status	• Traffic capacity • Distance • State of public facilities • Information infrastructure
• Cost	• Transport costs • The local labour wage level • Use of land resources • Environment protection
• Economic environment	• Foreign trade
• Policy environment	• Policy-orientation

(Source: Author's Own)

As revealed from the literature review and the above discussion, in order to have a successful dry port implementation, a collaboration of three main issues should be effectively managed. First; *Dry port requirements*; as declared by Jaržemskis, and Vasiliauskas (2007) that there are two general objectives to ensure an effective dry port system; consolidation of maritime goods in intermodal transport flows and the collection and distribution of international transport - whether local, regional or international.

Likewise, *Policies and regulations* highly affect dry port efficiency especially in developing countries as stated by Vandervoort and Morgan (1999), they ensure the involvement of both the public and the private sector should be optimized by the legislative and institutional systems. As shown in Figure 2.3 dry ports demands significant coordination and cooperation between numerous governmental agencies concerned with transport, trade, commerce, finance, the environment, customs, ports, and logistics in addition to private sector organizations, financing companies and banks as indicated by ESCAP, Institutional and Regulatory Issues for the Development and Operation of Dry Ports (2010).

And finally, *Factors affecting the development of dry port* Location decision have been studied by several authors, and an evaluation indices has been formulated through their studied as illustrated in table 2.5, table 2.6 and table 2.7 and based on these studied a table summarizes the most common variables affecting dry port location decision has been established (see table 2.8).

Accordingly, based on the collaboration of the above literature, most of the Delphi statements were generated to reflect the criteria that highly affect location and capacity decisions regarding dry port implementation.

Figure 2.4 shows the importance of the coordination between the three criteria which highly affect effectiveness of dry port implementation.

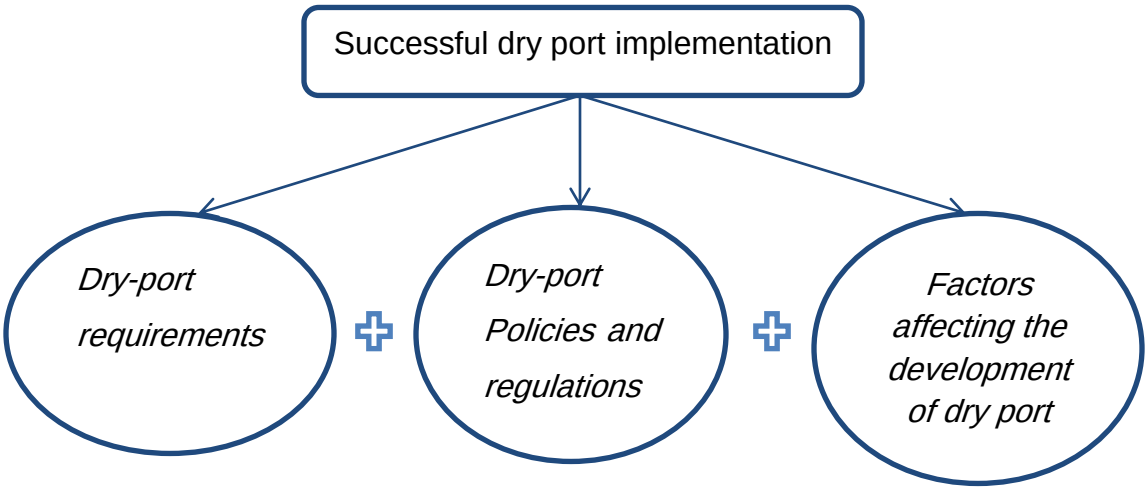


Figure 2.4 Conceptual guide or Drivers for successful Dry Port Implementation

2.7 Key Performance Indicators

Port performance indicators are measures of various aspects of the port's operation which are necessary to be measured and evaluated since they directly affect the nation's economy (UNCTAD, 1976).

According to the International Organization for Migration (IOM) handbook (2008), performance indicators are defined as "*Pre-determined measurements that track specific changes or results of a project. Performance indicators are directly linked to measuring progress toward project objectives and are often a combination of monitoring and evaluation*".

Several authors discussed the key performance indicators (KPIs) for ports and container terminals (UNCTAD 1976; UNCTAD 1987; U.N. 1982; Chung 1993; Fourgeaud 2000; Bichou and Gray 2004; De Langen *et* al. 2007; Esmer 2008; IOM 2008; Holloway 2010). The most popular and comprehensive studies according to (UNCTAD 1976; Chung 1993) will be discussed below.

Chung (1993) indicated that a progressive port manager would also wish to know how extensively and intensively his assets are being utilized as well as how well

the operations perform financially. Indicators to measure these performances are determined generally in relation to the tonnage of shipping calling at the port and of the volume of cargo handled since port services in the main are rendered to ships and cargo.

According to UNCTAD (1976) port performance indicators were classified into financial and operational categories. Financial statements, including income statements, profit and loss accounts, and balance sheets, determine the financial indicators, which intend to associate port income and expenditure with cargo total tonnage handled at the port. While operational indicators concentrate on many aspects in ports, including ship turn-around time, the cargo volume, the amount of delay, the duration of a ship's stay in port, the average calls number, the average flow-volume or weight-of-goods over a standard period of time, cargo volume handled per call or per day and the number of calls per berth and per year (Table 2.9).

2.9 -Table summarizing financial and operational indicators for port performance:

Financial indicators	**Operational indicators**
-Tonnage worked -Berth occupancy revenue per ton of cargo -Labour expenditure -Capital equipment expenditure per ton of cargo -Contribution per ton of cargo -Total contribution	-Arrival date -Waiting time -Service time -Turn-around time -Tonnage per ship -Fraction of time berthed ships worked -Number of gangs employed per ship per shift -Tons per ship-hour in port -Tons per ship hours at berth -Tons per gang hours -Fraction of time gangs idle

Source: (UNCTAD, 1976)

Similarly, Chung (1993) shed light on both the operational and the financial performance of indicator categories by explaining that the operational performance indicators, such as vessel performance primary measures, are the ship turn-round time and the tonnage each ship day handles in port while

financial performance can be interpreted from common financial statements, such as the income statement, profit and loss account, and balance sheet. He added that port income generation, operating surpluses and expenditure may be related to both the shipping total Gross Registered Tons/Net Registered Tons (GRT/NRT) and the cargo total tonnage handled at the port. In addition to that, the return on turnover rate can help to measure port performance.

He listed 16 main port performance indicators used by ports as follows:

1- Average ship turn-round time

2- Average tonnage per vessel day (hour)

3- Average vessel time at berth

4- Average vessel time outside

5- Average waiting (idle) time

6- Average waiting time

7- Tons per gang hour

8- TEUs per crane (hook) hour

9- Dwell time

10- Berth throughput

11- Throughput per linear meter of wharf

12- Berth occupancy rate (%)

13- Berth utilization rate (%)

14- Income (expenditure) per GRT (or NRT) of shipping

15- Operating surplus per ton of cargo handled

16- Rate of return on turnover.

2.8 Research Gap

As the literature review revealed (see section 2.3 and 2.4), most studies concerning location and capacity decisions have focused only on optimizing the location network (Wang and Wei 2008; Wang and Wang 2010; Lv and Li 2009; Wei et al. 2010; KA 2011; Chang and Notteboom 2012; Regmi, 2012) and most of their studies were based on evaluation indices system. Others try to solve the problem but from the carrier or shipper's point of view not the port manager's point of view (Geo, 1997; Xu, 1999; Ahadi, 2002). Klose and Drexl (2005), Farahani et al. (2010) and Chang et al. (2011) have comprehensively reviewed the location problem.

In addition, the literature shows that studies on the dry port's location problem have been conducted and models to assist intermodal carriers in determining their inland depot network have been developed. Many articles reviewed the idea of the dry port concept as well as the environmental perspective of using modelling and simulation. Considerable investigation of dry port implementation has also been carried out. Meanwhile this research is concerned with developing a structured decision support framework for policies for dry port location and capacity where there has been comparatively little work; a Delphi technique will be used to assess how port operators can take better policy decisions about investing in dry ports such as the number of depots the terminal needs, the size of each depot, and whether the terminal needs only one nearby depot from which distribution starts or many depots in various locations. Since, building a dry ports a strategic level decision which could be highly influential in determining the efficiency or otherwise of the conventional terminal with which it is connected. It could result in a financial and logistical disaster due to the huge investment (money, time and effort) that will be consumed if it is the incorrect decision. This research is therefore practical, financially valuable and academically sound.

Based on the above literature review, it becomes clear that the capacity problem is a major drawback in terminal operations. Consequently, this research aims to develop a structured framework to identify policy decisions for location and

capacity of dry ports using a Delphi technique as a support tool for terminal managers and operators in taking decisions relevant to dry ports investment.

2.9 Discussion and Conclusion

This chapter begins by reviewing the literature on container terminal capacity and the under capacity problem and how researchers tried to find some solutions for this problem. The review shows five different solutions, whereas this research focuses on dry ports as one of the five suggested solutions and the most feasible solution for most container terminals, especially for land-locked countries or countries that use innovative technologies and try to best utilizes their resources and still face the capacity problem; at this stage, dry ports will be the only way to overcome this problem. Hence, the need for dry ports is justified and extensive review on Dry Port concept is proposed.

Also, this review reveals the importance of dry port implementation and how the attention has increased in recent years on how to design and implement an effective Dry Port system. The review illustrates the main aspects that should be considered when designing and implementing Dry Port system though reviewing factors affecting Dry Port implementation and its location. Today's maritime industry requires a shift towards Dry Port implementation. The need for such implementation has been now recognised. Several studies have been developed to provide a greater support for Dry Port implementation as presented in the literature.

The literature also highlights the problem of selecting the optimal location and capacity for a dry port. The problem was investigated by some researchers using different mathematical models to solve this issue. On the other hand, this research focuses on the development of policy decisions regarding capacity and location when investing in dry ports as a decision support tool for port planners, investors or terminal operators. Each researcher selects the suitable analytical tool that fits their case, and they also select the factors or the variables that highly affect the location decision. As a result, based on the previously reviewed factors,

a summary on the common factors “variables” affecting the Dry Port location decision were generated. Finally, the research gap was formulated from the above literature.

In developing countries such as Egypt, still there is a lack of understanding for the significance of Dry Port implementation. Paying attention to this concept represents an opportunity for container terminals in these countries to gain competitive advantages through focusing more on Dry Port implementation and gaining benefits behind such implementation.

In the next chapter, the process of methodology selection will be addressed. The chapter will also discuss the research method selected concentrating on the key characteristics associated with the method, potential limitations of the method and examples of the method utilised for maritime transport related research. Then the validation of this method through using a case study approach will be discussed in details.

CHAPTER THREE - RESEARCH METHODOLOGY

3.1 Introduction

As reviewed in the earlier literature considered in chapter 2, many researchers tried to solve the Dry port location and capacity problem by using mathematical models. Based on this review, and the clear shortage of qualitative research into issues of port location and development a different methodology for this study was chosen and is presented in this chapter. The Delphi technique was chosen as a predominantly qualitative method for location and capacity policy decision-making and the validation of this technique will be undertaken by conducting a case study on AICT (Alexandria International Container Terminal) in Egypt.

The current research is explorative in nature as it begins to investigate a concept or real world problem i.e. the potential policy decisions for location and capacity of Dry ports. Brett (2007) illustrates that Delphi has been utilised for transport and maritime related research, since its inception in the 1950's the technique has developed from research for military intelligence to concentrate on areas such as health, policy, planning and transport.

This research follows an inductive approach including two qualitative research methods whereby the Delphi technique will be run first for the development of the research framework followed by conducting an inductive qualitative case study to complete its validation. An insight to the design and implementation of the case study research method is provided in this chapter. The chapter discusses the methods, and techniques used in creating the framework for identifying policy decisions for location and capacity of Dry ports. The rationale of using such methods and techniques are illustrated in this chapter. The chapter finally concludes by presenting the conceptual framework of the research methodology.

3.2 Delphi Method

Dalkey and Helmer (1963) were pioneers in Delphi research, and in the1950s they were hired by the Rand Corporation; they named their study “Project DELPHI”. In using such a technique, they aimed at acquiring a group of experts’ to achieve a dependable consensus of opinion. The Delphi method as a qualitative research methodology was used in order to forecast and problem-solve complex topics (Benarie, 1988; Woudenberg, 1991; Buckley, 1995; Skulmoski et al., 2007; Linstone and Turroff, 2011).

Linstone and Turoff (2002) defined the Delphi method as “a method for structuring a group communication process so that the process is effective in allowing a group of individuals, as a whole, to deal with a complex problem”.

Skulmoski et al. (2007) also stated that the Delphi method is a repetitive process used to gather and refine experts’ judgements through a series of questionnaires, focusing on problems; opportunities, solutions or forecasts, with feedback inserted. The results of each questionnaire develop the subsequent one. The process stops once the research question is answered: for instance, when consensus is reached, a theoretical saturation is fulfilled, or when adequate information has been exchanged. The Delphi method has long been widely recognized throughout the world in many fields of industry, since it has its roots in the American business community; these industry fields include health care, defence, business, information technology, education, transportation, and engineering.

They added that in order strictly to acquire qualitative data, the Delphi method is the suitable choice. It may be regarded as a structured process within which qualitative, quantitative, or mixed research methods can be used. Such flexibility not only enables this method to answer research questions but also makes it well matched to the abilities and skills of many researchers and participants.

McKenna (1994) used the Delphi approach, in order to seek the opinion or judgment of a panel of ‘informed individuals’ in a specific field of application on a

certain issue. A questionnaire or an interview is presented, and after the panel's response, data are summarized and a new questionnaire is designed based only on the first application's results. This second questionnaire is returned to each subject, and, in the light of the results of the first round, they are asked to reconsider their first opinions and to once again give the researcher their responses. Repeat rounds of this process are carried out until either general agreement of opinion or a point of diminished returns is reached.

Buckley (1995) specified that there could be a possibility of collusion, but Delphi should not accept connived findings and excludes any hint of collusion from the study. In almost all cases, the experts consulted in Delphi studies would not know of each other's involvement. Delphi can never be expected to be used as a lucid, unambiguous and a fully instructive guide to a project procedure or a management style but instead can be used as a guide to possible problems or feasible goals.

Jillson's thesis (1975) showed that different decision-makers may predominately formulate policy using one or another view, and that this results in distinguished types of policy options and considerations which may appear attractive from one view, but turn out to be counterproductive from another. Delphi deals with policy considerations; it is largely oriented to collecting information and views from a diverse set of respondents through putting the pieces of the problem together.

3.2.1 Types of Delphi method:

Van Zolingen and Klaassen (2003) discussed the four main types of Delphi method, which showed that this method holds much potential. It is suitable not only for predicting future developments and/or events, but also for generating policy alternatives (particularly useful for this research) or decision making on them.

A) The classical Delphi

The 'classical' Delphi is a method whereby, on an individual basis, data are gathered from experts in a number of rounds. At each stage, the results of

previous rounds are fed back until stability in responses on a certain issue has been reached among the experts through iteration. That is, no more important changes are taking place between rounds.

B) The policy Delphi

Turoff and Linstone (2002) stated that Delphi was basically introduced and practiced to both handle technical topics and reach agreement among similar groups of experts while the Policy Delphi looks at the possible resolutions of a major policy issue and tries to develop the strongest possible contradictory views on these resolutions. In addition, the Policy Delphi is not a decision-making mechanism, but an analysis tool for policy issues as it assumes that the decision maker is not concerned with having a group generate his decision but rather has an informed group present all the possibilities and the supporting proof for their consideration.

A Policy Delphi should be capable of achieving any one or any combination of the following objectives:

. To make sure that all possible options are presented for consideration

. To calculate the effect and result of any specific option

. To test and calculate the accessibility of any specific option

C) The decision Delphi

Rauch (1979) developed the Decision Delphi, in which the technique can be used to provide decisions and to have an effect on social developments. As a result, a decision Delphi recruits its panellists only with attention to their positions in the decision-making hierarchy rather than dealing with experts or lobbyists.

Rauch noticed that reality is considered in decision Delphi, rather than predicted or described. As a decision-making tool, Delphi is seriously affected by the possibility of creating reality in the panel of decision makers involved in a Delphi study. In the social sciences regarding the situation as real is often more important than having a real situation.

Decision Delphi, however, has to be viewed as far more than a simple self-fulfilling prediction; its primary social function could be to manage and organize the general lines of thinking in the spread out field of social relations and change the future development of such an area into well-thought-of decisions from those of simple accident.

It is important for the practical application of such a decision to involve in the panel a high percentage of all the actual decision makers in the considered field as well as to include a large absolute number of participants or to handle all related areas as in the cases of classical Delphi and policy Delphi respectively.

Finally Rauch (1979) summarises decision Delphi objectives as to prepare, help, and make decisions rather than to obtain a group opinion about forecast statements as in classical Delphi or to analyse social situations as in policy Delphi.

D) The group Delphi/expert workshop:

Webler *et* al. (1991) developed the one day Group Delphi that may include three or four repetitions. For such an encounter, an expert panel of 10-20 members is the most desirable, which in the case of doubt aims at achieving fast results in opinion making. Moreover, they concluded that the Group Delphi is an efficient strategy for lessening doubt around knowledge of predictions and interpretations. It is more convenient than the traditional Delphi in terms of time and effort, but consequently it provides only a brief summary of the expert opinion on the subject. There are three advantages of the Group Delphi, not related to the traditional Delphi: first, it provides a more obvious picture of the disagreement among the expert panel. Second, it gives a rationale behind the disagreement. Finally, it directly tests the disagreement in a “peer review”.

3.2.2 Delphi’s Key Issues:

Some key points should be well understood about Delphi before applying it. The following section will highlight some of the information.

Rowe and Wright (2011), through detailed discussion of many papers, have stated the following ways as guidelines for how to enhance the use of the Delphi method: first, improving panellist recruitment and retention over Delphi rounds. Second, creating useful heterogeneity in panel membership. Also, to enhance information exchange between panellists. In addition the research should aim to improve question formulation and finally, considering combining Delphi with other techniques.

Rowe and Wright (1999) and Landeta *et* al. (2011) mentioned the main features of the Delphi method which are: (1) it is a repetitive process; (2) it keeps the participants, or at least their replies, anonymous as the replies go directly to the coordinating group; (3) it provides controlled feedback; and (4) it represents a statistical group response as all the opinions form part of the final reply.

Stitt-Gohdes and Crews (2004) believed that in order to achieve a successful Delphi study, a careful choice of the panel of experts is required, taking into consideration the experts' qualifications, size, and commitment. Rowe and Wright (1999) added that 'expertise' or 'knowledgeability' is one of the primary characteristics of panel-lists.

The wrong choice of the Delphi technique as a research tool will typically result in failure. Linstone and Turoff (1975) suggest several possible reasons for failure such as:

- Over specifying the structure of the Delphi, thereby restricting the respondent group from contributing other points of view related to the problem.
- Supposing that in a certain situation the Delphi can substitute all other human communications.
- Summarizing and presenting the group response using poor techniques and commonly interpreting the evaluation scales used in the exercise.
- Creating an artificial consensus through ignoring disagreements.

- Undervaluing the Delphi's challenging nature and the need for compensating the respondents for their time in case the Delphi is not a part of their job requirements.

3.2.3 Delphi's Strengths and weaknesses

As for any research method, Delphi has strengths and weaknesses. Iqbal and Pipon-Young (2009) has assembled some of Delphi's advantages and disadvantages listed in table 3.1:

Table 3.1 : Advantages and disadvantages of the Delphi method

Advantages	Disadvantages
Very adaptable methodology that can be convenient for many applications. Iqbal and Pipon-Young (2009)	Lack of direction and agreed standards considering analysis and interpretation of results, defining consensus in universally agreed upon terms, and providing selection criteria for panel-lists (Sackman, 1975)
Assembling existing knowledge and spotting areas of agreement and disagreement. Iqbal and Pipon-Young (2009)	Developing new knowledge and theories less effectively. Iqbal and Pipon-Young (2009)
Overcoming barriers of group communication such as geography, time and other confinements (Stone Fish and Osborn, 1992)	Having limited generalizations as different panels may reach different conclusions that could not be identified as the only or correct issues. Iqbal and Pipon-Young (2009)
Cost-effective and time saving for the participants. Participants with multiple inbuilt opportunities for feedback find this research process potentially rewarding. Iqbal and Pipon-Young (2009)	Panel-lists have to possess high levels of commitment; often high levels of drop-out. Iqbal and Pipon-Young (2009)
Restricting the occurrence of puzzling interpersonal processes that often take place in 'live' groups. Iqbal and Pipon-Young (2009)	Panel-lists have to possess high levels of commitment; often high levels of drop-out. Iqbal and Pipon-Young (2009)
Anonymity between panel-lists can foster innovativeness, integrity, and balanced regard of ideas (De Meyrick, 2003)	Anonymity may establish less 'ownership' of ideas. Delphi process supposes panel-lists are inclined to or capable of individually clarifying issues and honestly responding. Iqbal and Pipon-Young (2009)

Source: adapted from Iqbal and Pipon-Young (2009)

Turoff and Hiltz (1996) believe that one of the definite advantages of groups is that they give the opportunity for individuals with different points of view or differing cognitive abilities to contribute with both their useful knowledge and applicable problem solving skills to parts of a complicated problem.

Ludwig (1994: 45) clarifies that a disadvantage of Delphi was that the questionnaire method might considerably slow the process as there may be several days or weeks between rounds.

3.2.4 Comparing Delphi with other Methods

Although traditional survey could be conducted to gather input from group of experts, this research assumes that the Delphi method is a stronger methodology for a rigorous query of experts. The table below shows a comparison between the Delphi survey versus the traditional survey approach and summarising the key areas of the Delphi method addressed in this chapter. In Table 3.2 adapted from Okoli and Pawlowski (2004) compares the issue of procedure, sample, sample size, response, validity, anonymity and the richness of data.

Table 3.2 Comparison of Delphi with Traditional Surveys

Evaluation criteria	Traditional survey	Delphi study
Summary of procedure	In order to develop a good survey, the researchers must consider numerous issues regarding the validity of the relevant questions. The questions included can require quantitative or qualitative data, or both. The researchers determine the population that the hypotheses apply to, and select a random sample of this population on whom to conduct the survey. The respondents (who are a fraction of the selected random sample) fill out the surveys and return them. The researchers then analyze the responses to investigate the research	A Delphi study involves all the questionnaire design issues of a survey. After designing the questionnaire, the researchers select an appropriate group of qualified experts to answer the questions. The researchers then conduct the survey and analyze the responses. Next, they design another survey based on the responses to the first one and re-administers it, asking respondents to revise their original responses and/or answer other questions based on group feedback from the first survey. The researchers repeat this process until the respondents arrive at a satisfactory degree of consensus.

	questions.	
Representativeness of sample	The researchers randomly select a sample that is representative of the population of interest with the use of statistical sampling techniques.	A Delphi study is a virtual panel of experts gathered to find out an answer to a difficult question of high uncertainty. Thus, a Delphi study could be considered a type of virtual meeting or as a group decision technique.
Sample size for statistical power and significant findings	The researchers need to select a sample that is large enough to detect statistically significant effects as the goal is to generalize the findings to a larger population. Power analysis is required to determine an appropriate sample size.	The Delphi group size is not determined by statistical power, but rather by group dynamics in order to reach consensus among experts. Thus, the literature recommends 10 to 18 experts on a Delphi panel.
Individual vs. group response	The researchers generalize the average response of the sample to the relevant population.	Research has clearly shown that the Delphi method proves that for questions requiring expert judgment, the average of individual responses is inferior to the averages produced by group decision processes.
Reliability and response revision	Reliability of the measures is a significant criterion for evaluating surveys, which is assured by pretesting and by retesting to assure test-retest reliability.	For the Delphi method, pretesting is also an essential reliability assurance, but test-retest reliability is not applicable as researchers expect respondents to revise their responses.
Construct validity	Careful survey design and pretesting guarantee construct validity.	The Delphi method can employ further construct validation by asking experts to validate the researcher's interpretation and categorization of the variables. Unlike many surveys, the fact that Delphi is not anonymous (to the researcher) permits this validation step.
Anonymity	Respondents are almost always anonymous to each other, and often anonymous to the researcher.	Respondents are always anonymous to each other, but never anonymous to the researcher. This gives the researchers a better chance to follow up for further qualitative data.
Non-response issues	In order to make sure that the sample remains representative of the population, researchers	As most researchers in Delphi surveys personally obtain assurance of participation, non-response is typically very low.

	need to examine the possibility of non-response bias.	
Attrition effects	While for single surveys attrition is a non-issue, for multi-step repeated survey studies researchers would rather examine attrition to make sure it is random and non-systematic.	In Delphi studies, attrition tends to be low, and the researchers can easily determine the reason by talking with dropouts.
Richness of data	The form and the depth of the questions as well as the possibility of follow-up, such as interviews, determine the richness of data.	As a result of their multiple iterations and their response revision due to feedback, Delphi studies inherently yield richer data.

(Source: Okoli and Pawlowski, 2004)

Some research has been undertaken related to the supply chain management and transport field using a Delphi technique. The following section will review some examples.

Starting with supply chain management examples, Akkermans *et* al. (2003) concluded from a Delphi study on how Supply Chain Management (SCM) could be affected by Enterprise Resource Planning (ERP) and that ERP systems are effective with small enterprises only and were never designed to support SCM in extended enterprises.

Seuring and Müller (2008) stated in their core topics of sustainable Supply Chain Management that the Delphi study causes a structured gathering of these opinions. They identified the following four major topics: (1) sustainable Supply Chain Management pressures and catalysts, (2) spotting and assessing the effects on sustainable Supply Chain Management, (3) supplier management (focusing on issues related to the supplier-buyer interface), and (4) Supply Chain Management (handling issues across all companies pertaining to the supply chain).The research presented assists in corroborating and reinforcing the sustainable Supply Chain Management field.

In order to demonstrate and evaluate the convenience of the Delphi technique for risk analysis, including risk identification and estimation, Markmann *et* al. (2013)

focused their research on man-made risks in universal supply chains that are not well-established regarding type, location, and affected supply chain partners. Therefore, these issues could be labelled as “wicked” issues; issues that are multidimensional and produce unpleasant results. The recent report on -- , from the Australian Public Service Commission (2007) stated that complex policy problems are sometimes called ‘wicked’ problems. Also, it was argued earlier by Rittel and Webber (1973) that Planning problems are inherently wicked, and the kinds of problems that planners deal with, essentially societal problems, are different from the problems that scientists and engineers deal with. Delphi can accommodate risk and uncertainty and thus some of the issues central to wicked problems. Markmann et al. (2013) demonstrate how the Delphi technique contributes to risk analysis in five ways: (1) recognizing and measuring risks; (2) figuring out the notions of the stakeholders; (3) activating a global communication process; (4) identifying weak signals, outlier opinions, and wildcards; (5) and expediting risk scenario development. Consequently, the researchers concluded that Delphi can help in decreasing uncertainty and thereby the companies’ sensitivity towards different kinds of disruptions.

For transport examples, Mason and Alamdari (2007) predicted the air transport market structure in the EU in 2015 in terms of network carriers, low cost airlines and passenger behaviour using a Delphi panel of 26 air transport experts who unanimously believed that EU players will be decreased to less than five through network carrier consolidation, only two or three large low cost carriers will be available, short hauls will stop having Business Class products, and an increasing number of multiple short-duration holidays will be taken by leisure travellers.

Due to the inadequacy of data and knowledge on the GDR (Greater Dublin Region) as a possible cluster for the maritime transport sector, Brett and Roe (2010) used the Delphi Method to facilitate the process and added that when examining complicated social systems such as industrial clusters, the Delphi method is a useful approach. The Delphi study fulfilled its goal and by general

agreement delivered the valid opinion that the GDR is a maritime transport cluster unlike an industrial area demonstrating basic clustering. Also, Will (2010) demonstrated in his book the benefits of RFID (Radio Frequency Identification) using Delphi in maritime container logistics.

Piecyk and McKinnon (2009) submitted a full report on the Environmental Impact of Road Freight Transport in 2020 which summarizes the results of a Delphi survey of 100 logistics specialists. The survey sought their opinions on future freight transport and environmental trends in the UK up to 2020. By 2015, climate changes are likely to have a considerable impact on the activities of 50% of the companies partaking in road freight transport operations, according to the panel of experts in the Delphi survey. These trends, according to the results of the survey presented in this paper, are anticipated to increase to at least 80% until 2020. Moreover, the researchers showed the very complex inter-relationships among a wide range of business trends, freight traffic levels and related CO2 emissions.

Listed as the most likely to occur up 2020 are the following trends:

- Production capacity relocation in other countries.
- Primary consolidation increase of inbound loads to manufacturing factories and/or distribution centres.
- Online retailing and its important growth.
- More products re-entering the supply chains for recycling, renovation, and resale are likely to cause reverse logistics gain in significance.
- More frequent ‘out-of-hours’ operation, particularly raising the proportion of night-time deliveries.
- Increase in using advanced IT systems for transport planning and management (telematics, computerized vehicle routing and scheduling, etc.)
- More logistical collaboration initiatives between companies

- Increase in using online freight exchanges and load matching services.
- Listed as major threats to the industry of road freight are fuel prices and drivers' availability.

The research, in which Schuckmann *et* al. (2012) ran a Delphi-based scenario regarding the factors that will affect transport infrastructure future development until the year 2030, lists and evaluates various long-term developments of different factors, including supply and demand, financing, competitiveness, and sustainability, which will have an impact on the transport industry's future and its infrastructure. The final possible scenario, consisting of four different aspects that can develop new strategies or examine current strategies in respect of their future robustness or sufficiency, presents the results.

Recently, Liimatainen *et* al. (2013) conducted research on the future of carbon dioxide (CO2) emissions of road transport in Finland, using a Delphi method to predict GDP changes and seven indicators determining road freight CO2 emissions. This offered the Finnish Ministry of Transport and Communications help in planning future transport policy by assisting the understanding of the effect of the changes of one indicator on total CO2 emissions. In addition, the study pinpointed several trends affecting the emissions' future development, thus enabling the policy makers to follow procedures in order to put these trends into effect.

The previous section comprises some examples of research that used Delphi technique in their studies to reach their research aims. Furthermore, Linstone and Turoff (2011) predicted that the future of Delphi will be in cooperative organizational and community planning systems that are uninterrupted, spread out, and not occurring at the same time. It could replace the effect of controlled surveys as a strategy to influence different organizational and community decision processes.

Therefore, in this research, Decision Delphi will be the most suitable type to be used. According to the research aim and objectives, Delphi should help in reaching a decision about policies for the location and capacity of the Dry ports through development of list of statement that will be gathered by specialised experts in the maritime field. Hence, reaching conclusions and recommendations through a series of Delphi rounds, therefore, will provide indicators and guidance that help and affect port operators and planners' decisions regarding policies for the location and capacity of the Dry ports. In-order to achieve this, Decision Delphi is the only appropriate mechanism as referred to in section (3.1.1.).

In this research, according to its interpretive position and the type of research question, this makes in addition to the Delphi a case study method the most appropriate as it uses a systematic approach to collect data, analyse information and report the findings, thereby understanding a specific problem in greater depth. Therefore, conducting a case study method will be very helpful to validate Delphi results through comparing these results with interviewee's feedback and opinions. Practical views should be in relations with the theoretical outcomes. A case study helps to check that the Delphi results are meaningful.

3.3 Case Study Method

Baxter and Jack (2008) believed that by using various data resources, a qualitative case study helps to explore a phenomenon within its contexts, which guarantees exploring any issue through different lenses which allows the phenomenon to be understood through many facets.

"*A case study is an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident*." (Yin, 2009, p. 18)

Also, (Creswell, 2002, p. 61) defined a case study as "*A case study is a problem to be studied, which will reveal an in-depth understanding of a "case" or bounded system, which involves understanding an event, activity, process, or one or more individuals."*

3.3.1. Types of Case Study:

Research methods using a case study can be classified by purpose to exploratory, descriptive, and explanatory. Yin (2003) has well-defined these types as follows:

A) Exploratory: This case study type is used to explore situations in which the interventions under evaluation do not have clear, single set of results.

B) Explanatory: This case study type is used to answer questions that seek to explain the assumed causal links in real-life which are too complicated for survey or experimental strategies. These explanations would link program implementation with program effects.

C) Descriptive: This case study type is used to describe an intervention and the real-life context in which it occurred.

According to Kothari (2004) the following are the major phases involved in case studies:

I. Identification of the status of the phenomenon under investigation.
II. Data collection, examination and history of the specific phenomenon.
III. Identification of causal factors as a basis for developmental treatment.
IV. Application of remedial procedures, often regarded as case work.
V. Follow-up programme to ensure the effectiveness of the applied treatment.

Kothari (2004) listed different advantages and limitations of the case study approach but the author's argument was that, although having the previously mentioned limitations, case studies are conducted in different disciplines, especially sociology, as a scientific research tool. He added that most of the limitations can be eliminated if researchers are always aware of them and are well-trained to both collect case study data using modern methods and to

assemble, classify and process the same data using scientific techniques. Besides, case studies are becoming popular in modern times due to the fact that they can be conducted in a way that makes the data open to quantification and statistical treatment.

Baxter and Jack (2008) contend that because of the complicated nature of this research method, reporting a case study can be a difficult job for any researcher. Both reporting the findings in a brief way and simplifying any complex phenomenon into a comprehensible format are challenging tasks. This report aims at describing the study in an inclusive manner that gives the readers the sense of active participants and helps them decide whether the findings are relevant to their situations.

The case study is only one of different ways of conducting research in social science. Among the other ways are experiments, surveys, histories, and economic and epidemiological research. Each method has both advantages and disadvantages depending on three factors: the kind of research question, the control the researcher has over actual behavioural events and the focus on modern rather than historical phenomena. Generally speaking, case studies are preferred when (a) “how” and “why” questions are being asked, (b) the researcher has little control over events, and (c) the focus is on a modern real-life phenomenon. This situation differentiates case study research from other kinds of research in social science. However, the methods are not marked by sharp boundaries, overlapping in many ways (Yin, 2009).

Therefore, in this research a case study application in addition to the Delphi technique will be conducted on Alexandria International Container Terminal; to assist port operators’ “policy makers” in taking decisions related to determining the location and capacity of their Dry ports. The reasons behind choosing this container terminal specifically are: first due to data availability in this company (data recorded and updated). Second: It is a private terminal that is eager for continuous improvement and development. Hutchison Port Holdings (HPH) operates two terminals at Egypt's main commercial ports - Alexandria Port called

Alexandria international container terminal (AICT A) and El Dekheila Port called Alexandria international container terminal Dekheila (AICT DKH), located on the Mediterranean Sea. The capacity utilization in Dekheila Terminal exceeds 85% as noticed in the informal interview with AICT marketing manager in the earlier stage of this research. The aim of this informal interview was to have an over view on the area under research. So, the terminal faces a real capacity problem. Therefore, investing in dry-ports might well be the suitable solution in their case. But the question is where to locate, along with size and to determine the number of these depots.

This study proposes a structured decision support framework which can be applied to many container terminals according to the following steps:

1. Based on the literature review, the main capacity problems in the container terminals and the ways of solving these problems will be investigated and then the impact of investing in Dry ports for solving these problems will be studied.

2. Identifying and measuring the parameters or the indicators that affect testing the location and capacity decision will be developed and carried out by selecting the common indicators already applied in the port system in the literature and then, using a Delphi Technique to support container terminal location and capacity policy decisions.

3. To demonstrate the applicability of the research method, a case study will be conducted on Alexandria International Container Terminal (AICT). During the data collection phase, face-to-face interviews will be conducted, archived data will be collected, and analysis will be proposed.

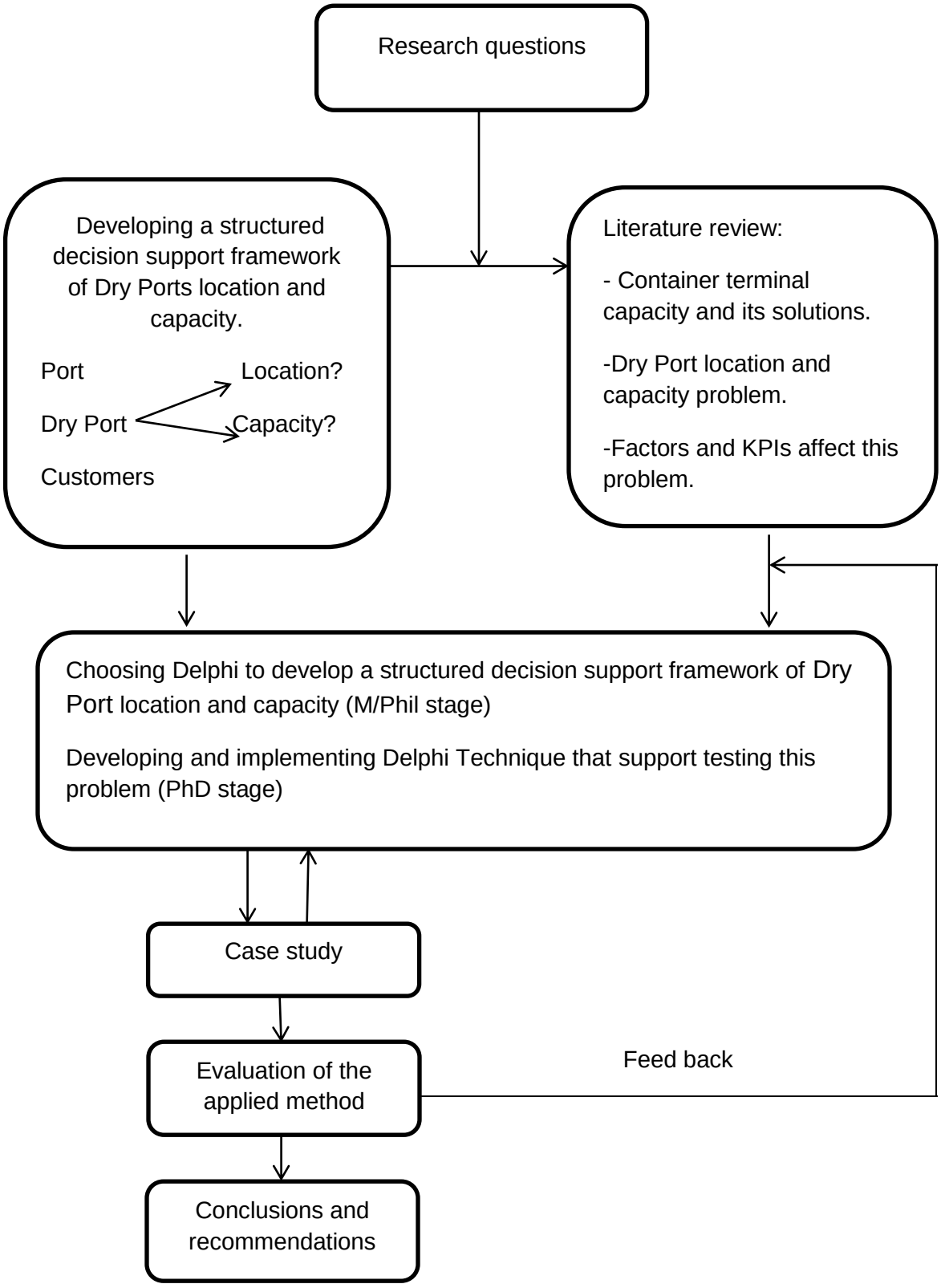
After reviewing the research objectives, the following table will show the link between them both by relating each question with its consistent objective, also the method and the analytical approach applied will be illustrated in table 3.3.

3.3 Data collection Method/Technique/ Model

-Research Question	Research Objectives	Research Method	Analysis approach
1 & 2	-To assess the current status of the container sector. -To investigate and identify the main capacity problems with reviewing the suggested solutions.	Literature review	Systematic review
3 & 4	-To identify and measure the parameters or the indicators that affect testing the location and capacity decision. -To develop a Delphi technique that support testing the Dry port location and capacity policy decisions.	- Literature review. - Delphi technique.	Systematic review
5 & 6	Testing the validity of the Technique.	Application of the case study on AICT.	Results interpretation qualitatively

Table 3.3 displays the research data collection methods and techniques. Figure 3.1 shows the research phases starting with research questions that should be answered by the structured decision support framework using the Delphi Technique; developing the technique will be based on key areas in the literature review on dry ports location and capacity issues. However, for the model validity, a case study should be conducted for evaluation (or analysis) and comparing Delphi's results with the actual outcomes from the case study and then research findings will be determined. Finally, the last step will be conclusion and recommendations.

Figure 3.1 Research phases



3.3 Conclusion

This chapter provides the different research methods used to create the framework to achieve research objectives.

The research follows an inductive research approach whereby qualitative research methodologies are incorporated to achieve research objectives. . A full picture of the case study method is presented. The full process of conducting a case study has been discussed in detail

In addition, a summary of the application procedures to conduct the current study at different research phases is presented.

The next chapter will display the actual process conducted in the Dry Port location and capacity policies Delphi and specify the result of each Delphi statement concluded over each of the two rounds

Chapter Four

Dry Port Location and Capacity policies Delphi

This chapter aims to discuss the process of the Delphi method formulation through two rounds and the results of each round will be illustrated. This chapter begins with evaluating the data gathered by the experts as to their established industry experience to support the discussion and provide a context for the Dry Port Delphi results. 12 statements were designed to start Delphi rounds. Any statement that will reach consensus will not enter the second round. Only disagreement statements will need to be modified according to the expert's feedback and comments to enter the second round till consensus has reached. Therefore, to what extent they changed to achieve panel agreement will be illustrated. Finally, a conclusions and Delphi study summary will be displayed.

4.1 Problem Definition

The existing research questions are based on identifying the right policy decisions for Dry Port location and capacity. It is concluded from the literature that container terminal capacity has become a major problem in many ports around the world. As Dry Ports are considered one of the suitable solutions for this problem, therefore, clear attention should be taken when deciding such strategic decisions.

4.1.1 Framework for Questions

The purpose of this Delphi study was to acquire information and perspectives from experts in port management and the maritime field concerning the policies that help port operators in identifying dry port location and capacity. The application of the Delphi will help to highlight, specify and prioritize areas for further research in terms of new policies related to dry ports in the maritime transport sector. Formulation of the questions was highly based on the literature review.

4.2 Delphi Panel Members

When a project requires a highly specialized input, expert panels are needed. Based on different fields of expertise, a variety of experts are involved, and they discuss various courses of action and propose recommendations. These experts are often used when there is a controversial issue and legal ramifications may arise from certain decisions or when the best possible results are required. Expert panels could help participants reach an agreement on a topic or develop some recommendations on proposals, which can then be sent to decision-making bodies (Department of Sustainability and Environment, 2005). Moreover, the panel specialists, who are part of an expert panel which deals with the implementation or the effect of a programme, are taked with reaching conclusions and giving recommendations through consensus. The expert panel is particularly appointed for the evaluation and according to the settled procedures in conformity with a precise and repetition working plan for a Delphi study (Europa, 2005).

4.2.1 Number of experts.

Delphi panels do vary in size and it is argued that there is no fixed rule or optimal number of experts required in order to form a panel. The size of Delphi panels reported in past researches involved a wide range from tens to hundreds (Yeong *et* al., 1989; Loo, 2002). The size determination depends on the nature and the scope of the study in order to achieve reasonable accuracy in a Delphi study, the minimum panel size required can vary from 15 to 20 as stated by Dalkey (1969). Hasson *et* al. (2000) noted that the number of experts in other studies has ranged from 15 to over 60 experts. Adler & Ziglio (1996) contend that whatever the number of experts is, it cannot be considered one of the standpoints of a statistical sample size, as the Delphi technique does not target a random sample from a population. However, they agreed that even 10-15 experts can provide good results with the Delphi. Moreover, Hsu and Sanford (2007) noted that researchers suggest that the number of experts be the least number possible as long as it is regarded as representative of viewpoints in the topic area.

Furthermore, Skulmoski *et* al. (2007) noted that it is enough to have a number of 10 to 15 experts when a group is homogeneous.

When Round One responses were reviewed, all experts received an individual number, which was the identifying information available. This strategy preserved the confidentiality for specific responses that is strength of a Delphi study. The following section describes the results of the expert selection process.

4.2.2 Panel Selection

As for the basis of selection of Delphi subjects, individuals can be invited to participate in a Delphi study if they have background and experience related to the target issue, are able to add useful input, and are willing to revise their previous judgments in order to reach consensus (Pill, 1971; Oh, 1974).

Regarding the necessity of choosing the most qualified individuals, Delbecq *et* al. (1975) specifically recommend three groups of people who are well-qualified to be subjects of a Delphi study: "(1) the top management decision makers who will utilize the outcomes of the Delphi study; (2) the professional staff members together with their support team; and (3) the respondents to the Delphi questionnaire whose judgments are being sought" (p. 85). Expert principals were asked to serve on the panel of this study as the quality of the data from the Delphi will be only as good as the quality of the panel (Linstone & Turoff, 1975; Hasson *et* al. 2000). Helmer (1967) believes it is necessary to choose the experts wisely and ensure that the conditions for the work of the experts are convenient. The principals requested to serve on this study were those who have received national recognition related to performance in and contributions to the field of education.

As mentioned before, the research problem area is on many terminals worldwide. Therefore, panel members were chosen from both academicians (researchers in maritime sector) and practitioners (experts working in public terminals, private terminals, stevedoring company, etc.) around the world. Additionally, professional experience is the criterion used to appoint the panel for the selection of experts

who should have specializations in the fields under evaluation. Although, experts should not be either judges or judged, so they must be independent of the program of study but also work experience and the time spent in the maritime transport industry is important as well.

For this study, a total of 33 agreed participants received the Delphi first round and, with the heterogeneous nature of the Dry Port Delphi, every returned response has been assigned a category to represent an individual sector of the maritime transport industry. Every panel member's individual response represents the company/business they are presently employed at but also their personal views. Table 4.1 shows, for each round of the Delphi study, the number of Delphi participants along with their representation for every certain industry sector. As the Delphi Method utilizes expert opinion, it does not ask for a statistically representative sample of the maritime transport sector population in order to collect the data although the more it could do so it would be better.

Experts:

1. Academics: this list was populated almost entirely using a literature review of academic and practitioner journals under the heading" Related Literature".
2. Practitioners: Contacting various experts who work in container terminals, shipping lines and any others in the maritime field were involved in populating this list.

Table 4.1 Delphi Panel Member Representation per Round per Industry Sector

Sector	**Round 1**	**Round 2**
Academics	16	12
Port operations	9	7
Marine agencies	2	2
Shipping lines	1	1
Freight forward	3	2
Marine consultant	2	1
Total	33	25

(Source: Author’s Own)

As shown in Table 4.1, the academics and the port operations including experts working in public terminals, private terminals, stevedoring companies, etc are the highest sectors represented as these two sectors are the most involved in practical problems because academics look for new solutions whilst practitioners face the problem in their daily work.

As both industry experience and expertise development are closely related to the validity of the panel members' opinions through the Delphi rounds, and as they also help to offer a generally more balanced perspective of the panel's provided opinions with regard to the number of sectors represented in the Delphi, each panel member was requested in the Delphi study's first round to submit additional information to make it clearer the origin of opinions, and the candidates were asked to provide both information on their current position of employment and a concise summary of their work experience within the industry to date (Appendix 2: Demographic Information). The process of selecting industry personnel for the prospective Delphi candidates targeted senior management levels as the maritime transport industry. Table 4.2 demonstrates the current position of each panel member per round.

Table 4.2 Delphi Candidates Current Positions of Employment

No	Position Round 1	Position Round 2
1	Professor	✓
2	Lecturer	✓
3	Ports Operations Expert	✓
4	Vice dean for educational affairs	✓
5	Senior Advisor of Transport Corridors	×
6	Sales & Marketing director in Tag Marine Egypt Ltd	✓
7	Freelancer marine expert	×
8	Manager at EBS Business School	×
9	Vice dean of CITL and international port consultant	✓
10	Associate Professor	✓

11	Senior Research Fellow	✓
12	Graduate Research Assistant / Doctoral student	✓
13	Marine Consultant	✓
14	Ass. Professor	×
15	Lecturer	✓
16	Traffic Manager	✓
17	CEO of Dekhila terminal and vice president of ACCHC	✓
18	Head section at ACCHCO	×
19	operation manager	✓
20	Lecturer	✓
21	Dean of upgrading studies institute	✓
22	Chairman of Unifreight Co.	✓
23	Documentation at HPS	✓
24	Assistant claims handler	✓
25	President of Arab Institute of Navigation	✓
26	Lecturer	×
27	Marketing Manager at Alexandria International Container Terminals	✓
28	Supervisor of the storage department in the revenue management	✓
29	Supervisor of loading & discharging department in Alexandria Container Terminal	×
30	Head of Economic Studies Department	✓
31	Dubai Ports World-Sokhna Port-Planning / Planner	✓
32	Assistant manager	×
33	Shift Manager at HPH	✓

(Source: Author's Own)

Being experts in their fields and holding high positions within the range of high levels of management accentuates the importance of the Delphi Panel member's current position of employment as many of the Delphi candidates hold current positions of Managing Directors, Associate Directors, Directors, Area and General Managers, Professors, Chairs, Partners, CEOs and Consultants (As indicated in Table 4.2). The attainment of such positions requires a considerable amount of industry experience, knowledge and qualifications.

In order to attain a complete picture of the variety of opinions about the research questions, a diversified group of experts with appropriate expertise has to be selected from the fields of education and work, which is an essential decision that had to be made in the course of the study, according to Van Zolingen and Klaassen (2003). Rosenberg (2006) argues that expert experience and knowledge can help find a solution to a problem or a possible "correct" answer to a question, and it can also deal with incompletely resolved concepts such as new research issues, technologies for investigating and improving new knowledge on areas that lack adequate data or contemporary knowledge as planned by the Delphi Method’s use of experts

The following is an example of the information the Delphi panel members provided concerning their work experience and the time spent in the maritime transport industry.

. Academic experts spent from 8 to 42 years in the field.

. Practitioners spent from 10 to 45 years working in container terminals, shipping lines, agencies, stevedoring and any other field in the maritime industry.

Martino (1983) and Jacobs (1996) believe that selecting participants with adequate expertise in the subject matter is of crucial significance to a Delphi study and directly affects the quality of the results; consequently, the best experts in the relevant field are sought to be secured in the current study.

Through the two rounds of the Delphi the panel member were asked questions with three options for response: agree, disagree, or not sure, and then they were given the opportunity to provide their opinions about regardless of which answer option they selected. The Dry Port Delphi aims at gathering opinions to form new knowledge and understanding on the potential of the Dry Port location and capacity policies in the maritime transport industry. Since all panel members are required to fill all the required boxes and to include an opinion to statements through an established system, Delphi was conducted on a website or through email.

In addition, the Delphi requires a percentage of agreement to calculate a consensus. Although the results are regarded as an indication rather than an absolute fact as the method deals with opinion, the current research is important as it increases the understanding and the potential of the sector and raises questions for further research. Consequently, the opinion returned for statements in disagreement with the final consensus helps in further understanding the sector.

4.3 Round 1

Thirty three agreed panel members received the first round of the Delphi survey, including authorization letters of their consent on participation (Appendix 1: Round 1 Authorization Letter), the Round 1 Delphi questionnaire (Appendix 3: Delphi Round 1 Questionnaire), and each panel member's demographic information, along with a brief career history at the end of the first round questionnaire. Clear and precise instructions were given to the panel members on how to administer the questionnaire. In addition, the Delphi facilitator’s full contact details were given to the panel members in case there are any problems or concerns that may require clarification.

4.3.1 Development of Delphi Round 1 Questionnaire

A literature review on both the Delphi technique and dry ports and their development and potential was conducted before the Delphi Round 1

questionnaire was developed (Refer to Chapters 2& 3). The first round questions were decided upon as clarified in details from the literature review chapter. The first round usually follows a detailed literature review, consults with relevant individuals, and considers the objectives of the Delphi study (Iqbal and Laura Pipon-Young, 2007).

The Delphi statements of this research were generated from the literature that influences the objectives of the research as the first stage, which is called "Exploration", (Linstone and Turoff, 2002) and is a free-flowing and unstructured investigation of the issues, limitations, challenges and problems that affect or are affected by the elements within the study domain.

4.3.2 Round 1 design

The questionnaire was developed with a combination of closed and open-ended questions or in other words closed question with obligatory comments about some of these questions. The first round questions ware designed with 12 questions for the subject area and other demographic information at the end of the questionnaire. This is for the purpose of easing the processes for the respondent instead of requiring them to answer two different surveys.

Q 1: "Container Terminal Capacity (CTC) has become a major problem nowadays in many ports around the world". Do you think investing in dry ports is the most suitable solution for capacity problem and reducing port congestion?

It is essential to ask the panel members whether they basically consider dry ports as an appropriate solution for reducing the port capacity, congestion and over delays or not. It is important to get a consensus on the statement as it would be ineffective to ask the panel members' questions based on a faulty theory or pre-supposition, so if they do not consider it a suitable solution, there will be no need for the rest of the survey.

Q 2: Can dry ports help terminal operators to become more successful in regional competition?

The importance of Round 1 is to achieve a consensus among the panel members whether or not they believe that dry ports have any future potential to develop further success for container terminals that would help them become more dynamic, competitive and successful on the domestic level.

Q 3: Is it better that all terminals be operated by private companies rather than the public state?

The aim of Question 3 is to highlight and identify the panel's opinion about terminal operators in the maritime transport sector and whether public or private companies could successfully operate the terminal.

Q 4: Is it better to provide a list of regulations and legislation by government that supports, controls and governs investment policy and decisions in new dry ports?

Question 4 is addressed to the panel members to know whether they consider that the existence of dry port regulations and legislation by government will positively affect new investments or not.

Q 5: Is it preferable that dry port policies be governed by the ministry of transport or by terminal operators?

Question 5 asks individual panel members about his or her opinion on who could better manage dry port policies, and they can comment on how that could possibly specifically affect their sector.

Q 6: Can dry ports help to maintain maritime growth and global sustainability?

Question 6 asks the panel members about the importance and ability of dry ports to escalate international trade within the maritime transport sector. Also, this question supports Q2 because disagreement with Q2 (failure in domestic market) will result in global downscale.

Q 7: Does environmental regulation affect policy decisions regarding dry port location?

Question 7 is addressed to the panel members to find out whether environmental regulations should be considered when dry port location decisions are to be taken.

Q 8: Do terminal operators who decide policies take account of the size of dry port(s)?

Question 8 asks the panel members about the level of importance of the size of dry port(s) when terminal operators are deciding policies relevant to the development of new dry port(s).

Q 9: Are dry ports becoming much more important in increasing the terminal processes of logistics within ports and between ports and the hinterland?

The aim of Question 9 is to highlight and identify the panel's opinion on the significance of dry ports and the maritime sector through increasing the logistic services and terminal processes.

Q 10: Should rail transportation be constructed for a successful dry port system or is road access alone adequate?

In order to construct a successful dry port system, modes of transport should be available to ease the process. The question is whether it is preferred to use rail transportation, or road transport.

Q 11: Do you think the development of dry ports provides serious issues of port safety and security?

Question 11 asks individual panel members about their opinion in port safety and security issues regarding policy decisions for the development of new dry port(s).

Q 12: Do you believe that dry ports have a positive effect on trade and maritime transport?

Question 12 is addressed to the panel members to figure out whether they consider that the dry port concept has a significant effect on the overall trade and transport system in the maritime industry.

Question 12 was followed by some demographic information for Coding/Analysis purpose only. This included name, age range, sex, nationality, position/title, years of experience, education/highest degree, preferred email, telephone and address as referred to appendix 2. These personal data was analysed above (section 4.2).

Prior to the development of the final form of the survey or questionnaire, it is very useful to conduct a pilot study to figure out if some statements are unclear or other information may need to be added. A pilot study can give advance warning regarding the weaknesses in the proposed study as described by Polit *et* al. (2001). For this research a pilot survey has been examined first with 4 port experts in Egypt to test the Delphi statements understandably, accuracy, and importance. It was very helpful as it was found that two statements needed adjustments. They could be used with confidence in the main Delphi study.

4.3.3 Round 1 Results:

A total of 130 requests were sent to different experts all over the world to participate in the study. Their background were related ports, shipping and the maritime sector but careers may differ, as some of them are academic and have researched and published papers in the proposed field, others are practitioners in the maritime industry. 40 replied, 5 would like to participate but they are over

scheduled so they apologized, 2 professors in ports area also apologized because they feel their expertise is limited in this area and 33 agreed to participate. The pre-agreed panel members were asked to return the first survey as soon as they could, given a maximum of two-week time limit in order not to prolong the whole process of the Delphi survey. After the submission deadline, the panel members who had not returned the survey were contacted by phone and were given an extension to return their responses. After five weeks, Round 1 of the Delphi was over, and 33 responses were collected for processing in Round 2.

4.3.4 Round 1 Analysis

The first process aimed at distinguishing between the positive responses, negative responses, and the lack of response due to uncertainty (Table 13). A combined feedback document was produced by the opinion responses given by each panel member for each question and served for addressing the Delphi Round 2 questions. Dyer et al. (2011) believed that the idea of consensus is hard to define and therefore problematic. According to published research practice in the field, a level of consensus is reached after a number of rounds the Delphi process goes through. The levels of agreement that could be called consensus, however, commonly range in some research from 70% as stated by Hasson *et* al. (2000) or 80%, Finger *et* al. (2006), although there are examples of consensus taken from 50-70% as the case in Biondo *et* al. (2008). Meanwhile McKenna (1989) apply 51% the agreement level.

In this Delphi study, a statement achieves consensus when it reaches 70% or more and therefore does not enter the subsequent round. The nature of this research is based on policy decisions which involve very confidential and strategic decisions, less than 70% agreement will represent a very low and risky statement to be practically applied. Giannarou and Zervas (2014) clarifies that in both theoretically and practically issues, to assist any researcher in management or business field to conduct Delphi technique demands a response rate above 70%. Hence, a low consensus is reached with a result of 70%-79% while medium

consensus is between 80-89% and consensus that falls between 90% and 100% is considered a high consensus as applied by Brett (2007).

Table 4.3 Consensus Ranking

Low Consensus	70% - 79%
Moderate Consensus	80% - 89%
High Consensus	90 – 100%

Source: adopted from Brett (2007)

Each individual question is calculated to obtain a percentage. For example Q1 achieved a consensus of 29/33 = 81.82%. Because Question 1 has a majority agreement result, the 29 is then divided by the number of responses i.e. 33. The individual statements and their results for Round 1 are outlined in Table 4.4.

Table 4.4 Total Survey Response Round 1

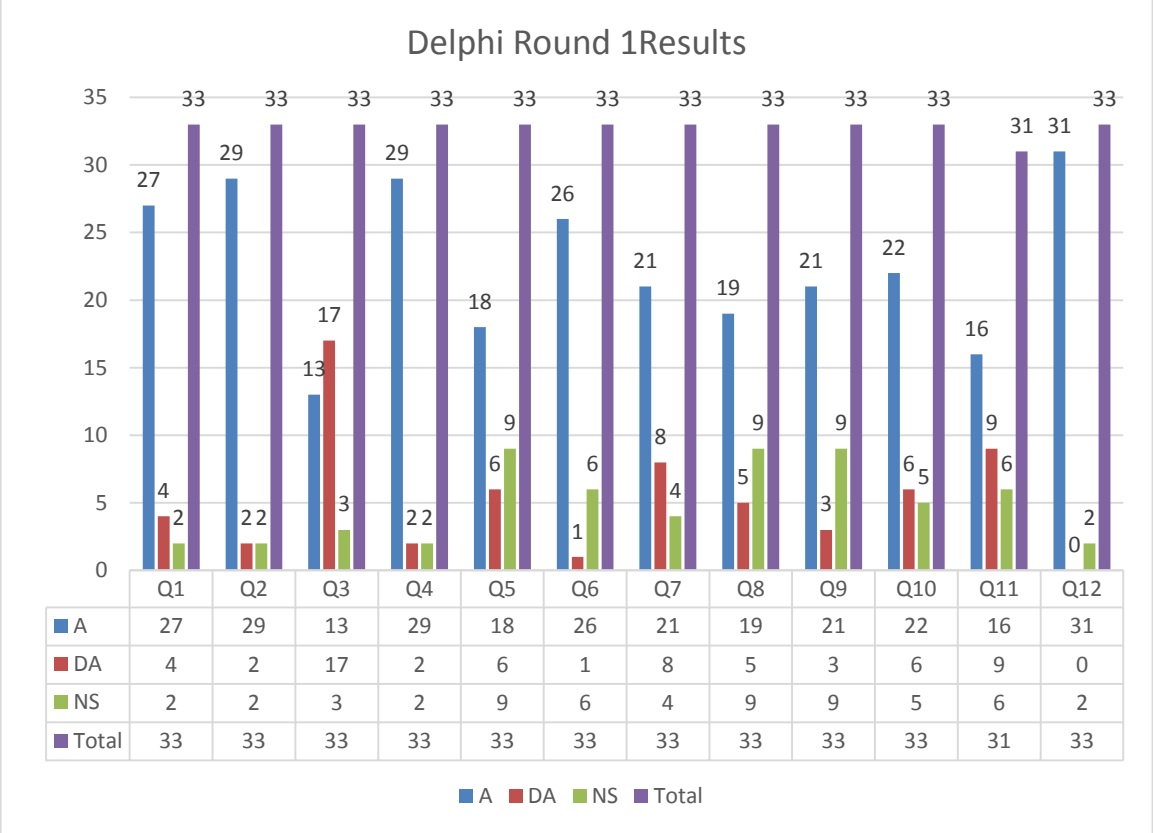
#	Delphi Round 1	A	DA	NS	Total	%
Q1	"Container Terminal Capacity (CTC) has become a major problem nowadays in many ports around the world". Do you think investing in dry ports is the most suitable solution for capacity problem and reducing port congestion?	27	4	2	33	81.82
Q2	Can dry ports help terminal operators to become more successful in regional competition?	29	2	2	33	87.88
Q3	Is it better that all terminals be operated by private companies rather than the public state?	13	17	3	33	39.39
Q4	Is it better to provide a list of regulations and legislation by government that supports, controls and governs investment policy and decisions in new dry ports?	29	2	2	33	87.88
Q5	Is it preferable that dry port policies be governed by the ministry of transport or by terminal operators?	18	6	9	33	54.55
Q6	Can dry ports help to maintain maritime growth and global sustainability?	26	1	6	33	78.79
Q7	Does environmental regulation affect policy decisions regarding dry port location?	21	8	4	33	63.64
Q8	Do terminal operators who decide policies take account of the size of dry port(s)?	19	5	9	33	57.58
Q9	Are dry ports becoming much more important in increasing the terminal processes of logistics within ports and	21	3	9	33	63.64

	between ports and the hinterland?					
Q10	Should rail transportation be constructed for a successful dry port system or is road access alone adequate?	22	6	5	33	66.67
Q11	Do you think the development of dry ports provides serious issues port safety and security?	16	9	6	31	51.61
Q12	Do you believe that dry ports have a positive effect on trade and maritime transport?	31	0	2	33	93.94

(N.b. note: A = Agree, DA = Disagree, NS = Not Sure)

A graph was designed depicting the response level for each question. The purpose of the graph in Table 4.1 is to provide an overview of the response rate for each individual question and not a statistical evaluation of the responses.

Table 4.1 Delphi Round 1 Graph Display Results



	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12
A	27	29	13	29	18	26	21	19	21	22	16	31
DA	4	2	17	2	6	1	8	5	3	6	9	0
NS	2	2	3	2	9	6	4	9	9	5	6	2
Total	33	33	33	33	33	33	33	33	33	33	31	33

(Source: Author's Own)

The following section includes details of the results of each individual question: Round 1, Question 1 had a majority agreement result of 81.82%. Question 1 has therefore reached a consensus and will not enter the second round.

Q1	"Container Terminal Capacity (CTC) has become a major problem nowadays in many ports around the world". Do you think investing in dry ports is the most suitable solution for capacity problem and reducing port congestion?	27	4	2	33	81.82

Round 1, Question 2 had a majority agreement result of 87.88%. Question 2 has therefore reached a consensus and will not enter the second round.

Q2	Can dry ports help terminal operators to become more successful in regional competition?	29	2	2	33	87.88

Round 1, Question 3 had a majority disagreement result of 39.39% and therefore will enter Round 2 for further clarification by the Delphi panel with the supplemented Round 1 feedback document.

Q3	Is it better that all terminals be operated by private companies rather than the public state?	13	17	3	33	39.39

Round 1, Question 4 had a majority agreement result of 87.88%. Question 4 has therefore reached a consensus and will not enter the second round.

Q4	Is it better to provide a list of regulations and legislation by government that supports, controls and governs investment policy and decisions in new dry ports?	29	2	2	33	87.88

Round 1, Question 5 had a majority agreement result of 54.55% and therefore will enter Round 2 for further clarification by the Delphi panel with the supplemented Round 1 feedback document.

Q5	Is it preferable that dry port policies be governed by the ministry of transport or by terminal operators?	18	6	9	33	54.55

Round 1, Question 6 had a majority agreement result of 78.79%. Question 6 has therefore reached a consensus and will not enter the second round.

Q6	Can dry ports help to maintain maritime growth and global sustainability?	26	1	6	33	78.79

Round 1, Question 7 result had a majority agreement result of 63.64% and therefore will enter Round 2 for further clarification by the Delphi panel with the supplemented Round 1 feedback document.

Q7	Does environmental regulation affect policy decisions regarding dry port location?	21	8	4	33	63.64

Round 1, Question 8 result had a majority agreement result of 57.58% and therefore will enter Round 2 for further clarification by the Delphi panel with the supplemented Round 1 feedback document.

Q8	Do terminal operators who decide policies take account of the size of dry port(s)?	19	5	9	33	57.58

Round 1, Question 9 result had a majority agreement result of 63.64% and therefore will enter Round 2 for further clarification by the Delphi panel with the supplemented Round 1 feedback document.

Q9	Are dry ports becoming much more important in increasing the terminal processes of logistics within ports and between ports and the hinterland?	21	3	9	33	63.64

Round 1, Question 10 result had a majority agreement result of 66.67% and therefore will enter Round 2 for further clarification by the Delphi panel with the supplemented Round 1 feedback document.

Q10	Should rail transportation be constructed for a successful dry port system or is road access alone adequate?	22	6	5	33	66.67

Round 1, Question 11 result had a majority agreement result of 51.61% and therefore will enter Round 2 for further clarification by the Delphi panel with the supplemented Round 1 feedback document.

Q11	Do you think the development of dry ports provides serious issues port safety and security?	16	9	6	31	51.61

Round 1, Question 12 had a majority agreement result of 93.94%. Question 4 has therefore reached a consensus and will not enter the second round.

Q12	Do you believe that dry ports have a positive effect on trade and maritime transport?	31	0	2	33	93.94

Round 1 of the Delphi survey therefore obtained a total of five consensuses. For the second round, the Delphi questionnaire was constructed based on the feedback of the first round. From the reading of the previous Delphi studies, there is no expected or standard number of responses for each round to compare it

with the above outcomes. However, it seems normal to have some agreed statements and other disagreed which will need reformulation in order to enter the Delphi second round.

4.4 Round 2

The second round of the Delphi survey was sent to a total of 33 agreed-upon panel members who agreed to continue with the next round of the survey. The second round documentation included the Round 2 Delphi questionnaire (Appendix 3: Delphi Round 2 Delphi Questionnaire) and a subsequent document which contained the feedback from the Round 1 questionnaire (Appendix 3: Delphi Round 2 Delphi Questionnaire). The panel members were given instructions to first read the feedback of each question from Round 1 before answering the subsequent question in Round 2 of the Delphi.

The second round of the Delphi was divided into two parts: the first part prior to the survey includes feedback from the Round 1 questionnaire and then the Round 2 questions followed. Since both the feedback and the Round 2 questionnaire were included in a single document, it became obvious during the test runs of the second round of the Delphi that the nature of the individual document was overwhelming. Consequently, a decision was made that it would be easier for panel members if Round 2 of the Delphi was divided into two separate documents.

4.4.1 Development of Round 2 Questionnaire

The Round 2 questionnaire included the Round 1 questions that reached no consensus, which were Q3, Q5, Q7, Q8, Q9, Q10, Q11 and were modified according to the responses of the experts. The development of the Round 2 questionnaire is demonstrated in the following Delphi model Development Round 2 (Figure 4.2).

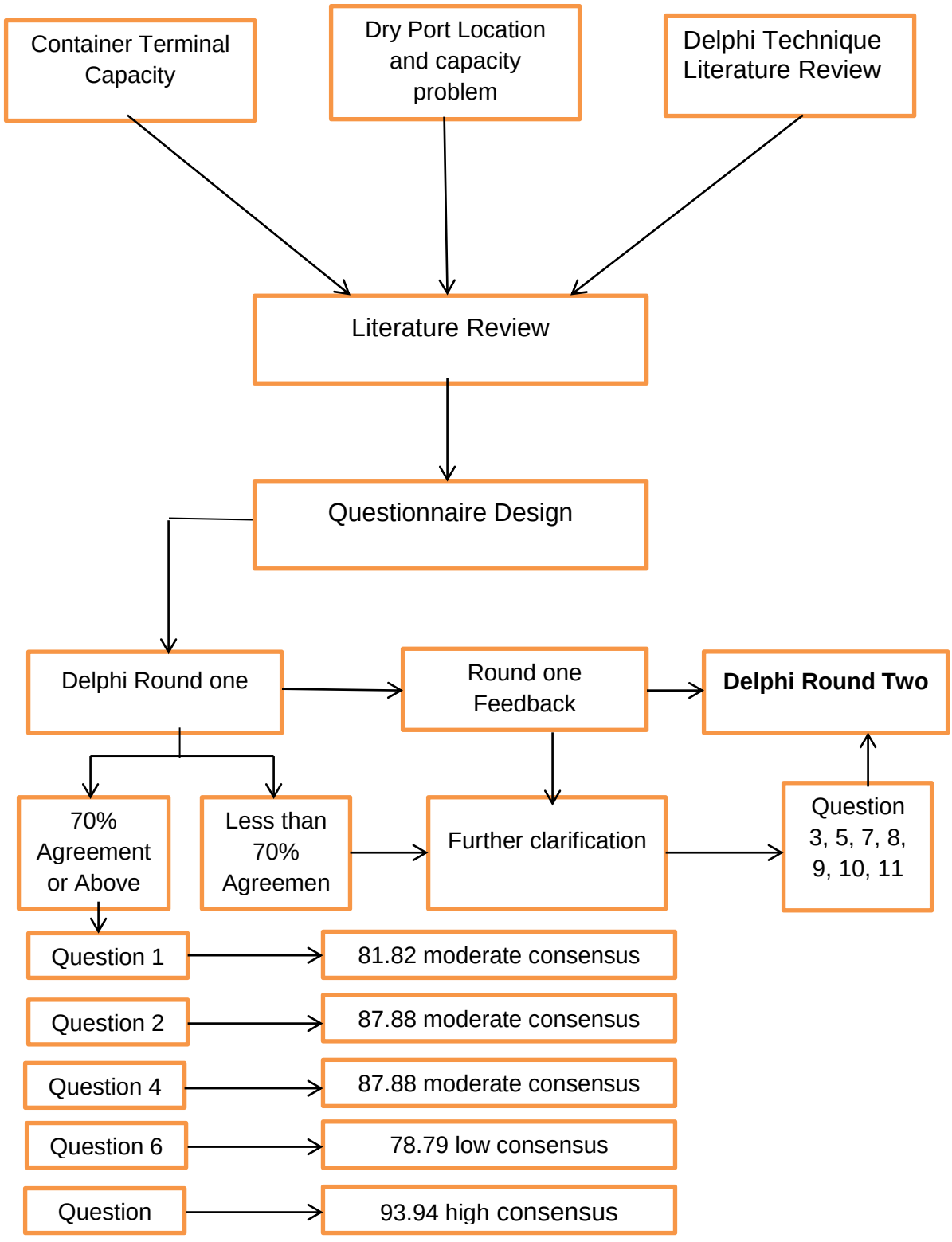


Figure 4.2 Delphi Model Development Round 2

Questions 3, 5, 7, 8, 9, 10 and 11 did not achieve consensus therefore some amendments were needed to enter another round for expert discussion. These changes were made according to the expert comments in round 1. The following section will review how the new statements have been formulated.

Statement 3:

"*Is it better that all terminals be operated by private companies rather than the public state?*" was modified after reviewing expert answers to be: "*It is not necessarily a guarantee for efficiency and effectiveness if all terminals be operated by private companies*". The statement achieves only 39.39% agreement. 3 experts were not sure to answer, 17 were disagreed and 13 agreed that all terminals should be operated by private companies.

Disagreement Arguments:

"Not necessary"

"Private operations are not necessarily a guarantee for efficiency and effectiveness"

"We have successful models for both scenarios, PPP is much more appropriate"

"Public state could have a significant contribution in subsidizing terminals during market recession"

"There could be cases where public operation is the only option"

"It depends on the situation and whether you mean fully public/private or something like a PPP or landlord model"

"It's better to be operated by both of them"

"Each one has advantages"

"Not a requirement"

"If ports are related to governmental it will be more facility to customer as Jebal Ali port in Dubai"

Unable to comment

"*It depends in Multiple factors that differ from country to country; there are success stories with public operators like PSA*"

Both disagreement arguments and the people that were unable to give a comment in Round 1 were debating that it could not be a rule that private companies are better than public ones. They were sure that every port has its own situation that may not be applicable to others. Some ports have a public operation which is the only option for them, others can be better run by the private sector but with governmental intervention and others are successful cases dealing with public privet partnership (PPP). Each type of operation has its own advantages and disadvantages. Therefore, rewriting the statement as follows "*It is not necessarily a guarantee for efficiency and effectiveness if all terminals be operated by private companies"* was felt to be more likely to model the expert's opinion.

Statement 5:

"*Is it preferable that dry port policies be governed by the ministry of transport or by terminal operators?*" The statement achieves only 54.55% agreement. 9 experts were not sure to answer, 6 were disagreed and 18 agreed that all terminals should be operated by ministry of transport. As noticed 9 is large number reflecting a lack of clarity in relation to 33 which give an indicator that the statement was somehow vague and really needs clarification.

Disagreement Arguments:

"It should be operated by terminals operators"

"Both of them must be cooperated for ease Dry Port operation"

"Always i prefer that these ports should independent"

“Regulated by the state and operated by terminal operators”

Unable to comment

“This is a double barreled question; my answer means Ministry responsible for Transport”

“It depends on the situation, and on what policies you mean”

“Not a question you can agree or disagree with. Policy should be made by governments’ not private companies”

“Terminal operators are more preferable”

“Terminal operators of course as they will be better equipped to amend their policies in the course of their operations.”

“I think it is preferable to governed by terminal operators within Governance framework”

This question was debatable. Around half of the experts agree and the others either disagree or are unable to comment. For the disagreed experts, also, half of them preferred that dry ports policies should be operated by terminal operators. The other half preferred the cooperation between ministry of transport and terminal operators. Similarly, experts unable to comment are divided into two groups of answers. One group prefers terminal operator’s independency and the other seeks government interference. For that reason, the modified statement was as follows “Dry port policies should be governed by terminal operators within Governance framework “under the supervision of ministry of transport”.

Statement 7:

“*Do environmental regulations affect policy decisions regarding dry port location?*” The statement achieves only 63.64% agreement. 4 experts were not sure how to answer, 8 were disagreed and 21 agreed on environmental regulations have an effect on policy decisions regarding dry port location.

Disagreement Arguments:

"I think, dry ports aren't harmful to environment so the environmental regulation not affect to the locations of dry ports"

"No many situations require environmental regulations"

"Containers are green means of cargo transportation and storage"

Unable to comment

"Could affect the Dry Port"

The debates here focused on that dry ports are not harmful especially for transporting containers which are green and environmentally friendly. For these reasons, some experts thought that there was no need for environmental regulations. Experts that are not sure thought it could be important. On the other hand, there are containers called IMO containers which are dangerous, so may harm the environment if any damage happened during handling operations. Also, a dry port location demands a lot of space which might be occupied by a valuable ecosystem. Thus, the statement was modified to be as follows "one of the main factors that must be involved in selecting port location is environmental regulations".

Statement 8:

"Do terminal operators who decide policies take account of the size of dry port(s)?" This statement achieves only 57.58% agreement. 9 experts were not sure to answer, 5 were disagreed and 19 agreed on the importance of the size of dry port(s) which should be considered when deciding port policies.

Disagreement Arguments:

"In fact the size of trade and traffic is the important factor"

Unable to comment

“Sizes can be decided by the regulator/policy maker or the operator ... any how it need a thoroughly study”

“The question is unclear”

Going through the analysis of this statement clarifies that the statement should be clearer. All the received opinions justify the importance of size factor. Hence, the new statement was “The size of dry ports is one of the main factors that must be considered in establishing dry ports”.

Statement 9:

“*Are dry ports becoming much more important in increasing the terminal processes of logistics within ports and between ports and the hinterland*?” The entire statement reaches 63.64% agreement. 9 experts were not sure how to answer, 3 were disagreed and 21 agreed on the statement. These ratios reflect that disagreed experts were very small number in relation to agreed ones, 21 from 33 from the total expert panels. Also experts that were unable to give comments were 9, this means repeating the question with more clarification according to their comments will end with to either consensus or disagreement.

Agreement Arguments:

“I agree and in this case dry ports will become logistic centers”

“Dry ports effective contribution in the withdrawals of goods and storage”

“Dry ports are very important to provides the logistics services between marine ports and the hinterland”

“Between ports and hinterland”

“This role could be increase more and more if all system is operated in triangulation process to minimize empty containers movement on roads”

“Not within ports but between ports and hinterland”

“Depending on the geographic location the answer can vary but generally one of the purposes of dry ports is to increase those opportunities.”

“Yes”

“As long as added value logistics are taking place within ports area”

“Dry ports are becoming much more important between ports and the hinterland”

The only comments received for this statement were on the agreed one. Neither disagreed experts nor experts whom were not sure how to answer gave comments. Consequently, it was considered that the agreed comments as an indicator of how to judge the statement. The modified statement was “Dry ports are very important to provide the logistics services between marine ports and the hinterland”.

Statement 10:

“*Should rail transportation be constructed for a successful dry port system or is road access alone adequate*?” Again the statement reaches 66.67% agreement but with 5 experts was not sure to answer, 6 were disagreed and 22 agreed on the statement.

Disagreement Arguments:

“Railway is very costly where road can do the work at least to nearest railway terminal”

“Railways are very high investment and needs long time to be established therefore if it is not exist road is adequate”

“Rail and road access are necessary”

“May be road again”

Unable to comment

"It depends on the situation. Rail is only feasible on certain distances with density of flows, whereas a short distance dry port may be road-only as its goal is more related to streamlining administrative or customs matters"

"It depends on the distances between dry and marine ports in that rail is more feasible in long distance than road transport"

"Rail is preferable"

This statement was very close to reach an agreement since it achieved 66.67%. The arguments for this statement show the importance of rail transport under certain conditions. If the distance is small, no need for huge investment is required for the rail system. The majority of disagreed experts are for the cost of rail establishment and if there is road accessibility, it can carry on. The members, who are not able to pass comment, were certain about the situation itself. Again rail is important for long distances and not for the short distances and that rail is preferred than road. Consequently, the modified statement was "Rail transportation is more feasible in long distance than road transport be constructed for a successful dry port system"

Statement 11:

Do you think the development of dry ports provides serious issues port safety and security? The statement achieves only 51.61% agreement. 6 experts were not sure to answer, 9 were disagreed and 16 agreed on the importance of port safety and security when establishing a dry port.

Disagreement Arguments:

"If it is well controlled security issue can be accepted"

"I think the relation is far away"

"Dry ports are far from maritime ports so there is no safety or security connection"

"There are a lot of regulations in place to ensure these problems do not arise"

"Has nothing to do with each other"

"It needs the normal measures of safety and security"

Unable to comment

"It depends on the establishments' considerations and the governed regulations"

"Not serious but dry ports require more concerns about security and safety"

The statement only reached about 50% agreement. This means it was a highly debatable statement. The discussion divided between two thoughts. The first opinion is that dry ports have no security issues. The question asks about the importance for setting safety and security measures, not about the location of a dry port. Experts may have assumed that dry ports are far from the marine port as if there is only one type of dry port. However, there are three types of dry port as mentioned in the literature review (see section 2.4.5) distant, midrange and close dry ports. The second opinion is that it needs normal not serious measures for safety and security. Therefore, the modified statement: *"Dry ports requires safety and security measures the same or additional to as marine ports".*

After analyzing statements that did not achieve consensus and explaining how changes has made for these statements then entered a new round. The next section will show the detailed analysis for the new round (round 2).

4.4.2 Round 2 Results

The panel members who returned Round 1 responses were a total of 33. In Round 2, 25 responses were returned. Hsu and Sanford (2007) argued that due to the multiple feedback processes, the potential exists for low response rates or discontinuation of experts responses during several stages of the Delphi process and striving to maintain robust feedback can be a challenge. It was predicted that responses in the second round will be reduced than the 33 member. However, 25

is a good response rate because the number on the expert panel is still in the safe range as discussed in the number of experts section 5.1.1.

4.4.3 Round 2 Analysis

As seen in the initial analysis of Round 1, the Round 2 result analysis will show each question's response as agree, disagree or not sure from each individual response.

For addressing the questions in Round 2 of the Delphi, the opinion responses given by each panel member for each question were formulated into a combined feedback document. Finally, a graph was designed to describe each question's response level.

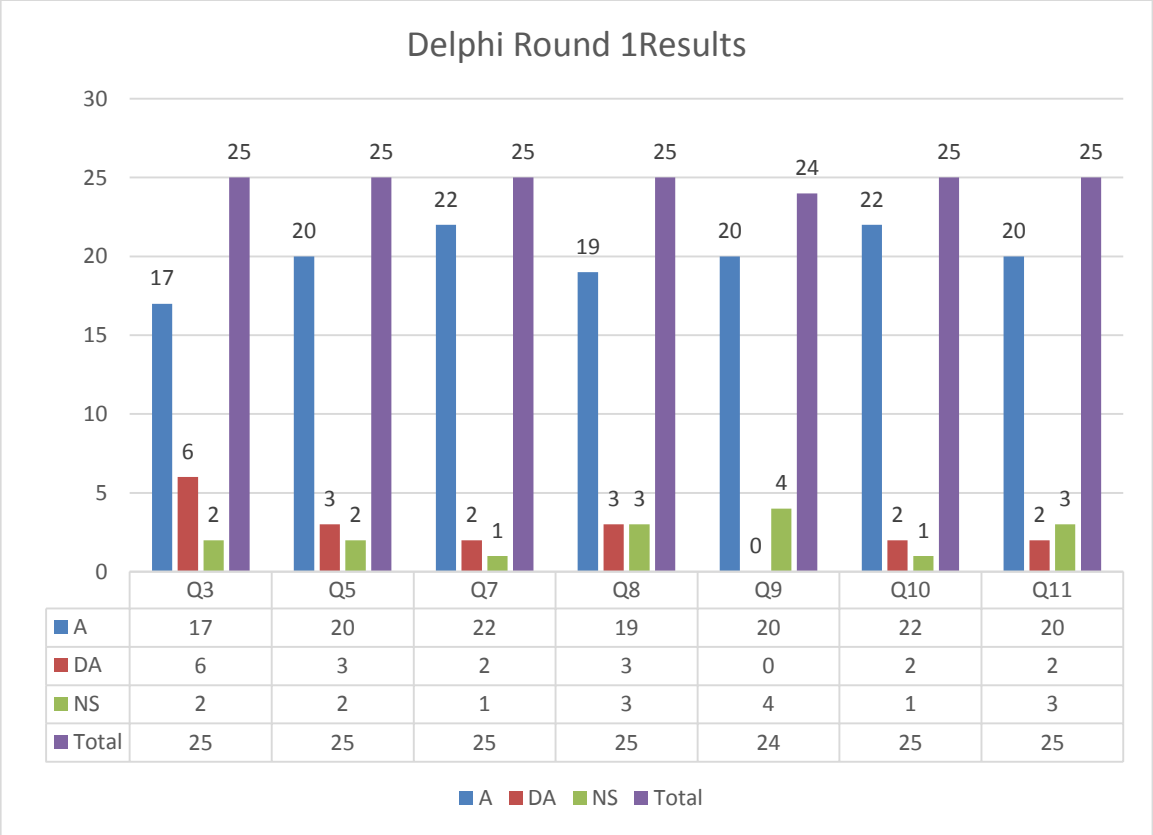
Table 4.5 Total survey Response Round 2

#	**Delphi Round 1**	**A**	**DA**	**NS**	**Total**	**%**
Q3	It is not necessarily a guarantee for efficiency and effectiveness if all terminals be operated by private companies.	17	6	2	25	68
Q5	Dry port policies should be governed by terminal operators within Governance framework “under the supervision of ministry of transport”	20	3	2	25	80
Q7	one of the main factors that must be involved in selecting port location is environmental regulations	22	2	1	25	88
Q8	The size of dry ports is one of the main factors that must be considered in establishing dry ports	19	3	3	25	76
Q9	Dry ports are very important to provide the logistics services between marine ports and the hinterland.	20	0	4	24	83.33
Q10	Rail transportation is more feasible in long distance than road transport be constructed for a successful dry port system.	22	2	1	25	88
Q11	Dry ports requires safety and security measures the same or additional to as marine ports.	20	2	3	25	80

(N.b. note: A = Agree, DA = Disagree, NS = Not Sure)

Outlined below in Table 4.5 is a statistical overview of the results with respect to the agreement, disagreement and not sure how to comment response from the Delphi panel in Round 2.

Figure 4.3 Delphi Round 2 Graph Display Result



	Q3	Q5	Q7	Q8	Q9	Q10	Q11
A	17	20	22	19	20	22	20
DA	6	3	2	3	0	2	2
NS	2	2	1	3	4	1	3
Total	25	25	25	25	24	25	25

(Source: Author's Own)

Round 2, Question 3 had a majority agreement result of 68%. Therefore, the statement has not reached a final consensus.

Q3	It is not necessarily a guarantee for efficiency and effectiveness if all terminals be operated by private companies.	17	6	2	25	68

Round 2, Question 5 had a majority agreement result of 80%. Therefore, Question 5 has reached consensus and will not enter the third round.

Q5	Dry port policies should be governed by terminal operators within Governance framework “under the supervision of ministry of transport”	20	3	2	25	80

Round 2, Question 7 had a majority agreement result of 88%. Question 7 has reached consensus and will not enter the third round.

Q7	one of the main factors that must be involved in selecting port location is environmental regulations	22	2	1	25	88

Round 2, Question 8 had a majority agreement result of 76%. Question 8 has reached consensus and will not enter the third round.

Q8	The size of dry ports is one of the main factors that must be considered in establishing dry ports	19	3	3	25	76

Round 2, Question 9 had a majority agreement result of 83.33%. Therefore, Question 8 has reached consensus and will not enter the third round.

Q9	Dry ports are very important to provide the logistics services between marine ports and the hinterland.	20	0	4	24	83.33

Round 2, Question 10 had a majority agreement result of 88%. Question 10 has reached consensus and will not enter the third round.

Q10	Rail transportation is more feasible in long distance than road transport be constructed for a successful dry port system.	22	2	1	25	88

Round 2, Question 11 had a majority agreement result of 80%. Question 11 has reached consensus and will not enter the third round.

Q11	Dry ports requires safety and security measures the same or additional to as marine ports.	20	2	3	25	80

The conclusion with respect to the Delphi survey second round is that a total of six consensuses were achieved. The second round was designed with seven modified statements. Hence, there is one statement that did not reach a consensus. It achieved 39% agreement in the first round. The statement was "*Is it better that all terminals be operated by private companies rather than the public state*" and then modified to be "*It is not necessarily a guarantee for efficiency and effectiveness if all terminals be operated by private companies*" then reached 68% agreement in the second round. It was near to reach consensus but the issue is that this statement was very debatable; some experts believed that private companies are more successful in operating terminals. Others did not accept this concept especially there are some successful cases for terminals operated by public companies and public private partnership. So, by all means these are their point of views. Even after altering the statement that it is not necessarily a guarantee of their success to be operated by private companies. Some experts disagree and said "*No*" it is necessarily. Therefore, it was decided that there is no need for a third round on only one statement that already results in a reasonably clear concept concerning experts debating the efficiency and the success of the terminals with regards to their ownership type.

4.5 Delphi Study Summary

· The Delphi study had a total of 11 consensuses of the 12 statements; only 5 statements reached the desired agreement. Therefore, the rest entered the second round for further discussion and modifications. Hence, 6 statements achieved consensus. The following is a quick summary of the consensus results.

· Investing in dry ports is the most suitable solution for capacity problem and reducing port congestion (agreement of 81.82%, Round 1)

· Dry ports help terminal operators to become more successful in regional competition (agreement of 87.82%, Round 1).

· The Egyptain Government should provide a list of regulations and legislation that supports, controls and governs investment policy and decisions in new dry ports (agreement of 87.88%, Round 1).

· Dry port policies should be governed by terminal operators within a governance framework “under the supervision of ministry of transport” (agreement of 80%, Round 2).

· Dry ports can help to maintain maritime growth and global sustainability (agreement of 78.79%, Round 1).

· One of the main factors that must be involved in selecting port location are environmental regulations (agreement 88%, Round 2).

· The size of dry ports is one of the main factors that must be considered in establishing dry ports (agreement of 76%, Round 2).

· Dry ports are very important to provide the logistics services between marine ports and the hinterland (agreement of 83.33%, Round 2).

· Rail transportation is more feasible in long distance than road transport and should be constructed for a successful dry port system (agreement of 88%, Round 2).

· Dry ports require safety and security measures the same or additional to as marine ports (agreement of 80%, Round 2).

The next chapter will introduces a detailed analysis at the individual consensus achieved and the opinions retuned for each of the statements.

Chapter 5

Dry Port Location and Capacity policies Delphi Results

This chapter aims at discussing the Dry Port location and capacity policies' Delphi results for each round, the achieved consensus in each round, the total Delphi final consensus, and the consequence of the statements that did not achieve a level of consensus. The chapter will concentrates on analysing results in each round, ends by a summery to conclude this chapter.

5.1 Delphi Analysis

The Delphi study achieved three consensuses that have been ranked at three levels; low consensus, medium consensus, and high consensus (See Table 4.3). From the Dry Port Delphi point of view, the most significant consensus is from 70 - 79 % as statements achieving either an agreement or disagreement consensus of 70% do not move into the following round.

The Dry Port Delphi could have implemented a clear 70% cut off mark; however, a ranking approach post the initial consensus of 70% was identified to help apply a level of caution and validity to the results due to the divergent nature of the consensus issue and the possibility of inferring a consensus in many modes.

Both of the agreement and disagreement opinions of the panel members support the discussion and analysis of each statement achieving a consensus in each of the rounds.

There were 12 statements in the Delphi study, and due to the similarity of responses in some examples through the rounds and in order to empower a reasonable control on the analysis, the responses have been arranged into threads of opinion.

5.2 Consensus Achieved in Round 1

In round 1 of the Delphi a total of five consensuses were achieved.

5.2.1 Round 1, Consensus 1

The first consensus ranked at 81.82% which according to Table 4.1 is a moderate consensus agreement. Therefore 81.82% of the 33 returned responses for Round 1 consider that investing in dry ports is the most suitable solution for capacity problem and reducing port congestion.

5.2.1.1 Round 1, Consensus 1 Analysis

Of the total 33 returned responses, 27 agreed, 4 disagreed and 2 were not sure how to answer. The importance of the first question in Round 1 of the Dry Port Delphi is to determine if the Delphi candidates consider that Dry ports is an appropriate solution for solving container terminals' capacity problem, reducing port congestion and over delays. If the Delphi panel had returned a disagreement result for Round 1, Question 1 statement, it may have had a result of altering the perception of the research theory itself which is based on determining decision policies for building Dry Ports as a suggested solution for capacity problems. In the first instance the agreement result of this statement indicates that the Dry Ports could be a possible solution. The following text will analyse some of the opinions retuned by the panel members.

Agree Arguments:

Agree Arguments: Thread A

"Dry Port is one of the alternatives available"

"It's an alternative especially for old port congestion and restriction of hinterland"

Agree Arguments: Thread B

"It differs from port to port depending on conducting feasibility study that will compare between marine expansions and establishing dry ports"

"I think, investing in the main ports is important also so, invest in both parallel"

Agree Arguments: Thread C

"Sure, and there are some ports already apply this solution"

“Due to limited spaces in ports therefore dry ports are the new lungs for maritime ports”
“No available spaces now in maritime ports”
“It may solve the capacity problem”

Agree Arguments: Thread D
“Because it might help to reduce the volume of containers in the port and meanwhile to reduce logistics cost to the factories located in its area”
“In-addition of better choices for the allocation of logistics services in the hinterland connections”

There were four main threads of opinions identified among the opinions returned in agreement with Round 1, Question 1. Of the 33 returned responses, 27 agreed that dry ports are the most suitable solution for the capacity problem and for reducing port congestion. Nevertheless, this opinion seems to include some objections. Consequently, the overall result is that dry ports could be an appropriate solution but with considerations that need to be further addressed and examined. It is significant to identify those considerations for any further research, future policy recommendations or developmental strategies regarding investing in Dry Ports.

The Thread A opinion agreed that dry ports are a solution, but not the only solution which is a true and logical outcome. It was discussed in the literature review that dry ports are one of the suggested solutions; there are six alternative solutions which are physical expansion, using automation and new technology, improving the utilization of the available resources, floating and dry docks and investing in Dry ports.

Thread B opinion discusses the importance of investing in the marine port itself as well as dry ports, and experts refer to physical expansion, which is also one of the suggested solutions. But this research seeks a solution that appears and can be applicable in many ports where there is no space for expansion due to

hinterland or landlocked countries. This means that the operators are restricted with space expansion and also searching for a solution with a reasonable cost.

The opinion in thread C accentuates the importance of dry port implementation, which is already applied and proved successful in some ports around the world. In addition, experts argued about space limitations in many ports, especially old ones; therefore, dry ports are the new ‘lungs’ for maritime ports in order to cope with the increasing number of handled containers, port congestions and delays.

Thread D arguments take a different approach on the agreement as they highlight the fact of allocating logistic services in the hinterland connections and reducing logistic costs to the factories located in its area. Meanwhile, this means a shift of large number of container outside port area.

Disagreement Arguments:

Disagree Arguments: Thread A

“Dry port are only a small part of the solution and only applicable in certain instances”

“It depends on the context - dry ports might or might not be most suitable”

“It is not necessarily the "most" suitable solution”

Disagree Arguments: Thread B

“Dry ports especially close dry ports are cost adding nodes, they are useful as short term solution but not long term”

The disagreement arguments were divided into two threads: Thread A’s opinion was that dry ports might or might not be the most suitable solution depending on the situation, but this argument does not contradict with this research theory, because this research is about identifying policies that assist terminal operators in taking such strategic decisions. Therefore, it could be very successful to some terminals and not for another, but the significance here is to take the right decision.

Thread B opinion assumes that costs of implementing dry ports especially a close dry port will be a cost adding node, it will be useful as a short term solution. Henttu et al. (2010) tried to find out if a dry port solution could decrease costs of transport, especially external costs. They concluded in their research that was applied to the city of Kouvola (Finland), the financial and environmental impacts (CO2 emissions, congestion, accidents and noise) of a dry port implementation decreased total costs of transport in terms of both the internal and external costs. Cost-efficiency of the transport system can be improved with dry port implementation. They suggested using more distant dry ports than a dry port situated near the seaport.

5.2.2 Round 1, Consensus 2

The second consensus ranked at 87.88% which is a moderate agreement consensus. 87.88% of the 33 responses returned for Round 1 Question 2 believe that dry ports can help terminal operators to become more successful in regional competition.

5.2.2.1 Round 1, Consensus 2 Analysis

Of the total 33 returned responses, 29 responded with an agreement opinion, 2 returned a disagreement opinion, and 2 were unsure how to respond. The importance of Round 1, Question 2 is indicated by if panel member believe that dry ports have any future potential to develop further success for container terminals or not which in return would help them become more dynamic, competitive and successful at the regional level. The following text will analyse some of the opinions retuned by the panel members.

Agree Arguments:

Agree Arguments: Thread A

“I agree that dry ports will add value and support marine ports”

“Dry ports are one of many reasons to achieve success and consider one of strength points”

“it Facilitate and improve terminal performance”

Agree Arguments: Thread B

"it will raise the pressure rested upon their shoulders to perform high productivity"
"if there are available space productivity may increase"
"if it has enough capacity to accommodate more capacity"
"Because port terminal might be able to receive a higher volume of containers"
"it will help in increasing terminals capacities"
"For the limitation of releasing congestion pressure & ease of access"

Agree Arguments: Thread C

"Good connections to dry ports are important but unlikely to be the deciding factor between competing ports. Dry ports are only a part of the solution."
"Dry ports are of eminent importance in network strategy"
"Especially for distant dry ports"

Of the opinions returned in agreement with Round 1, Question 2 there were three main threads of opinion identified. Of the 33 returned responses, 29 returned in agreement that dry ports can help terminal operators to become more successful in regional competition. However opinion appears to concentrate on some benefits of dry port implementation such as increasing terminal capacities, improve performance and decreasing port congestion. Many authors supported this point as reviewed in chapter two (see section 2.4.3 & 2.4.4) where the benefits of dry ports and importance of implementation were discussed extensively.

Thread A opinion was in agreement of dry ports as a value added to marine ports which helps in facilitating and improving performance. So, it can be considered as one of the key success and strength points for container terminals.

Thread B opinion focused on the benefit of dry ports in increasing capacity and productivity. All their comments refer to the fact that a terminal might be able to receive a higher volume of containers due to space availability which means a

terminal can accommodate more capacity which in return leads to higher terminal productivity.

The opinion in thread C highlights the importance of the dry port network strategy. Any solution can result in failure if it is not implemented in the right way, so choosing dry port location is very important to the success of the whole network. Dry port location can vary according to several factors as previously discussed in chapter two (section 2.6). Also, three types of dry ports were identified: distant, midrange and close dry ports (Roso *et al.* 2009). Therefore choosing good terminal connections should be carefully selected because it will affect the whole transport chain.

Disagreement Arguments:

"There are other factors can help terminal operators in regional competition"

The opinion clarified that there are other factors that help terminal operators to become more successful in regional competition. A dry port is not the only deciding factor, which is not against the statement. The statement says "*dry port can help terminal operators to become more successful in regional competition*" but it does not suggest that it is the only factor in terminal success.

5.2.3 Round 1, Consensus 3

The third consensus ranked at 87.88% which is a moderate agreement consensus. 87.88% of the 33 responses returned for Round 1 Question 4 believe that it is better to provide a list of regulations and legislation by government that supports, controls and governs investment policy and decisions in new dry ports

5.2.3.1 Round 1, Consensus 3 Analysis

Of the total 33 returned responses, 29 responded with an agreement opinion, 2 returned a disagreement opinion, and 2 were unsure how to respond. The importance of Round 1, Question 4 is to ascertain whether the panel member consider the existence of dry port regulations and legislation by government will

positively affect terminal operators decisions regarding new investments in dry ports or not.

Agree Arguments:

Agree Arguments: Thread A

"I agree but to some extent"

"Governments should regulate not operate"

"Yes, there are rules for airports and seaports; there should be ones for DRY-ports as well"

"Policy making is important in order to safeguard effective and ecological developments"

"In order to ensure the absence of constraints"

"The important to be rigid policy for long period"

Agree Arguments: Thread B

"That could reduce the risk of monopoly"

"Something to fight monopoly"

The agreement arguments had two clear threads of opinion and the opinion of Thread A illustrates a strong agreement on setting dry ports' regulations and legislation by government but only to a certain degree. Panel member stressed the difference between "regulate" and "operate"; in other words, rules should be set by government but terminal operation and control should be left to the terminal operators. While panel members in thread B agree on the statement but from different perspectives, they suggest that governmental regulation will fight against the risk of monopoly.

Disagreement Arguments:

"*I prefer that these ports should be independent"*

The disagreement argument reflects the other point of view, which is that each port should be operated and governed by itself. This argument agrees with

independency, they do not prefer any control on their decisions. Whether to invest in dry ports or not, where to locate this dry port or even its capacity, etc. they prefer to take their own decisions by their top management and the way they feel it is acceptable to their goals.

5.2.4 Round 1, Consensus 4

The fourth consensus ranked at 78.79% which is a low consensus. 78.79% of the 33 responses returned for Round 1 consider that dry ports can help in maintaining maritime growth and global sustainability.

5.2.4.1 Round 1, Consensus 4 Analysis

Of the total 33 returned responses, 26 agreed, 1 disagreed, and 6 were unsure to comment. Round 1, Question 6 asks the panel members about the importance and ability of dry ports to positively affect international trade within the maritime transport sector. i.e. can dry ports be a good opportunity for maritime sustainable growth?.

Agree Arguments:

Agree Arguments: Thread A

"I agree in that dry ports will add to marine ports capacity"

"As they make an effective contribution in easing Tkdt yards container terminals"

"Because receiving cargo instead of congested ports thus ports productivity will increase"

"Avoid congestion which will increase the handling volume"

Agree Arguments: Thread B

"Only to a small degree"

"Somewhat, especially at development countries"

Agree Arguments: Thread C

"It can be, if there are effective and efficient transportation network"

"Sure, when it is operated in line with the industry flows and needs"

Panel member in thread A agreed with the statement since they realized that dry ports will have an effective contribution in increasing terminal capacity. They clarified that decreasing port congestion will improve handling volume, also, accepting more containers due more space availability and then port productivity will be enhanced, which in-turn will positively affect international trade growth.

Opinions in thread B also indicate their agreement to the statement but to a certain degree. They ensure that a dry port can be a reason for maintaining maritime growth and its global sustainability, but not the only reason. One opinion did highlight that especially in developing countries where terminal capacity problems and congestion mostly occur, dry ports can be a solution.

Subsequent opinions provided in the response in Thread C also indicate the importance of dry ports as a good opportunity for maritime sustainable growth on condition that these dry ports are connected to an efficient transportation network. As mentioned in the literature review, infrastructure is one of the key factors for successful dry ports implementation. Also, it should be operated according to industrial needs of each country.

Unable to Comment Arguments:

"*Question covers a very broad area. Maritime growth will be a response to global economic growth. Dry ports will be part of the solution in handling the trade and global economic sustainability"*

The opinions provided in the unable to comment section again reiterate the opinion declared by panel member in thread B. Dry ports are part of the solution in handling the trade and global economic sustainability not the only reason. The statement stated that dry ports could share in increasing or maintaining international trade growth, and this did not mean that dry ports will be the only reason. Terminals are situated all over the world in different countries with different problems, what could be helpful for one, might not be for others. So,

experts just try to figure out reasons that may lead to maintaining global economic growth which lies under the big umbrella of many other sectors such as maritime growth, regional growth, etc.

5.2.5 Round 1, Consensus 5

The fifth consensus ranked at 93.94% which is a high consensus. 93.94% of the 33 responses returned for Round 1 believe that dry ports have a positive effect on trade and maritime transport.

5.2.5.1 Round 1, Consensus 5 Analysis

Of the total 33 returned responses, 31 agreed, there were no disagreed responses, and 2 were unsure how to comment. Round 1, Question 12 is very relevant to question 6 but on a smaller level. Question 6 asks about the big umbrella which goes globally while this question asks particularly on trade and transport in maritime industry. It is a very logical result to gain a high level of consensus on this question, because disagreement on this statement will contradict agreement achieved by question 6 agreement.

Agree Arguments:

Agree Arguments: Thread A

"If it adds values"

"Of course have a positive impact"

"Sure"

"Trade flow facilitation, added value activities, adding time and place utilities to the product etc..."

Agree Arguments: Thread B

"I agree in that dry ports will assist marine ports in expanding capacity"

"Of course withdrawal of cargo from ports as soon as possible will allow new spaces for receiving new cargos"

“Because dry port help in freeing ports from cargo so ports productivity will increase”

“Accommodating higher capacity”

Agree Arguments: Thread C

“*If planned and operated well then they can have a positive effect. But if the market is not there or the flows are not consolidated then they may fail”*

“Both positive and negative effects”

“In the presence of effective land transportation network”

The current question received a dominant number of agreement opinions; however panel members who returned an unable to comment response did not provide statements of opinion.The agreement arguments had three clear threads of opinion and the opinion of Thread A illustrates the general agreement on the statement. Panel member in thread A clarify certain points or reasons behind their agreement. They totally believe that the dry port concept has a significant effect on the overall trade and transport system in the maritime industry. They concentrated in their response on the added value gained from applying dry port concept such as time and place utility, trade flow facilitation, etc.

However from the responses illustrated in Thread B above it describes the advantages of dry ports in gaining capacity since the allowance of space for receiving more cargos as marine ports cargos will be shifted to dry ports. So, this means higher productivity, and higher productivity means a boom in the international trade and transport in maritime industry.

Thread C appears like a conditional agreement. Panel members agreed that a dry port could be successful on condition that they must be well planned and operated. The market should be studied well, because the need for building new dry ports will be derived from the demand of the market to a new space and more capacity to be accommodated. Otherwise it could end in failure. They also added

that planning to a dry port needs some environmental factors such as the presence of an effective land transportation network to support cargo flow.

5.3 Consensus Achieved in Round 2

In round two of the Delphi a total of six consensuses was achieved.

5.3.1 Round 2, Consensus 1

The first consensus ranked at 80% which is a moderate consensus. 80% of the 25 returned responses for Round 2 believe that Dry port policies should be governed by terminal operators within Governance framework “under the supervision of ministry of transport”.

5.3.1.1 Round 2, Consensus 1 Analysis

Of the 25 returned responses, 20 agreed, 3 disagreed and 2 were retuned unable to comment. Round 1 question 5 achieved an agreement consensus of 54.5% and through the repetition of the question in the second round and through the provision of feedback from Round 1, the agreement increased by 25.5% to 80%. The current question discusses who should govern dry port policies. Do panel members prefer that terminal operators are best people to govern their dry ports or not. And the question added that even if the terminal operator will have the full control on their dry ports this should happen under the ministry of transport supervision.

Agree Arguments:

“I think this is true to some extent in which terminal operators should governed through ministry transport to achieve national aims”

“Agree because dry ports accumulated with terminals in the same framework”

This question received an acceptable panel member agreement; however two opinions only were delivered. Panel members who returned disagreement and unable to comment responses did not provide statements of opinion. Opinions raised in support for the ministry of transport to govern the terminal operators to

achieve national aims. A port may contain many terminals managed by different companies; some of them may be private and other public. So, a different style of management inside the same port has its own aims that must be achieved by these companies. Therefore, there should be one overarching governance organisation to govern these companies. The ministry of transport is the most relevant institution to carry over this responsibility.

5.3.2 Round 2, Consensus 2

The second consensus ranked 88% which again is a medium consensus. 88% of the 25 returned responses for Round 2 believe that environmental regulation should be considered when selecting port location.

5.3.2.1 Round 2, Consensus 2 Analysis

Of the 25 returned responses, 22 agreed, 2 disagreed and 1 was unable to comment. In Round 1, the question achieved an agreement result of 63.64% while in round 2 through repetition of the question and through providing feedback from Round 1 the question increased in agreement by 24.36% to 88%. The significance of this question was to identify if the panel members as participants within the maritime and port management sector felt the importance of involving environmental regulation when selecting port location.

In the first instance the statement reached 88% consensus and therefore it can be taken with reasonable confidence that such opinions provided indicate the importance of such knowledge. Literature on location selection and factors affecting such decision were discussed chapter 2 (section 2.6). Also, table (2.7) summarizes the most common variables affecting dry port location decision was introduced.

Agree Arguments:

"Nowadays this issue became one of the main factors especially with green aspects"

"Governments have environmental regulations to handling types of cargoes"

An adequate number of panel member agreements on this question were received; however two opinions only were delivered. Panel members who returned disagreement and unable to comment response did not provide statements of opinion. Both comments argued environmental regulation as one of the main factors that should be highly considered when planning and identifying for port location. Especially from the green side; lately, governments have some for a less polluted solution in order to save the society. Cullinane *et* al. (2012) argued for the importance of a sustainable solution is to be found that overcomes the potential multifaceted conflicts which may exist between the need for capacity expansion, environmental considerations, community restrictions (not least those imposed by the geography of a port) for facilitating the future evolution of container ports. According to Hanaoka and Regmi (2011), new methods and procedures need to be explored in order to create changes to more environmentally-friendly modes and so receive net environmental benefits from intermodal transport. It was also suggested by Roso et al. (2009) that the ideal mode between seaports and dry ports is the railway as it reduces Co2 emissions and the production of other pollutants.

5.3.3 Round 2, Consensus 3

The third consensus ranked at 76% which can be considered as a reasonably confident agreement consensus. 76% of the 25 returned responses for Round 2 believe that the size of dry ports is one of the main factors that must be considered in establishing dry ports.

5.3.3.1 Round 2, Consensus 3 Analysis

Of the 25 returned responses, 19 panel members agreed on the statement, 3 disagreed and 3 were unable to respond. In Round 1, the question achieved an agreement result of 57.58% while in round 2 through repetition of the question and the providing of feedback from Round 1 the question increased in agreement by 18.42% to 76%.

Agree Arguments:

"This is important in order to play good role in supporting marine port traffic"

"Dry ports should have economy of scale"

An adequate number of panel member agreements on this question were received; however two different opinions only were delivered. Panel members who returned disagreement and unable to comment response did not provide statements of opinion. The first comment illustrates the agreement that dry port is a crucial factor to be considered when planning for a dry port(s) as determining the right size (equal to the required demand or the absorb the over capacity plus a safety space for the future expansion) will highly support the growth in container traffic which may results in port congestion and bottle necks. The panel member demonstrates that setting a right size for dry port(s) will extremely maintain and facilitate cargo movement in port area and hinterland. However, the other opinion also sustenance the statement agreement as the panel member focuses on the idea of economy of scale. Dry ports means increasing in capacity which results in decreasing in the total cost as the concept of economies of scale may occur.

5.3.4 Round 2, Consensus 4

The fourth consensus ranked at 83.33% which can be considered as a reasonably confident agreement consensus. 83.33% of the 24 returned responses for Round 2 believe that Dry ports are very important to provide the logistics services between marine ports and the hinterland.

5.3.4.1 Round 2, Consensus 4 Analysis

Of the 24 returned responses, 20 panel members agreed on the statement, 0 disagreed and 3 were unable to respond. In Round 1, the question achieved an agreement result of 63.64% while in round 2 through repetition of the question

and the providing of feedback from Round 1 the question increased in agreement by 19.86% to 88.33%.

Agree Arguments:

"That is one of the main roles that dry ports must play"

The opinions returned for the current question again reiterate the significance of the role of dry port(s), the panel member recognise and identify that dry port must play an important part in providing logistics services between marine ports and the hinterland. FDT (2007) emphasizes that dry port should have all logistics activities as shown in their definition as follows: *"A Dry Port is a port situated in the hinterland servicing an industrial/ commercial region connected with one or several ports with rail- or road transport and is offering specialized services between the dry port and the overseas destinations. Normally the dry port is container and multimodal oriented and has all logistics services and facilities, which is needed for shipping and forwarding agents in a port".* And many other definitions stress the logistics activities offered by dry ports or Dry Ports such as UNCTAD (1991), UN ECE (1998) and the United Nations (1992a) referred to chapter 2.

Unable to Comment Arguments:

"Not necessarily"

The opinions provided in the unable to comment section reveals that it is not necessarily important to provide the logistics services between marine ports and the hinterland. The expert point of view shows that dry ports have several activities so it is not necessarily that dry ports should serve between them.

5.3.5 Round 2, Consensus 5

The fifth consensus ranked at 88% which can be considered as a confident agreement consensus. 88% of the 25 returned responses for Round 2 believe

that Rail transportation is more feasible over long distance than road transport be constructed for a successful dry port system.

5.3.5.1 Round 2, Consensus 5 Analysis

Of the 25 returned responses, 22 panel members agreed on the statement, 2 disagreed and 1 were unable to respond. In Round 1, the question achieved an agreement result of 66.67% while in round 2 through repetition of the question and the providing of feedback from Round 1 the question increased in agreement by 21.33% to 88%.

Agree Arguments:

"This is fact"

The agreement opinion has again brought up the importance of an agreement result of 88%. Some people defined the dry port concept that is based on seaport directly connected by rail with inland intermodal terminals as referred to Woxenius et al. (2004). They also considered the environmental benefits of dry ports as in how shifting flows from road to rail would benefit both the ecological environment and the quality of life. In addition, Notteboom and Rodrigue (2012) maintained that rail accessibility to gateway seaports is very essential to the functioning and development of most dry ports worldwide. Through analysing the setting and development of rail-based dry ports in North America and Europe, Notteboom and Rodrigue argued that rail-induced dry port development takes many shapes such as a function of the regional and local governance and regulatory settings, the strategies of stakeholders involved, the spatial and functional relations with adjacent and/or distant gateway ports, the dynamics in logistics network configurations, and the specific competitive setting (i.e. competition with trucking and barges in Europe). However, Cezar-Gabriel (2010) and Hanaoka and Regmi (2011) argued positive environmental benefits resulted through an electrified railway network instead of road transport.

Unable to Comment Arguments:

“What is a "long distance"? Where? In theory yes but in practice...”

One unable to comment opinion was received. The expert agreed on the statement theoretically but in practice he was not sure that rail transportation is more feasible than road transport for a successful dry port system.

5.3.6 Round 2, Consensus 6

The sixth consensus ranked at 80% which can be considered as a confident agreement consensus. 80% of the 25 returned responses for Round 2 believe that dry ports requires safety and security measures the same or additional to as marine ports.

5.3.6.1 Round 2, Consensus 6 Analysis

Of the 25 returned responses, 22 panel members agreed on the statement, 2 disagreed and 3 were unable to respond. In Round 1, the question achieved an agreement result of 51.61% while in round 2 through repetition of the question and the providing of feedback from Round 1 the question increased in agreement by 36.39% to 88%.

Agree Arguments:

“To ensure proper cargo handling and to avoid incidents”

“This is true”

“I believe dry ports require additional safety measures”

There are a dominant number of agreement opinions for the current question; however panel members who returned a disagreement response did not provide statements of opinion.

Panel members believed that safety and security measures are an integral part in dry port transport system which can avoid the occurrence of unexpected events. Gujar and Thai (2013) contend that container security at nodes in the

international supply chains such as inland dry ports has recently become an essential issue on the international maritime agenda. They added that security measures and initiatives can have a great negative effect on the entire maritime transport chain if they are not well-planned and effectively used. Gujar and Thai also argued that the positive results of container security at dry ports could be achieved only if the dry ports used effective container security management strategies.

Unable to Comment Arguments:

"According to many factors such as location, types of cargoes, distance between dry port and terminals"

Opinion discusses that the importance and settlement of safety and security measures will vary according to several variables like the location, types of cargoes, distance between dry port and terminals.

5.4 Summary of Delphi Results

Table 5.1 shows both a summary of the Delphi results concerning the consensus reached in each of the two rounds and a summary of the consensus reached concerning the Delphi questionnaire's original sections.

There were 12 designed statements. A total of 11 consensuses were achieved with 2 achieving a low grade consensus, 8 achieving a medium grade consensus and 1 statement achieving a high consensus.

Table 5.1 Low, Medium and High Ranking in Round 1and 2

	Round 1	Round 2	Total
Low 70 -79	1	1	2
Medium 80 – 89	3	5	8
High 90 - 100	1	0	1
Total	5	6	11

(Source: Author's Own)

5.5 Concluding remarks

As long as the core data derived from the Delphi are opinions, which are difficult to present, the Delphi results in the current discussion are examined by formulating the returned opinion into a number of similar threads. The discussion not only focuses on the statements that achieved a level of consensus but also incorporates opinions that went against the final agreed consensus. Since no statement reached a consensus of 100%, there are disagreeing opinions within panel. Therefore, not disregarding an opinion simply because it does not agree with the majority of opinions helps to provide a balance regarding developing future research agendas. The nature of the research is explorative.

Chapter six

Case Study Discussion and Analysis

6.1 Introduction:

As referred to in chapter three, conducting the case study is outlined in the methodology chapter. In this chapter, the detailed process is discussed and reviewed starting from how this approach was chosen and why specifically the chosen case followed by a detailed discussion on the case it self and then analysing the results. At the end, the Delphi results are compared with the case study outcomes and then chapter conclusions are provided.

6.2 Validation:

This research assumed that the proposed structured decision support framework can be applied to a variety of container terminals to assist port planners, policy makers, and investors to adopt the right policy decisions for Dry Port location and capacity.

As illustrated in the previous chapter, the Delphi study results revealed some perceptions that should be tested to validate these results. Therefore, a case study was chosen to be conducted on a terminal that suffers an over capacity problem in recent years, the same as this research problem. Semi-structured interviews were conducted with managers from different departments to discuss these results. Dry Ports policy decisions are strategic decisions, so that interviews were made with upper level managers.

Alexandria port is one of the main Egyptian ports as referred to in chapter 1 section 1.2 where a map is also provided. There are two container terminal operators at Alexandria port:

- Alexandria Container Handling Company, a public sector company.

- Alexandria International Container Terminal (AICT), a private sector company, where Hutchison Port Holding (HPH) made an agreement with the government to construct and operate two terminals in both Alexandria and Dekheila ports (AICT, 2013).

AICT were chosen for the case study validation for the following reasons:

- Data accessibility and accuracy.
- AICT faced a real overcapacity problem since 2010, hence was the same timing for screening which company to select. So, and this was the reason behind deciding this specific company as it will serve this research. In addition they opened a new dry port in an attempt to solve this problem last year.
- The validity of the results on an international company will be more feasible that a national company. This is because the results have to be applicable to most ports not a single port.
- The popularity and reputation of the company as AICT is one of HPH branches, were HPH considered the 2nd terminal operator in the world top 5 terminal operators by market share percentage as of the year ending 2013 (Port Technology, 2014) and also 2nd terminal operator achieving an increase in container numbers and an remarkable level of growth, combined with automation and new development initiatives in the top 10 port heavyweights according to Lloyd's list (2016). Feedback from such successful company will be more valuable.
- The ability to access the company and the interviewee's willingness to participate in the study.

Conducting a case study of AICT Company verified the applicability of the research framework in the maritime sector. Case study nominations from the chosen company were screened in order to select the most appropriate candidate to serve this research

Criteria for selecting potential candidate:

1. The candidate should have been working in AICT (or in the field) for not less than 10 Years.
2. The candidate should be a manager or section head; it is not important to interview the company's CEO as it is more important to interview nominees from main departments and divisions who have good knowledge and understanding of the processes under examination; interviewees were selected who had access to the information desired, had the willingness and the ability to communicate relevant knowledge and that were objective and unbiased.

The case study protocol was developed to provide an overview of the case study. The detailed case study protocol and case study questions are illustrated in Appendix 1.

The researcher scheduled two visits to the company, two interviews each day for the four managers nominated in the case.

6.3 Company's profile:

The following section comprises the company's profile including basic data on Hutchison Port Holdings Limited (HPH) Company, and then the discussion will focus on Alexandria International Container Terminal (AICT) where the case study was conducted.

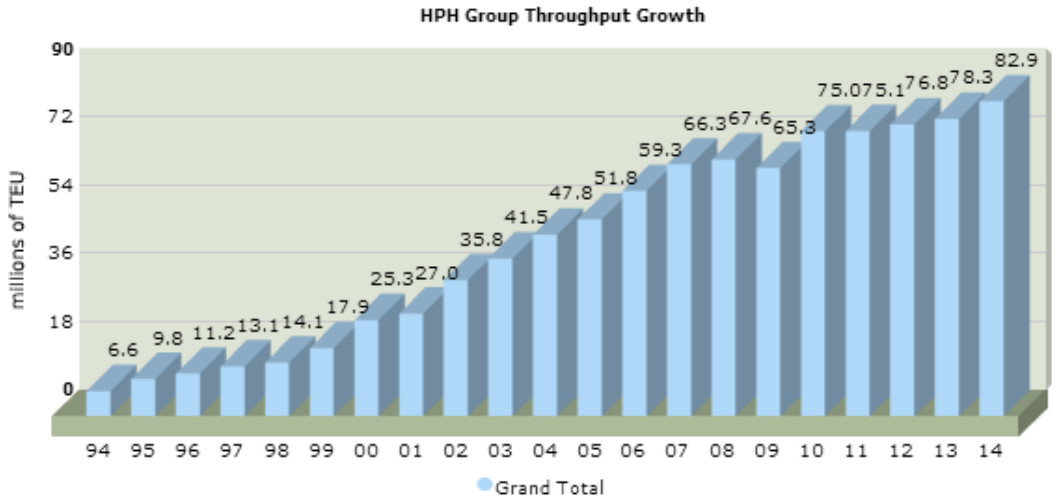
Company's Background:

Hutchison Port Holdings Limited (HPH), a subsidiary of the multinational conglomerate CK Hutchison Holdings Limited (CK Hutchison), is the world's leading port investor, developer and operator. The HPH network of port operations comprises 319 berths in 52 ports, spanning 26 countries throughout Asia, the Middle East, Africa, Europe, the Americas and Australasia (HPH, 2015).

In 1866, the Hong Kong and Whampoa Dock Company was established as the first registered company in Hong Kong, this is when the history of HPH began. The Hong Kong and Whampoa Dock Company provided ship construction and repair services for over a hundred years; then in 1969, it changed into cargo and

container handling operations after establishing its flagship operation, Hong Kong International Terminals (HIT). In order to manage this growing international port network, HPH was founded in 1994. HPH has gradually expanded worldwide into other locations and businesses that are transportation-related, such as cruise ship terminals, airport operations, distribution centres, rail services, and ship repair facilities. In 2014, the HPH port network handled a combined throughput of 82.9 million TEU worldwide.

Figure 6.1 HPH Group Throughput Growth



Source (HPH, 2015)

Table 6.1 Throughput figures published in HWL Annual Report 2014

Port / Business Unit	**Throughput (millions of TEU)**	**Change over 2013**
HPH	82.9 million	+6.0%
Port / Business Unit	**Throughput (thousands of TEU)**	**Change over 2013**
HPH Trust		
HPH Trust	24,700	+6%

Hong Kong - Kwai Tsing	13,000	
Mainland China – Yantian	11,700	
Hong Kong and Mainland China - Ancillary Services	N/A	
Mainland China and Other Hong Kong		
Mainland China and Other Hong Kong	14,000	+10%
Shanghai	7,800	
Ningbo	2,000	
Ports in Southern China - Jiuzhou, Nanhai, Jiangmen, Shantou, Gaolan, Huizhou and Xiamen	2,800	
Hong Kong - Tuen Mun	1,400	
Europe		
Europe	16,000	+6%
The Netherlands	10,200	
United Kingdom	4,300	
Spain	1,000	
Poland	400	
Italy	100	
Sweden	---	
Asia, Australia and Others		
Asia, Australia and Others	28,200	+4%
Malaysia	8,400	
Panama	3,900	

Indonesia	3,200	
South Korea	2,400	
Thailand	2,100	
Mexico	2,000	
Saudi Arabia	1,800	
The Bahamas	1,400	
Pakistan	900	
Egypt	700	
Tanzania	400	
Oman	300	
Argentina	300	
United Arab Emirates	100	
Australia - Sydney	100	
Australia - Brisbane	100	
Myanmar	---	
Vietnam	---	

Source (HPH, 2015)

HPH Investment:

HPH offers local industry a passageway to world markets and also helps in the long-term development of local market infrastructure by managing all aspects of port operation through transferring proven operational practices to guarantee the best environment for the development of commerce and by directly investing in hubs that cater for large hinterlands and that either supplement international trade or are likely to become key transport centres.

HPH Employees:

HPH have around 30,000 employees worldwide who are committed to providing efficient services. HPH is concerned with professionally developing its employees through continuous skills training.

HPH Innovations:

Hutchison Port Holdings (HPH) is one of the world's most technologically advanced port operators. The company has created the most advanced solutions that contain each aspect of our operations, including service-enhancing technologies that enhance productivity. HPH aim is to make sure that each port in their worldwide network has the most effective tools to satisfy the shipping needs of the 21st century, by using many innovations, technologies, and advanced equipment as well.

In the transport industry nowadays, HPH has one of the most technology-intensive commercial operations. It has led innovations in all its operational areas and became one of the most advanced port operators in the world through decades of research in enhancing operational efficiency. HPH is a greatly desired partner by companies throughout the transport and maritime community because it has an outstanding achievement in areas such as process re-engineering, IT infrastructure, and the design and implementation of automated systems.

HPH has contributed to making the transportation supply chain more efficient and made local manufacturers and import-export businesses more competitive worldwide by boosting the IT usage at its network of ports.

HPH storage yard inventory record is both precise and up-to-date because its RTGCs are provided with GPS sensors that enable us to track them using satellites.

In order to organize complex and time-critical operations, HPH automated terminals demand the combining of different complicated information systems. The IT-system sustains the whole container process, including quay planning,

reception of EDI messages, routing of automated guided vehicles (AVGs), stacking of containers and invoicing.

At the automated terminals waterside, the AVGs transport the containers between quay cranes and the automated stacking cranes (ASCs) at the container storage area while manned straddle carriers transport the containers between the ASCs and the trucks at the landside.

Corporate Social Responsibility:

HPH is committed to aiding the communities in which it operates, concentrating on a range of education programmes, social-service projects, medical initiatives, and environmental-protection efforts. The HPH Dock School programme is the one leading this community service and actively urges HPH member ports worldwide to support local schools.

Since it was first put into effect at Hong Kong International Terminals in 1992, the Dock School Programme has considerably developed. Today, the HPH Dock School Programme involves 20 local schools.

Company's Equipment:

Quay cranes are designed to offer quick loading and discharging of containers to/from large ocean vessels. They are built to be in charge of Panamax- and post-Panamax-size ships. In addition, the super-Post-Panamax Quay Crane has a 60-tonne, twin-lift capacity and 60 metres of boom length, allowing it to reach across 22 containers. Tandem-Lift quay cranes are able to lift two 40-foot containers. Other cranes are available such as Rail-Mounted Gantry Cranes, Rubber-Tyer Gantry Cranes (RTGC) and Electric Rubber-Tyer Gantry Cranes (E-RTGC), Automated Stacking Cranes (ASCs) and Automated Guided Vehicles (AGVs).

After reviewing briefly information on the company's profile for HPH, Alexandria International Container terminal (AICT) will be discussed in details.

Alexandria International Container Terminal (AICT)

AICT is a free zone company and operates two terminals at Alexandria Port and Dekheila Port, Egypt's main commercial ports. These terminals, located on the Mediterranean Sea, make both local and international trade activities easier as the country develops its industrial base. The two terminals are now ready for use as they have been completely modernised, both having a 12 metre depth alongside. In March 2007, Alexandria terminal started operations and Dekheila terminal followed three months later.

In 2005, Hutchison Port Holdings (HPH) agreed with an association of companies led by Alexandria Port Authority to build, operate and manage the two terminals at the main commercial ports of Egypt, Alexandria Port and Dekheila Port. These terminals, located on the Mediterranean Sea, make both local and international trade activities easier as the country develops its industrial base. AICT operations are run with a reasonably high level of efficiency, security and service as it endorses the global experience and the leading-edge technologies of the HPH Group. The first phase of developing AICT was completed in June 2007 (HPH, 2015).

A subsidiary of the multinational corporation Hutchison Whampoa Limited (HWL), Hutchison Port Holdings Group (HPH) is the leading port investor, developer and operator in the world, having interests in 23 countries throughout Asia, Africa, the Middle East, Europe, and the Americas. AICT is a member of HPH, one of the most innovative and technologically progressive port operators in the industry. Today, HPH has operating rights in 45 ports and is the owner of a number of transportation-related service companies (Hutchison-Whampoa, 2015).

Alexandria Port is considered one of the largest and most important ports in the Mediterranean. It's also one of the oldest, originally built around 2000 B.C. Due to its crucial location, the Port of Alexandria handles almost 60% of Egypt's foreign trade according to Alexandria Port Authority (APA) (AICT, 2013).

Terminals Location:

Figure 6.2 Terminals Location

Source: (AICT, 2013)

Terminal Layout

Figure 6.3 El Dekheila Terminal Layout

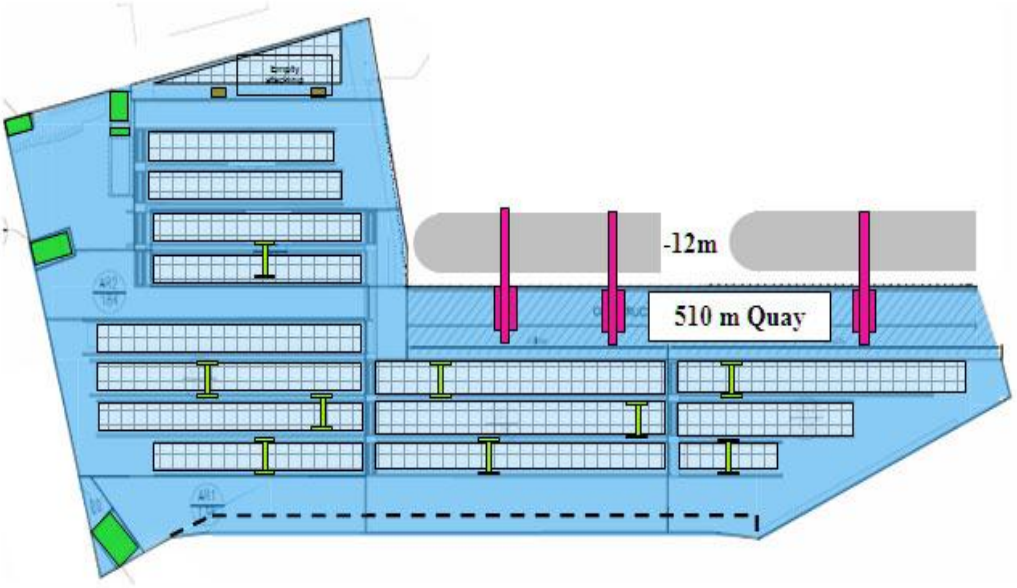
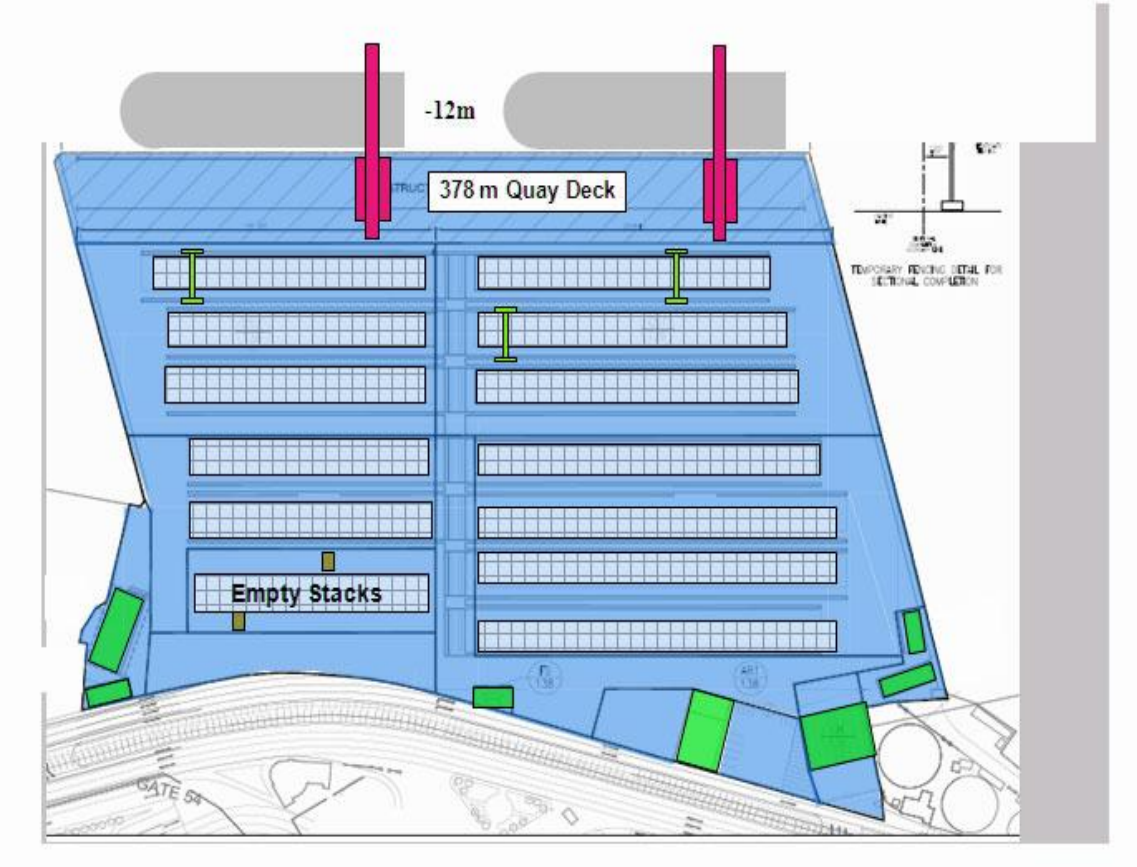


Figure 6.4 Alexandria Terminal Layout



Source (HPH, 2015)

AICT'S Terminals

AICT offers high productivity and vessel dispatch to container lines. In addition, full custom examination service for Container Yards (CY) or Container Freight Station (CFS) containers are provided to all shippers and consignees.

The terminals operate on a 24/7 basis. All terminal operations, customer support and instant tracking systems are covered through implementing the latest technologies and software applications to support end-to-end automated

systems. Most importantly, AICT system is integrated with Alexandria Port Authority (APA) and Customs Authority; this integration makes it easier for seamless handling of containers and cargo (AICT, 2013).

AICT'S Equipment:

The latest Post-Panamax- Gantry cranes, which can reach 17 rows across a vessel, are provided at terminals while Rubber-Tyred-Gantries (RTGs) can stack containers up to 6 tiers high. Reach stackers, empty handlers, internal movement trucks and forklifts are among the ancillary equipment that supports the fully integrated terminal operations.

AICT'S Technology:

A fully integrated software system (Container Terminal Management System - CTMS), which is used for Electronic Data Interchange (EDI); Baplie exchange; planning of vessel; yard and gate operations, is utilized to plan and implement terminal operations. A Wi-Fi network using Hand Held Terminals (HHT) and Vehicle Mounted Terminals (VMT) placed on RTG cranes, reach stackers, empty container handlers and internal trucks is used to manage tracking containers.

AICT use of the finest technology in all aspects of terminal management including support functions and the use of world class ERP applications. Moreover, AICT utilizes CCTV technology for security, surveillance and complete access control system (AICT, 2013).

AICT'S Services

AICT uses advanced technology and equipment to offer shipping lines fully integrated end-to-end container handling services, both standard and customized, such as shipping cargo that fills a full container load (FCL), less than a container load (LCL), and pallets. Furthermore, the company has several value added services, through the operation of two fully integrated terminals at Egypt's main commercial ports of Alexandria and El-Dekheila; AICT provides services

ranging from CFS operations and Reefer Operations to Out-of-Gauge cargo and also handles dangerous cargo and helps in One-Window-Customs. For both terminals, AICT provides *CFS operations* with competent and well-trained CFS work teams inside its two terminals. Also for *Reefer Operations***,** as there are enough reefer points in AICT terminals, AICT is regarded as the main gateway for Egypt's fresh products exports. AICT offers its valued customers 24 hours reefer monitoring services as well as other related services, such as Pre-Trip Inspection (PTI) & Pre-Cooling. In-addition, AICT can handle *Out-of-Gauge cargo* shipped on top decks with a maximum gross weight of 60 tons. Moreover, AICT can handle all *dangerous cargo* classes through its terminal except for the International Maritime Organization (IMO) 1&7. Finally, AICT provides its valuable customers with simple procedures through *one-window customs* clearance operations inside the terminals (AICT, 2013).

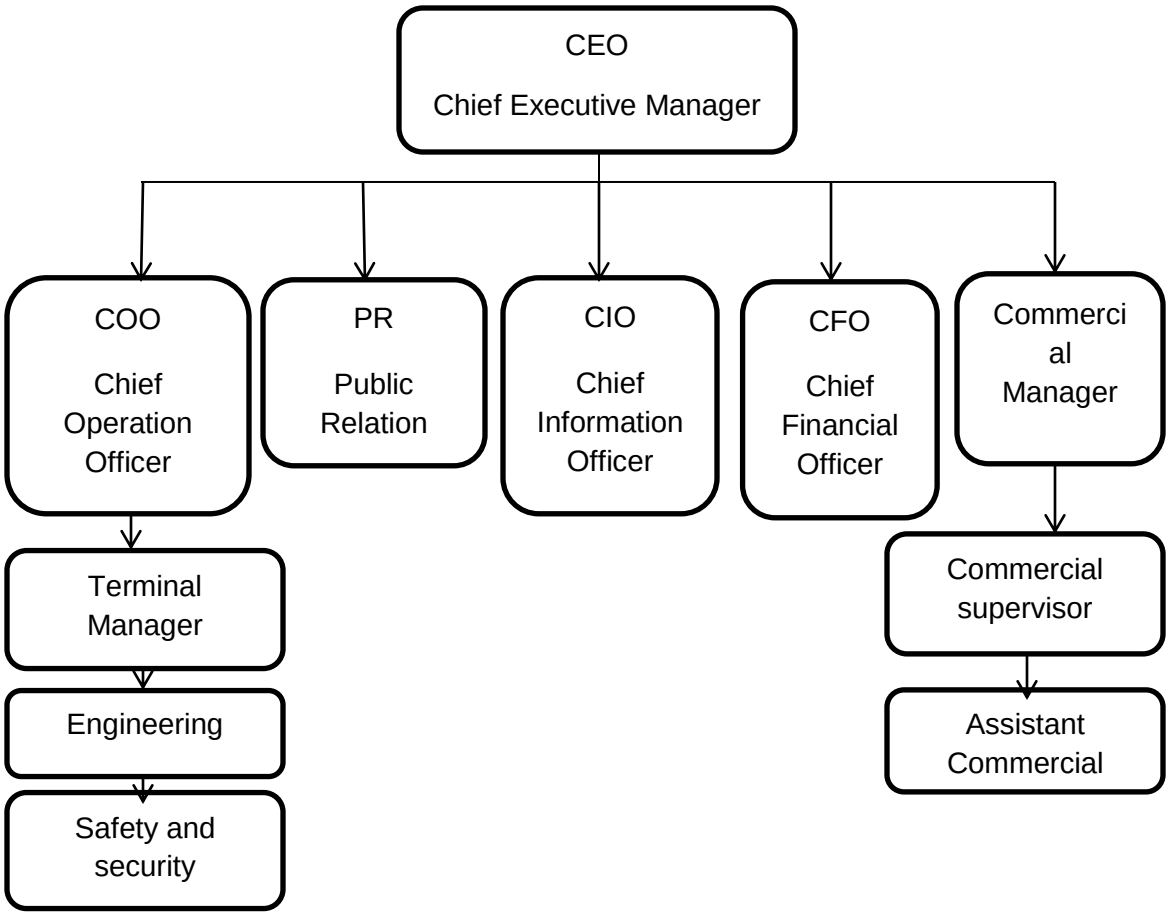
After reviewing the AICT Company in details, the interview analysis will be explained in the following section.

6.4 Case Study Analysis:

The following section will demonstrate the analysis for the each interview, followed by a conclusion to sum up the outcomes of the four interviews; whereby research findings are formulated. Then, a discussion comparing the case study outcomes with the Delphi’s results as referred to in chapter 4 (section 4.4) will be displayed to validate Delphi’s results .

The following chart (Figure 6.5) comprises the top management organizational chart for AICT to clarify the position of the targeted interviewees that also have been willing to be engaged in this study; thereafter, the reason behind choosing the interviewees will be discussed.

Figure 6.5 – AICT Organizational structure:



(Source: adapted from the case study company)

To get the detailed and rich data that can serve this research, appropriate selection was done in determining the interviewee. As noticed in the above figure, AICT has five main departments. The commercial and operation department are the targeted departments since the main terminal operations take place. Managers and senior managers of those departments are the one who understand and have good knowledge of the day to day operations of the company's terminal management.

The interviews were conducted with four interviewees sequentially, Operation Planning Supervisor (Control Room Supervisor), Operation Section Head (Man power), Commercial Manager and Commercial Supervisor. The operational

planning supervisor and the operation section head both of them report their work directly to the Terminal manager for evaluation and analysis.

6.4.1 First Interviewee (Operation Planning Supervisor)

The first interviewee is responsible for vessel planning and yard planning. The interviewee stressed the importance of dry ports as he believed that they are the main suitable solution for the capacity problem at container terminals. Also, he agreed that dry ports help terminal operators to become more successful in regional competition as dry ports will have a lower distribution cost with an improved capacity. Therefore, they are tools for terminal operators for trade development and ways to extend their cargo base, by increasing imports and exports which will support regional and international trade. He also added that dry ports can help to maintain maritime growth and global sustainability through increasing container terminal handling productivity and efficiency, lowering its capacity and increasing container terminal handling throughput. Consequently, dry ports have a positive effect on trade and transport.

However, the interviewee confirmed that private companies are not a guarantee for efficiency and effectiveness of terminals operation; there are a lot of examples worldwide. For the governmental regulations and legislation that support, control and govern investment policy and decisions in new dry ports, the Ministry of Transport and the Ministry of Investment have to develop strategies and policies to legalize the land use with some financial incentives to terminal operators. Furthermore, he did not agree that dry port policies should be governed by terminal operators within a Governance framework “under the supervision of the Ministry of Transport on condition that there will be a list of regulations and policies that controls the dry port”.

On the other hand, when talking about environmental regulations, the interviewee thought that they can be one of the factors that must be involved in selecting port location but not one of the main factors. Although, he agreed that the size of dry ports is one of the main factors that must be considered in establishing dry ports

as the size is crucial for future expansion and development. However, he considered that dry ports are locations actively developed to provide the logistics services within the supply chain management process. In addition, the interviewee was strongly convinced that rail transport systems should be constructed for long distances in order to achieve a successful dry port system. He accepted that dry ports require safety and security measures the same as marine ports do. From his point of view, throughput and volume are the key indicators that have the greatest impact on supporting policy decisions in dry ports. Finally, he concluded that the dry port concept is a must now for some Egyptian ports such as the port of Alexandria as it has been working on overcapacity for years and it is the main gate for the majority of the domestic cargoes.

6.4.2 Second interviewee: (Operations Section Head)

The second interviewee is responsible for running day to day operations and following up equipment's maintenance. He also agreed that dry ports are the most suitable solution for the capacity problem at container terminals because shifting overcapacity to dry ports will create space in port areas, and so port congestion can be reduced. Consequently, port terminals might be able to receive a higher volume of containers and will also have a lower distribution cost. Therefore, they will support regional and international trade. Moreover, increasing container terminal handling throughput and productivity will definitely result in maintaining maritime growth and global sustainability, which means that dry ports positively affect trade and maritime transport.

In addition, there are no two identical ports; there are successful examples for terminals operated by private companies, ports operated by public ports and others operated by a (PPP) Public Private Partnership. Therefore, it is not necessarily a guarantee for efficiency and effectiveness if all terminals are operated by private companies. However, a list of regulations and policies that supports, controls and governs investment policy and decisions in new dry ports should be developed. There are not any policies or regulations regarding dry

port decisions in Egypt. These decisions were totally controlled by port operators, according to the terminal operator's needs. Meanwhile, Ministry of Transport supervision of terminal operators is important as long as we have no list of policies or regulations regarding this issue.

Again the interviewee stressed that, unfortunately, there are no environmental regulations in Egypt as their branches in other countries have. He explained that the company's policies towards environmental perspective are that the dangerous cargo (IMO Containers) is not allowed to be shifted to dry ports. Only general containers are allowed to be transferred to dry ports. Another important factor is the size of the dry port. It depends on the amount of extra or overcapacity the company suffers from. Also, the forecasting for new productivity for the following years may affect the size of the dry port since future expansions and development may take place. Moreover, dry ports are locations actively developed to ease the flow within the supply chain management process.

When the discussion moved towards rail transportation and its importance for the dry port system, the interviewee highly recommended rail, especially for long distances. Nevertheless, in some countries it will be difficult for a rail system to be constructed due to their infrastructure. For security requirements, dry ports are facing the same procedures as marine ports, which mean that they should have the same safety and security measures as ports.

Throughput, location, safety and security are the key factors that have the greatest impact on supporting policy decisions in dry ports. Finally, the interviewee stressed the importance of the dry port solution nowadays. Dry ports have several advantages among other solutions, and this opinion is based on the company's experience and real situations.

6.4.3 Third interviewee: (Commercial Manager)

The third interviewee is responsible of relations with shipping lines and renewing service with them. He assured the importance for dry ports in solving the overcapacity problem. Dry ports have lots of advantages. He described the dry

ports concept as shifting overcapacity from marine ports to dry ports which will reduce terminal congestion and also reduce port traffic. Thus, a terminal will have more available space to accept the excessive demand which helps terminal operators to become more successful in regional competition. Consequently, it leads to maritime growth and maintaining market share and global sustainability. In addition, dry ports provide logistics services between marine ports and the hinterland through transportation, distribution, assembling containers, storing, etc. Conclusively, dry ports have a positive effect on trade and maritime transport.

The interviewee considered private companies to be a guarantee for efficiency and effectiveness of the operated terminal(s) because of their improved management skills, seeking high profit with fewer employees and reduced bureaucracy. While public companies are so bureaucratic; decision making is not easy, hence employees become afraid of being abused for corruption. In addition, public companies in Egypt hire lots of employees for their social relations not for their qualifications. Most of them are relatives of managers or board members even if the company does not want this number of employees and consequently this affects company profits. As a proof, major terminal operators worldwide are private companies such as HPH, PSA, APM Terminals, DP World, ICTSI, ..etc. His point of view on investment policy and decisions in new dry ports should be left to terminal operators who are the main decision makers since the free market concept should be applied. But, definitely there are some requirements for establishing a new dry port such as the height of the dry port, water, electricity, scale, etc. and also some institutional approvals should be obtained in order to have the legality to work, such as: health, environmental authorities and the district council. He added that AICT is planning to rent a new dry port near to the port; containers will be shifted through barges. The dry port location and size and everything are agreed upon by the company’s CEO but are just waiting for these approvals.

The interviewee believed that size, location and environmental regulations are main factors which should be considered when establishing a new dry port. Dry port size must serve the terminal overcapacity. Therefore, size should be carefully determined. Also, great caution should be taken for the dry port location as it greatly affects the company's decisions. For example: Last year the CEO refused a suggested dry port for the company because it was near a sewage treatment plant, and this is against HPH environmental regulations.

He was confident about using rail transportation for long distances rather than road transport for a successful dry port system and highlighted barge transportation. Moreover, he stressed that dry ports require safety and security measures the same as marine ports. He then gave an example of a company's dry port that has a security company responsible having CCTV, surveillance, complete access control system and all security requirements.

The key factors (indicators) that have the greatest impact on supporting policy decisions in dry ports from his point of view are financial indicators in which cost and revenue should be calculated. Location of the new dry port, the distance to and from the port and the distance to industrial areas also, should be considered. And port utilization factors including trade growth and future expansion should be determined. Finally, dry ports are very important nowadays and Egyptian ports finally realized the importance of this concept. AICT is a good example; the company's new dry port saves the company from losing demand from major clients as Maersk Sea Land. And now we are heading a new dry port due trade growth. In conclusion, companies might lose business if they did not find the right solution.

6.4.4 Fourth interviewee: (Commercial supervisor)

The fourth interviewee deals with end-users and customers, he is responsible for ensuring and maintaining the service level and report to the company's commercial manager. He considered dry ports as an excellent solution for the terminal capacity problem, as the main issue is the long waiting/delay times for

cargo to be released from ports, due to long clearance process. Dry ports will shift a large amount of cargo directly to its place, giving available space at yards and terminals. Consequently, space for accepting new vessels will be available and the terminal's throughput will increase. As a result, dry ports can considerably help terminal operators to successfully strive in regional competition. Moreover, since dry ports add value to ports and terminals, increase their efficiency, maintain their market place and help in accepting the extra demand on them, dry ports positively affect trade and the maritime transport industry and increase maritime growth. Moreover, dry ports can provide an extra advantage for the logistic chain by easing the flow between ports and hinterland and may serve a certain industrial area, and in this case it will be similar to a distribution centre for this area.

The interviewee clarified that there are actual cases in the world where privately run terminals are drowning in the same problems that overwhelm the public terminals, so private companies are not a guarantee for efficiency.

He indicated that a list of regulations should be settled clearly; not everyone who wants to own a piece of land can take it and neglect the surroundings. Rules and legislation and approvals from responsible authorities and institutions should govern this issue. In addition, there should be a higher authority that governs the terminals and ports, which is the Ministry of Transport but only for the strategic issues not the daily operations.

The interviewee illustrated the importance of environmental regulations as a main factor affecting dry port location through some examples; if the dry port location is near urban areas, it is forbidden to send any container that may pollute the environment. Also, if the dry port serves a certain industrial area, a certain type of cargo will be transported through this route. Similarly, if the dry port serves a certain industrial sector, for example frozen food, this means that before that location is selected, the essential electricity must be made sure to be available in that expected place in order to serve the reefer containers. On the other hand, the size of dry port(s) is also one of the main factors that must be considered when establishing dry ports. Because the main issue of dry ports is the capacity

of cargo or the increase in demand. It is clear that the size of dry ports should serve the marine port's overcapacity and future expansion.

As for rail transportation, it is more feasible for long distances; rail transport has several advantages as it is fast, safe and with less delays to destination. Furthermore, dry ports will require safety and security measures but in case dry ports serve a certain type of cargo, there is no need for all the precautions required at marine ports for all types of cargo.

The interviewee also highlighted some key factors (indicators) that have the greatest impact on supporting policy decisions in dry ports, which are: location (distance to and from the port and also, the distance to industrial areas), laws and regulations, capacity and throughput. To conclude, dry ports nowadays have become a more significant and promising solution for capacity problems. Dry ports largely share in the economic growth, in developing marine ports and in increasing the marine ports' efficiency. Ports that have dry port(s) have a powerful status in the competition.

6.4.5 Case Study Findings:

The four interviewees believed that dry ports are the most suitable solution for the capacity problem at container terminals by shifting overcapacity to dry ports; hence, space in marine port areas will be available, and port congestion can be reduced. Therefore, dry ports help terminal operators to become more successful in regional competition by accepting the excessive demand since port terminals might be able to receive a higher volume of containers. Consequently, this leads to maritime growth and maintaining market share and global sustainability. In addition, dry ports provide logistics services between marine ports and the hinterland through the services and the activities offered such as transportation, distribution, assembling containers, storing, etc. Conclusively, dry ports have a positive effect on trade and maritime transport.

The interviewees confirmed that it is not necessarily a guarantee for efficiency and effectiveness if all terminals worldwide are operated by private companies

because there are several examples of successful terminals owned by either public or private companies, or even PPP. However, the case might be different in Egypt; most of the successful examples are related to terminals owned by private companies.

It was agreed that a list of regulations and policies that governs investment policy and decisions in new dry ports should be developed. Thus, the Ministry of Transport supervision on terminal operators is important since there are no clear policies or regulations regarding dry port decisions in Egypt. These decisions are under the control of terminal operators, according to terminals' needs. Meanwhile, some institutional approvals should be obtained in order to have the legality to establish new dry ports.

Size, location and environmental regulations were considered to be factors that affect policy decisions when planning for a new dry port. Also, the interviewees are strongly convinced that rail transport systems should be constructed for long distances in order to achieve a successful dry port system. For security requirements, it was confirmed that dry ports have the same environment as marine ports; thus, the same safety and security measures should be settled.

Last but not least, to sum up the key factors or indicators that have the greatest impact on policy decisions for establishing a new dry port as received from the interviewees:

- Throughput and volumes (which affect the size of dry port)
- Financial indicator (revenue and cost of establishing a new dry port)
- Location (distance to and from the marine port and also, the distance to industrial areas)
- Port utilization factor (trade growth and future expansion)
- Safety and security requirements.

In conclusion, the interviewees focused on dry ports' importance nowadays. Dry ports have several advantages among other solutions. AICT is a good example

since the company suffered from an overcapacity problem during recent years. Meanwhile, Alexandria port is the main gate for the majority of the domestic cargoes. Therefore, the dry port is a suitable solution that can help companies to cope with trade growth and maintain its position in the market.

After analysing the case study, a comparison between the Delphi results (11 consensuses) and the case study findings should be reviewed to assess the validity of the case study.

6.5 Results validation:

The following table indicates the approvals and validity of the Delphi results through illustrating case study findings.

Table 6.2 Comparing Delphi results with case study findings

Delphi statements results	Case study findings
Investing in dry ports is the most suitable solution for capacity problem and reducing port congestion (agreement of 81.82%, Round 1)	It was strongly approved since overcapacity will be shifted to dry ports.
Dry ports help terminal operators to become more successful in regional competition (agreement of 87.82%, Round 1).	It was confirmed as terminals can accept higher volume of containers.
Government should provide a list of regulations and legislation that supports, controls and governs investment policy and decisions in new dry ports (agreement of 87.88%, Round 1).	The importance of this issue was approved and it should be explicitly developed especially in Egypt since there are no clear policies or regulations regarding dry port decisions.
Dry port policies should be governed by terminal operators within Governance framework “under the supervision of ministry of transport” (agreement of 80%,	The interviewees agreed on the statement and stressed about the importance to obtain some institutional approvals such as: health, environmental authorities and

Round 2).	the district council.
Dry ports can help to maintain maritime growth and global sustainability (agreement of 78.79%, Round 1).	Maritime growth and maintaining market share and global sustainability is a subsequent result of establishing dry ports.
One of the main factors that must be involved in selecting port location is environmental regulations (agreement 88%, Round 2).	Is was agreed that environmental regulations were considered as factors that affect policy decisions when planning for a new dry port
The size of dry ports is one of the main factors that must be considered in establishing dry ports (agreement of 76%, Round 2).	It was agreed that a dry port is an important factor as size must serve the terminal overcapacity and future expansion.
Dry ports are very important to provide the logistics services between marine ports and the hinterland (agreement of 83.33%, Round 2).	The statement approved the importance of dry ports to provide the logistics services between marine ports and the hinterland through transportation, distribution, assembling containers, storing, etc.
Rail transportation is more feasible in long distance than road transport be constructed for a successful dry port system (agreement of 88%, Round 2).	It was strongly convinced that rail transport systems should be constructed for long distances in order to achieve a successful dry port system. Nevertheless, in some countries it will be difficult for a rail system to be constructed due to their infrastructure. So, road transport or barges can take the major place instead.
Dry ports requires safety and security measures the same or additional to as marine ports (agreement of 80%, Round 2).	It was confirmed that dry ports are positioned in the same environment as marine ports and thus the same safety and security measures should be settled.

The remaining Delphi statement achieved only 68% agreement "*It is not necessarily a guarantee for efficiency and effectiveness if all terminals be operated by private companies*". This statement did not reach a consensus.

Some experts consider private companies are more efficient, others mention successful examples for terminals owned by public government and PPP. However in Egypt, increased efficiency was considered more likely in the private companies according to the case study findings and also a successful example of public and PPP worldwide was mentioned.

The following chapter will presents the overall conclusions derived from this research, and recommendations for future research. Also, the fulfilment of the research aim and objectives will be shown through reviewing the research processes.

CHAPTER SEVEN - CONCLUSION AND RECOMMENDATIONS FOR FUTURE WORK

7.1 Introduction

This chapter presents the conclusions this research reached and the recommendations for further research. At first, it discusses how the research objectives were fulfilled through reviewing the research processes that have been undertaken to address these objectives. Then, it demonstrates the research contributions to theory and practice. Finally, it identifies the limitations of the study, upon which areas for further research are proposed.

The rest of this chapter is organised as follows: section 7.2 assesses the fulfilment of the research objectives, section 7.3 discusses the research contributions to knowledge, section 7.4 presents the research limitations, and finally section 7.5 proposes recommendations for future research.

7.2 Realisation of the research aim and objectives

The aim of this research is to provide port planners, policy makers, and investors with a structured framework to adapt the right policy decisions for Dry Port location and capacity (section 1.2). To achieve this aim, five research objectives has been formulated. Also, the research methodology stated in chapter 3 has successfully addressed these objectives as illustrated in table 3.2. However, the following text will explain each research objective in details.

Research objective 1: To assess the current status of the global Egyptian container sector.

This objective has been addressed by a review of published research concerning the current status of the global container terminals where overcapacity exists. The review of literature reveals that recent developments in world container transportation have increased the demand for more terminal capacity to

accommodate bigger numbers of containers and to attract more traffic. Consequently, it becomes clear that the capacity problem is a major drawback in terminal operations that will reduce their efficiency and their market place.

Therefore, the following objective is detecting the main capacity problems of container terminals and then reviewing the suggested solutions for these problems.

Research objective 2: To investigate and identify the main capacity problems of Egyptian container terminals with a view to reviewing the suggested solutions; the need for Dry Ports.

The main capacity problem and its suggested solution were comprehensively reviewed in chapter two sections 2.2 and 2.3. Dry Ports were one of the proposed solutions that this research focused on. Also, Dry Ports were discussed in detail in section 2.4 where the importance and the reason behind implementing such a solution were clarified.

The literature highlighted the need for suitable solutions for capacity problem. As shown in the literature, there are six suggested solutions; each one has its advantages and disadvantages. Dry Ports were the most suitable solution as suggested in this research, and the reasons behind choosing Dry Ports were discussed. It is well known that there are no two identical ports, so it is not easy to find a solution that fits all ports or terminals. However, this research tries to develop a structured framework to be provided as a decision support tool for policies regarding Dry Ports as one of the most suitable solutions suggested for this problem.

Research objective 3: To identify policies for providing optimal location and capacity decisions for container terminals.

A limited number of studies have been conducted to investigate Dry Port policies. However, it is possible to identify a series of existing policies from the literature review on the basis of insights developed from the review of published research

on optimal location and capacity decisions for container terminals. On the other hand, going through the interviews, it was found that dry port policies are not well clarified in Egypt. Those involved understood how policy-making might work and that they have to get some approvals from ministry of transport and some other institutions but there is no clear list of regulations and legislation that are available to any one regarding this issue as mentioned in the case study findings in section 6.4.5.

The Delphi technique has been proposed to assess how port and terminal operators can enhance policy decisions and that is proposed in the following objective.

Research objective 4: To develop a technique that supports assessing container terminal location and capacity policy decisions with particular reference to Dry Ports.

The Delphi technique was chosen as a qualitative method for location and capacity policy decision making approach and the validation of selecting this technique was achieved by conducting a case study on AICT in Egypt referred to in the next objective. It was reviewed in section 2.4 that many researchers tried to solve Dry Port location and capacity problem by using mathematical models. Some of them use quantitative methods and others use mixed methods, but they all focused in their methodology on a similar modelling approach. In this research, qualitative methodology using Delphi technique was applied. Taking from the Delphi types detailed in section 3.1.1, decision Delphi was selected to be the tool that should assist port operators (policy makers) in deciding the location and the capacity policies when investing in Dry Ports.

Applying such a technique enables experts experience to be shared and modifying statements and re-asking to reach a final exact answer that could be generalized. Delphi comprised of 12 designed statements. After two rounds of Delphi, a total of 11 consensuses were achieved between low, medium and high consensus. Analysis of the experts' panel opinions was discussed in detail. To

test and validate these results, the case study has been conducted with the following objective.

Research objective 5: To apply principles established using a case study on Alexandria International Container terminal.

To demonstrate the applicability of the proposed procedure through conducting a case study on a Container terminal on one of the main Egyptian ports, a case study on Alexandria International Container Terminal (AICT) was conducted to demonstrate the applicability of the proposed research procedure and to test it prior developed theoretical proposition. The proposed procedure was applied to the case study through the following sequences: an overview of AICT Company's information was displayed, then case study nominations were screened and the appropriate case was selected, and finally the case study protocol was developed.

The case study comprises four interviews. Survey and other tools were neglected since the objective behind this case is to validate Delphi's results on such strategic decisions that need high level management. Therefore, face to face interviews were most suitable for the case study and to sort out some real examples about their policy decisions. In addition, choosing a company complaining about high terminal capacity, the same research problem, served this research through understanding the research phenomenon in a real-life context and challenging the research proposition through real-life situations and issues.

The previous discussion demonstrated how the research methodology and processes were undertaken to achieve the research objectives, and as a result the research aim was fulfilled. The next section presents the research contributions to theory and practice.

7.3 Contribution to Knowledge

This research provides an original contribution to knowledge by creating a structured decision support framework to adapt the right policy decisions for Dry Port location and capacity. The results and the findings from this framework can be used as a very helpful tool for port operators when deciding to invest in Dry Ports. By referring to research findings, port and terminals operators can safeguard their policy decisions toward this issue from a strategic failure.

Another contribution to this research, as reviewed in section 2.5, is that earlier researchers commonly focused on solving capacity and location problems using mathematical models; this research attempts to apply a different methodology by using the Delphi Technique. The Delphi technique is a qualitative approach and was applied to assess how port operators can take better policy decisions about investing Dry Ports such as the number of depots the terminal may need, the size of each depot as well as the location and distance between the Dry Port and the marine port or terminal. This indicates maybe a bit more about the value of qualitative Delphi for policy research.

Moreover, a case study has been conducted to validate Delphi results and to guarantee that it can be applicable in most terminals and can contribute in the improvement of the maritime industry.

7.4 Research limitations

As shown in the previous section, this research has valuably contributed to knowledge; however, the application of the research procedure has the following limitations:

First of all, the panel members who participated in the Delphi study were chosen from 2 segments, 16 academic experts who are always searching for new and better solutions and 17 practitioners who are facing the problem in their daily work. Practitioners include members who work in port operations, shipping lines, marine consultant and freight forwarders. Most of these members are located in

Egypt while academic members are all worldwide. The location limitation appeared here; these practitioners are giving their opinions according to the Egyptian situation that may vary considerably in different countries. The case study is chosen for validating the Delphi's results but if it is applied to practitioners in other countries, it may vary. Therefore, the quality of the panel members could be better if the practical respondents ware likewise worldwide.

Second, a population of 33 experts out of 130 requests participated in the rounds; only 33 experts might not represent the majority of the field, although this is an acceptable number of experts for running the Delphi from a theoretical point of view as referred to in section 5.1.1. In addition, the number has been reduced to 25 members in the second round. Sending reminders and follow-ups via email was decelerating the process. Also, it takes weeks between rounds itself.

Third, according to HPH confidentiality, it is prohibited for employees to share any numbers or printed data regarding their throughput. During the interview process, the interviewees have raised the issue for the need to have Dry Ports and that their terminal capacity is exceeding 85%. Nevertheless, they are not authorized to provide documents that support this percentage and similarly support this research.

Last but not least, the case study conducted comprises four interviews. As referred to in the organizational structure in section 6.4, there are four managers under the board and section heads and supervisors come under them. Only four interviewees were accessed to conduct the case. To overcome this limitation, I tried to interview people from different departments who vary in hierarchy within the upper level management. As mentioned before, the decision makers are generated from the top management and that is why lower level management would not be helpful for this research as it seeks strategic decisions in order to guarantee the quality of information. However, it would be better if all managers are questioned.

In order to address these limitations, recommendations for future research are discussed in the following section.

7.5 Recommendations for future work

1. The conducted case study was on an Egyptian container terminal; future work should consider applying on container terminal in different countries. What might suit the Egyptian terminal situation might not suit other terminals. A comparison could be made between result validation on Egypt and other countries, or between public terminals and private ones.

2. The expert panel that contributed to the Delphi rounds comprised 33 respondents out of a total of 130 requests, and then 25 of whom continued to respond in the second round. Future research should try a new system or other techniques which can help in getting a larger number of respondents. Consequently, more opinions will be received with much more data analysis in a shorter time which may affect the results and the research findings.

3. This research finding could be applied or repeated using the same approach but in a different sector other than container terminals, for example bulk terminals or general cargo terminals. Also, a comparison could be made between Delphi results regarding container terminals and the new research to add a valuable knowledge in this area.

4. This research was seeking policy decisions regarding dry port location and capacity. Further research should investigate dry port policy decisions.

5. More complicated decision variables and more objectives could be integrated in an enhanced version of the proposed framework.

In summary, this research tackled an important area in the field of port and terminal management through focusing on studying the dry port as a suggested solution for terminals over capacity problem, and then investigating location and capacity policy decisions. The research study makes an original contribution in the direction of identifying these policy decisions using the Delphi Technique.

The research offered recommendations for further research in order to address the limitations faced in this study and also in order to urge other researchers to conduct more research in the area of dry port policies.

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APPENDIX 1

First Letter/Email sent to Experts

Dear Sir/Madam,

I'm sending this email to you to participate in my online study of Maritime field, Ports, Dry ports and the Shipping and Transport industry.

A brief explanation: I am a doctoral candidate at The University of Plymouth, my topic is: An Analysis of Policy Making for Dry Port Location and Capacity; A Case study on Alexandria (Egypt) and as part of my thesis, I am looking for experts all over the world to provide insights into how port planners, policy makers, and investors can adapt the right policy decisions for Dry Port location and capacity and to do this using the Delphi Technique..

I have listed an overview of the study below:

1. My project is a Delphi Study. Delphi is similar to a focus group, except that it is conducted anonymously, and over the Internet. I am hoping to understand the insights of experts. My project is specifically aimed at getting information from experts in the field.
2. I am defining 'expert' as someone who has expertise in the areas listed previously.
3. I am estimating the project will require one hour over 3 month period.

There are three rounds of online questionnaires to complete, with about a 10-14 day break in between each. The study would begin within a few days after you consent to take part.

This study is completely voluntary and confidential. If you don't want to participate, please feel welcome to let me know, and you will not be contacted

further. I will also keep your decision to participate, not participate, or to discontinue the study entirely confidential.

If you are willing to participate, I need to let you know the following confidentiality safeguards and risks of the study, as determined by me and The University of Plymouth.

1. You will be asked to provide information over the Internet. It is possible that information provided over the Internet may be viewed by individuals who are not on my research team. I will use a secure website for the study questions.
2. I will use a study number and not your name to identify your responses. I will not collect your name or use any identifying information about you in the online study.
3. All information I collect from you will be kept in password-protected computer files.
4. After the study is completed, I will also ask if you would like your name included as part of the expert panel. These would be the only times your name would be identified as a participant.

If you have any questions about the research study itself, please contact me at aya.elgarhy@plymouth.ac.uk. You may also contact my research supervisor, Professor Michael Roe, at M.Roe@plymouth.ac.uk

I would appreciate it greatly if you could confirm your decision to participate in my research.
Thank you very much for your consideration of my study. I'm looking forward to learning more about your expertise.

Sincerely,
Aya Elgarhy
Doctoral candidate
The University of Plymouth

APPENDIX 2

Demographic Information

a. Date:

b. Age range: 30-34 35-44 45-54 55-64 64-70

c. Sex: Male Female

d. Nationality:

e. Position/title:

f. Total number of years worked:

9. Education/Highest degree earned to date:

Bachelor's degree/area of study:

Master's degree/area of study:

Doctoral degree/area of study:

h. Preferred email address for this study:

i. Preferred telephone:

j. Mailing address:

APPENDIX 3

Round one feedback

PLEASE NOTE THE FOLLOWING:

· There are a total of 7 questions in Round 2 of the Delphi Study Survey.

· Questions that achieved a result consensus of over 70% (from Round 1) are not included in the second round.

· Candidates are asked to read the feedback provided from Delphi Round 1 statements (in page 2) before proceeding to answer the Delphi Round 2 statements.

Total Survey Response Round 1

#	Delphi Round 1	A	DA	NS	Total	%
Q1	"Container Terminal Capacity (CTC) has become a major problem nowadays in many ports around the world". Do you think investing in dry ports is the most suitable solution for capacity problem and reducing port congestion?	27	4	2	33	81.82
Q2	Can dry ports help terminal operators to become more successful in regional competition?	29	2	2	33	87.88
Q3	Is it better that all terminals be operated by private companies rather than the public state?	13	17	3	33	39.39
Q4	Is it better to provide a list of regulations and legislation by government that supports, controls and governs investment policy and decisions in new dry ports?	29	2	2	33	87.88
Q5	Is it preferable that dry port policies be	18	6	9	33	54.55

	governed by the ministry of transport or by terminal operators?					
Q6	Can dry ports help to maintain maritime growth and global sustainability?	26	1	6	33	78.79
Q7	Does environmental regulation affect policy decisions regarding dry port location?	21	8	4	33	63.64
Q8	Do terminal operators who decide policies take account of the size of dry port(s)?	19	5	9	33	57.58
Q9	Are dry ports becoming much more important in increasing the terminal processes of logistics within ports and between ports and the hinterland?	21	3	9	33	63.64
Q10	Should rail transportation be constructed for a successful dry port system or is road access alone adequate?	22	6	5	33	66.67
Q11	Do you think the development of dry ports provides serious issues port safety and security?	16	9	6	31	51.61
Q12	Do you believe that dry ports have a positive effect on trade and maritime transport?	31	0	2	33	93.94

(N.b. note: A = Agree, DA = Disagree, NS = Not Sure)

Round 1 of the Delphi survey therefore obtained a total of five consensuses. Questions were modified according to your valuable comments and then round 2 were developed.

Thank you very much on your co-operation…….

APPENDIX 4

Semi structured interview protocol

Title

“Identify the main policies for providing optimal location and capacity decisions for container terminals**”**

Purpose

Investigate and identify the main capacity problems of Egyptian container terminals (at Alexandria International Container Terminals as a sample) with a view to reviewing the suggested solutions and whether dry port is one of the suitable solutions or not. Accordingly, policies for providing optimal location and capacity decisions for container terminals should be identified.

Participants

The interview will be conducted with the managers of main departments and divisions in the company:

- Operation planning supervisor
- Operation Section Head
- Commercial manager
- Commercial supervisor

Procedures

Semi-structured interview will be conducted with the managers of main departments and divisions in the company.

Introduction

Thank you for coming. Our interview today is to investigate and identify the main capacity problems of Egyptian container terminals with a view to reviewing the suggested solutions. In addition, identify policies for providing optimal location

and capacity decisions for container terminals in Egypt. The discussion will take approximately 30 minutes. Anything you say here will be held in strict confidence.

Questions

The questions are as follows:

1. “Container Terminal Capacity (CTC) has become a major problem nowadays in many ports around the world”. Do you think investing in dry ports is the most suitable solution for capacity problem and reducing port congestion?
2. Can dry ports help terminal operators to become more successful in regional competition?
3. “It is not necessarily a guarantee for efficiency and effectiveness if all terminals be operated by private companies” comment on this statement.
4. Should government provide a list of regulations and legislation that supports, controls and governs investment policy and decisions in new dry ports?
5. Do you agree with dry port policies should be governed by terminal operators within a Governance framework “under the supervision of ministry of transport”?
6. Can dry ports help to maintain maritime growth and global sustainability?
7. Do you think that one of the main factors that must be involved in selecting port location is environmental regulations?
8. Do you agree that the size of dry ports is one of the main factors that must be considered in establishing dry ports?
9. Do you think dry ports are very important to provide the logistics services between marine ports and the hinterland?
10. Do you believe that rail transportation is more feasible long distance than road transport and should be constructed for a successful dry port system?
11. Do you have confidence that dry ports require safety and security measures the same or additional to as marine ports?
12. Do you believe that dry ports have a positive effect on trade and maritime transport?
13. What are the key factors (indicators) that have the greatest impact on supporting policy decision in dry ports?
14. Do you have any additional information that you think it should be added?

Conclusion

What I have heard you saying ……., did I summaries your words correctly? Is there is anything you would like to add or amend?

Thank you for your attending and participation.