EFFICIENCY ANALYSIS OF CONTAINER PORTS IN THE MIDDLE EASTERN REGION

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This research work specially dedicated to
my dearest parents, dearest brothers and sisters,
my beloved wife, and loving children.

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ABSTRACT

More than 80 percent of merchandise traded by volume is seaborne. Consequently, container ports become the most important gateways for international trade, which constitute a key element for increasing trade and economic growth rate of countries. Therefore, improving container ports efficiency is critical as it could boost a country's competitiveness and economy. In this context, an increasing number of studies have been conducted on improving the efficiency of container ports. However, most of these studies have focused on measuring efficiency using operational variables. Little attention has been given to exogenous factors that could influence container ports efficiency. Consequently, the knowledge on the relationship between operational efficiency and these exogenous factors is limited. Also, most of these studies focused on container ports in developed countries, while none so far has examined the influence of exogenous factors on the efficiency of container ports in developing countries such as the Middle Eastern region. This research, therefore, aims to determine and evaluate the influence of exogenous factors on the efficiency of container ports in the Middle East region. Two-stage methodological approach was used. First, Data Envelopment Analysis (DEA) measures the technical efficiency of 12 container ports in the Middle Eastern region. Second, Ordinary Least Squares (OLS) regression examines the effect of exogenous factors on the technical efficiency derived from the first stage. MATLAB R2013a software validated by DEA frontier with Excel solver was used to measure the technical efficiency in the first stage. Then, SPSS software was used to identify the significant and non-significant factors in the second stage. Findings revealed that, from 12 container ports, only 3 (25%) container ports were efficient, while the remaining 9 (75%) were inefficient. Furthermore, result showed that the value of R^2 for the OLS was 0.652, which suggests that the model is good as 65.2% of the variance in the dependent variable (container port efficiency) was explained by the regression model. In addition, the *F*-test indicates that the model as a whole significantly improved the ability to predict the outcome variable ($p = 0.031 < 0.05$). The result further showed that liner shipping connectivity is the only factor making a significant contribution to the prediction of the efficiency of container ports, while other factors were insignificant. The results showed that majority of container ports in the Middle Eastern region do not use the available resources to achieve maximum efficiency. This research concluded that the container ports authority should conduct yearly efficiency evaluation to compete globally, improve resources utilisation, and enhance their local economy. Also, any evaluation of efficiency should consider the effect of exogenous factors.

ABSTRAK

Lebih daripada 80 peratus perdagangan barangan mengikut isipadu adalah melalui laut. Sehubungan itu, pelabuhan kontena menjadi pintu masuk terpenting perdagangan antarabangsa, yang merupakan elemen utama meningkatkan perdagangan dan kadar pertumbuhan ekonomi negara. Oleh itu, meningkatkan kecekapan pelabuhan kontena adalah kritikal kerana ia dapat meningkatkan daya saing dan ekonomi sesebuah negara. Dalam konteks ini, semakin banyak kajian dijalankan untuk meningkatkan kecekapan pelabuhan kontena. Namun, kebanyakan kajian memberi fokus kepada pengukuran kecekapan menggunakan pembolehubah operasi. Kurang perhatian diberikan kepada faktor luaran yang dapat mempengaruhi kecekapan pelabuhan kontena. Akibatnya, pengetahuan mengenai perkaitan diantara kecekapan operasi dan faktor luaran adalah terhad. Kebanyakan kajian ini juga memfokuskan kepada pelabuhan kontena di negara-negara maju, sementara tiada kajian setakat ini yang mengkaji pengaruh faktor luaran terhadap kecekapan pelabuhan kontena di negara-negara membangun seperti negara rantau Timur Tengah. Oleh itu, kajian ini bertujuan menentukan dan menilai pengaruh faktor luaran terhadap kecekapan pelabuhan kontena di rantau Timur Tengah. Pendekatan metodologi dua peringkat digunakan. Pertama, Analisa Penyampulan Data (DEA) mengukur kecekapan teknikal 12 pelabuhan kontena di rantau Timur Tengah. Kedua, regresi *Ordinary Least Squares* (OLS) mengkaji kesan faktor luaran terhadap kecekapan teknikal yang diperolehi daripada peringkat pertama. Perisian MATLAB R2013a yang ditentusahkan oleh DEA Frontier dengan Excel Solver digunakan untuk mengukur kecekapan teknikal di peringkat pertama. Kemudian, perisian SPSS digunakan untuk menentukan faktor signifikan dan tidak signifikan di peringkat kedua. Dapatan kajian menunjukkan, dari 12 pelabuhan kontena, hanya 3 (25%) pelabuhan kontena adalah cekap, sementara baki 9 (75%) adalah tidak cekap. Keputusan juga menunjukkan nilai R^2 untuk OLS adalah 0.652, mencadangkan model ini adalah baik kerana 65.2% daripada varian dalam pembolehubah bersandar (kecekapan pelabuhan kontena) dapat dijelaskan oleh model regresi. Tambahan, ujian *F* menunjukkan model secara keseluruhannya dapat memperbaiki keupayaan meramal pembolehubah hasilan dengan signifikan ($p = 0.031 < 0.05$). Keputusan ini seterusnya menunjukkan kesinambungan perkapalan liner adalah satu-satunya faktor penyumbang yang signifikan dalam meramalkan kecekapan pelabuhan kontena, manakala faktor-faktor lain adalah tidak signifikan. Keputusan menunjukkan majoriti pelabuhan kontena di rantau Timur Tengah tidak menggunakan sumber yang ada untuk mencapai kecekapan maksimum. Kajian ini merumuskan bahawa pihak berkuasa pelabuhan kontena perlu menjalankan penilaian kecekapan tahunan untuk bersaing di peringkat global, menambahbaik penggunaan sumber, dan meningkatkan ekonomi tempatan mereka. Juga, sebarang penilaian kecekapan perlu mengambil kira kesan faktor-faktor luaran.

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LIST OF ABBREVIATIONS

AE	-	Allocative Efficiency
AGV	-	Automated Guided Vehicles
ASC	-	Automated Stacking Crane
BCC	-	Banker, Charnes, Cooper
CCR	-	Charnes, Cooper, Rhodes
CCRI	-	CCR Input-oriented
CRS	-	Constant Return to Scale
DEA	-	Data Envelopment Analysis
DMU	-	Decision Making Unit
DPW	-	Dubai Ports World
DRS	-	Decreasing Return to Scale
EE	-	Economic Efficiency
ESCWA	-	United Nations' Economic and Social Commission for Western Asia
FDH	-	Free Disposal Hull
FEU	-	Forty Feet Equivalent Unite
GDP	-	Gross Domestic Product
IPMB	-	International Port Management Beirut
IRS	-	Increasing Return to Scale
JOC	-	Journal of Commerce
Lo/Lo	-	Lift-on/Lift-off Ship
LP	-	Linear Programming
LPI	-	Logistics Performance Index
LPMA	-	Logistics and Port Management Americas
LSC	-	Liner Shipping Connectivity
LSCI	-	Liner Shipping Connectivity Index
MENA	-	Middle East and North Africa

OLS	-	Ordinary Least Squares
PPPL	-	Portia Peel Ports Limited
QC	-	Quay Crane
Q-Q	-	Quantile - Quantile plot
RMG	-	Rail Mounted Gantry Crane
Ro/Ro	-	Roll-on/Roll-off Ship
RTG	-	Rubber Tire Gantry Crane
SBM	-	Scale Efficiency
SFA	-	Stochastic Frontier Analysis
SPSS	-	Statistical Package for the Social Sciences
STS	-	Ship to Shore Cranes
SVA	-	Slack Variable Analysis
S-W	-	Shapiro-Wilk normality test
TE	-	Technical Efficiency
TEU	-	Twenty Feet Equivalent Unite
TPM	-	Total Productive Maintenance
UA	-	Unit of Assessment
UNCTAD	-	United Nations Conference on Trade and Development
VIF	-	Variance Inflation Factor
WTO	-	World Trade Organization

CHAPTER 1

INTRODUCTION

1.1 Introduction

The emergence of containerization as an important transportation tool in shipping has witnessed a radical transformation in the last decades (Suárez-Alemán et al., 2016). Although containerization has been in existence since 1950s, its impact on global trade patterns and manufacturing techniques came to fore in the 1990s (Rodrigue et al., 2013). Container ports serve as an important interface between inland and maritime transport. They are equally play a significant role in the country's trade increase and economic growth. Since container ports serve, as engine of growth both local and international, their efficiency evaluation has become important to stakeholders in the maritime industry. This section provides background information on container port industry, their efficiency evaluation, and the position Middle East occupies in the global maritime sector.

1.1.1 Container Port Industry

Globalisation has led to increasing geographical scale of political, social and economic relations (Wang *et al.*, 2005). Importing and exporting through international trade represents a fundamental aspect of globalisation (Janelle and

Beuthe, 1997). The globalisation of the world economy has increased the importance of transportation (Cullinane and Wang, 2010). Hoffmann and Kumar (2010), noted that transportation is an essential tool for the movement of imported and exported merchandise. In particular, maritime transport, because over 80 per cent of goods traded on the world market are seaborne (UNCTAD, 2013). Specifically, container transport plays a significant role in the process, because of its economic and technical advantages over the traditional ways of transportation (Cullinane *et al.*, 2005b). For instance, since the mid-20th century, containerization has decreased the transportation cost of international trade (Levinson, 2008). The reduction in transportaion cost as a result of containerization has made movement of goods more efficient and automated (Liu, 2010).

In the last few decades, container trade has increased considerably to represent about 17 percent of the global seaborne trade (UNCTAD, 2012). In fact, global container trade has steadily increased over the years. For instance, in 2010 the container throughput in all the world's container ports was 531.4 million TEUs (Twenty-Feet-Equivalent-Units), which is higher than previous year by an estimated 13.3% (UNCTAD, 2011). Then, in 2011 the throughput increased by 5.9% to 572.8 million TEUs (UNCTAD, 2012). It increased by an estimated 3.8% to 601.8 million TEUs in 2012 (UNCTAD, 2013) and by 5.6% to 651.1 million TEUs, in 2013 (UNCTAD, 2014).

The top 20 container terminals by container throughput TEUs during 2011-2013 are presented in Table 1.1. These container terminals represent about 46 percent of the world’s container throughput TEUs in year 2013. The table contains 15 container terminals from developing economies that are located in Asia. The remaining container terminals are from developed economies, three located in Europe and two in North America. The top 10 container terminals are located in Asia and one of such is Dubai in the Middle East region.

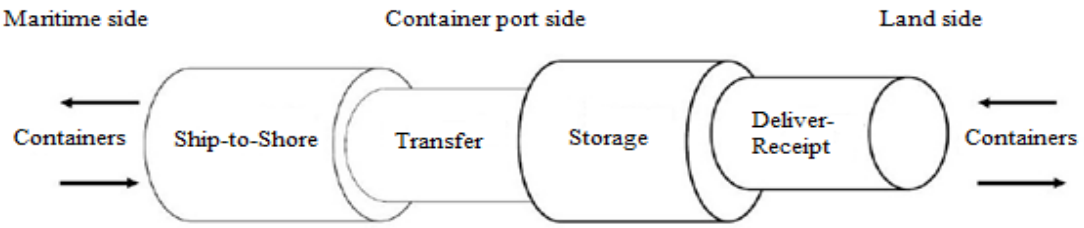
Table 1.1: Top 20 Container Terminals and their Throughput

Port Name	Container Throughputs TEUs			Percentage change 2012-2011	Percentage change 2013-2012
	2011	2012	2013		
Shanghai	31 700 000	32 529 000	36 617 000	2.62	12.57
Singapore	29 937 700	31 649 400	32 600 000	5.72	3.00
Shenzhen	22 569 800	22 940 130	23 279 000	1.64	1.48
Hong Kong	24 384 000	23 117 000	22 352 000	-5.20	-3.31
Busan	16 184 706	17 046 177	17 686 000	5.32	3.75
Ningbo	14 686 200	15 670 000	17 351 000	6.70	10.73
Qingdao	13 020 000	14 503 000	15 520 000	11.39	7.01
Guangzhou	14 400 000	14 743 600	15 309 000	2.39	3.83
Dubai	13 000 000	13 270 000	13 641 000	2.08	2.80
Tianjin	11 500 000	12 300 000	13 000 000	6.96	5.69
Rotterdam	11 876 921	11 865 916	11 621 000	-0.09	-2.06
Port Klang	9 603 926	10 001 495	10 350 000	4.14	3.48
Dalian	6 400 000	8 064 000	10 015 000	26.00	24.19
Kaohsiung	9 636 289	9 781 221	9 938 000	1.50	1.60
Hamburg	9 014 165	8 863 896	9 258 000	-1.67	4.45
Long Beach	6 061 099	6 045 662	8 730 000	-0.25	44.40
Antwerp	8 664 243	8 635 169	8 578 000	-0.34	-0.66
Xiamen	6 460 700	7 201 700	8 008 000	11.47	11.20
Los Angeles	7 940 511	8 077 714	7 869 000	1.73	-2.58
Tanjung Pelepas	7 500 000	7 700 000	7 628 000	2.67	-0.94
Total top 20	**274 540 260**	**284 005 080**	**299 350 000**	**3.45**	**5.40**

Source: (UNCTAD, 2014)

Containerized trade has not only increased at the cost of share of break-bulk cargo that are transferred by other methods of transport, but also growth in international trade (UNCTAD, 2012). Numerous container ports therefore, have adapted to this changing pattern of trade through conducting infrastructure improvement programs to raise their market share of containerized cargo and successfully engage in international trade.

Standing at the crucial interface of maritime and inland transportation, container ports are crucial connections between different transportation modes, as shown in Figure 1.1. They play vital role in container transportation procedure (Cullinane and Wang, 2006b). Thus, the importance of container port and its production abilities cannot be ignored (Wang *et al.*, 2003).



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

Figure 1.1 Movements of Containers between Maritime and Inland

Since much of the global trade are through the sea, the economic significance of container ports have gained prominence over the years. Container ports play a fundamental economic role for countries. Container ports contribute to the development of the countries through increasing traffic lines, generate national income through duty fees at port, and creation of jobs (Infante and Gutiérrez, 2013).

Furthermore, through higher container trade volumes, government can also generate more revenue from collection of tax which in turn increase the country's GDP (UNCTAD, 2012). Therefore, increased throughput of container port would increase revenue of ports via port dues and handling fees for containers. Going by the current outlook and increasing globalization of economies, there is need for higher efficiency from all actors in the transport sector, especially container ports (Bergantino *et al.*, 2013). Thus, improvements in container port efficiency is has become necessary (Vacca *et al.*, 2010).

1.1.2 Importance of Container Port's Efficiency

Optimizing port efficiency enhances the access of a country to global markets, leading to growth in trade and consequently higher income (Infante and Gutiérrez, 2013). According to UNCTAD (2014), increased efficiency could increase port's revenue and increase the country's GDP. Liu (2008), noted that efficiency of ports serve as an important index of economic development of a country. In addition,

an efficient operational system significantly help in making the best use of container port resources and infrastructure (Vacca *et al.*, 2010). The international flow of merchandise could be enhanced through increased efficiency of cargo handling within ports (UNCTAD, 2010a). Wilson *et al.* (2003), explored the importance of port efficiency and found that enhancement in efficiency yields the greatest growths in the flow of trade. Improvement in port efficiency could decrease costs of transaction and enhance competitiveness of exports of a country, which in the long term boost economic growth, create more jobs and general welfare (Kent and Fox, 2004). The results of increased trade include higher level of peace, security, health and living standards (UNCTAD, 2012). In addition, UNCTAD (2013) indicated that high level of port efficiency can perform to decrease the costs of transport and help enhance the competitiveness of a country.

Competition is one of the most important concepts in the market structure of the container port industry (Wang *et al.*, 2005). Increased competition between container ports greatly enhance the container throughput volumes (UNCTAD, 2012), which leads to increase in a country's economy. In the one hand, competition would bring about increased sense of responsibility from staff, promote innovation, free a port from bureaucracy and promote high efficiency (Cullinane *et al.*, 2005a). According to World Bank (2007) report, competition between ports operators has led to improvements in port efficiency. Intensive competition between ports worldwide has made container ports efficiency a key issue for operators (Liu, 2010).

On the other hand, Hyuksoo and Sangkyun (2015) observed that efficiency of container port could be regarded as one of the important components to improving port competitiveness. The level of efficiency in container ports largely influence the countries competitiveness as the ports represent a primary link in transport chain (Infante and Gutiérrez, 2013). In addition, Trujillo *et al.* (2013) noted that improving competitiveness can be achieved through improving the port efficiency, decrease in the costs of port service and making higher level of services in terms of time and quality. Past studies by Anderson *et al.* (2008); Luo *et al.* (2012); Song (2002); Tongzon and Heng (2005); Yap and Lam (2006); Yuen *et al.* (2013) have shown that efficiency plays a major role in container port competition. With regard to above

discussion, competition and efficiency are related to each other in that, increased efficiency could lead to improve the competitiveness that lead to better chances among competing ports, in the same time competition between container ports promote high level of efficiency.

According to UNCTAD (2012) increased competition between container ports, exporters, importers, and transport operators could lead to lower transport costs. Infante and Gutiérrez (2013), affirmed that efficiency could lead to reduction in the prices of export, favoring the international market products competitiveness. However, Micco and Pérez (2001) noted that efficiency of port can impact the costs of transport and that distance to a shipper's export market could be increased by 60% as a result of port inefficiency. In addition, Sánchez *et al.* (2003) found that more efficient ports are clearly associated with lower freight costs. The costs of exporting and importing merchandise could be affected by inefficient port and this has a negative influence on the competitiveness of a nation (Infante and Gutiérrez, 2013). The authors suggested a thorough redefinition of operations and procedures in an inefficient port to address the challenge.

Port costs constitute approximately 8–12% of total costs of transport from the origin of product to destination (Kent and Fox, 2004). Shippers who consider costs of port as a controllable costs in the logistics chain, build partly the decisions of shipping according to these costs (Tongzon, 2009). Bergantino *et al.* (2013), mentioned that costs of port are an agent for efficiency of port, and then efficiency of port affects shipper’s choice of markets. Indeed, ports with efficient operations can help to decrease the costs of transport via enabling merchandises to get to and from markets in a more cost-effective way and timely manner (UNCTAD, 2013).

Existing literature is replete with studies that show how inefficiencies in transportation could influence cost of transport, development, and trade success. For example, Hummels (1999, 2001) reported the effect of high cost of transport on development, and Henderson *et al.* (2001) showed in their study how cost of transport affect trade and welfare. In another study, Limao and Venables (2001)

reported that raising costs of transport by 10% could decrease trade volume by 20%. Annual growth of economy could slow by 0.5% if the shipping costs is doubled (Radelet and Sachs, 1998).

Against this backdrop, improving efficiency of container ports remain a high priority issue for countries. Container port managements, therefore, have largely been under pressure to increase efficiency by making sure that services provided are on a globally competitive base. In this context, measuring the efficiency of container port and its evolution becomes pivotal. The evaluation of efficiency is a mission that should play a significant role in ports management in order to enhance success and evolution in commercial activities among nations (Infante and Gutiérrez, 2013). Consequently, observing and comparing one port with other ports in terms of their efficiency has become a fundamental part of microeconomic reform programmes in most of the countries (Jiang and Li, 2009).

Indeed, improvement in efficiency is needed in developing countries where logistics costs and dwell time are still high. According to Arvis *et al.* (2014) report, the necessity to decrease the costs of logistics is more important in developing countries that face much higher trade costs when compared to developed countries. In ports with efficient logistics, dwell time could be two or three days, however, in developing countries such as Asia, North Africa, the Middle East, and Latin America, it is seven days or more (Arvis *et al.*, 2012). Port efficiency, therefore, should be a matter of interest to developing countries (UNCTAD, 2013).

1.1.3 Importance of the Middle Eastern Region in the Maritime Sector

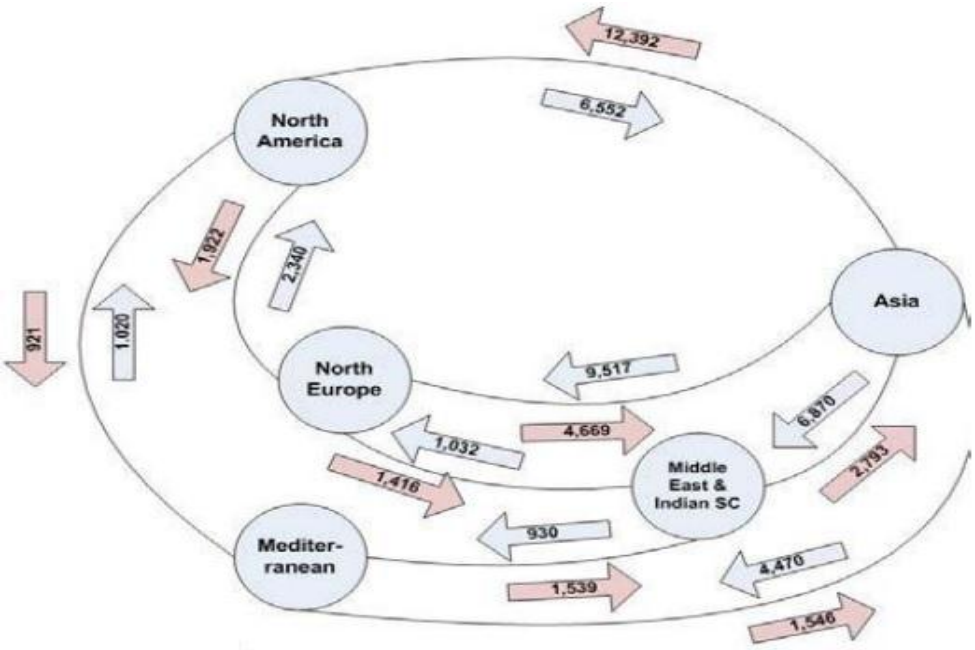
Distance from primary international maritime trade routes represents a significant advantage to access international markets, which indicates to the significance of geographical location of a region. In fact, ports that are close to the international maritime trade routes are more attractive for the world shippers in their

attempt to save time and reduce transport cost, than the long distant ports (Niavis and Tsekeris, 2012). Primary shipping routes are those supporting the most significant commercial shipping flows servicing major markets; while secondary shipping routes are mainly connectors between smaller markets (Rodrigue *et al.*, 2013). Classification of maritime passages are into two main categories: primary and secondary passages as shown in Figure 1.2. Primary passages are the most significant because without them, there would be lack of marine shipping alternatives and this would earnestly constrain worldwide trade. On the other hand, secondary passages support marine routes which have alternatives, however would still involve a remarkable turn (Rodrigue *et al.*, 2013). Among primary passages, those located in the Middle Eastern region which include: the Suez Canal, the Strait of Hormuz, and the Strait of Bab El-Mandab, which serve as key locations in the global trade of goods and commodities. Secondary passages include: for example, the Magellan Passage, the Dover Strait, the Sunda Strait and the Taiwan Strait.

Source: (Rodrigue *et al.*, 2013)

Figure 1.2 Maritime Shipping Routes and Passages

The waterway of the Middle East region is among the most important in the world as shown in Figure 1.2. This region is regarded as the mid of cord, which links East side and West side of world via marine routes (Al-Eraqi *et al.*, 2010). The Middle East countries lie inside the major East–West maritime trade routes, as shown in Figure 1.3. These routes link the three economic regions Asia, Europe and North America (UNCTAD, 2014).



Source: (UNCTAD, 2014)

Figure 1.3 Interregional Container Flows, 2011 (Thousands of TEUs)

The container ports of the Middle Eastern region are located at a critical geographic position in the international marine trade route linking East and West. The Middle East's container ports are regarded as the centre ports, at which merchandise transported from Europe and far East/Australia and vice versa are interchanged and transshipped to the countries in the Middle East (Al-Eraqi *et al.*, 2010). The strategic location of the region's ports has encouraged ships to conduct short calls among them for merchandise exchange. For example, shipping lines operating along Asia/America East Coast route, Asia/Mediterranean route, and Asia/Europe route (Al-Eraqi *et al.*, 2008). Thus, the efficiency evaluation and measurement of the container ports located in the Middle East region has become necessary.

1.2 Problem Statement

Despite increasing number of studies conducted on the efficiency of container ports, exogenous factors that are beyond the control of port management have attracted little attention from researchers. Most of the existing studies focused on measuring efficiency using internal (operational) variables. Consequently, there is no linking between container port technical efficiency and the exogenous factors. In addition, most of the studies have focused mainly on container ports located in European region, with only few dealing with some Asian countries.

None of these studies so far has examined the influence of exogenous factors on the technical efficiency of container ports in developing countries such as those of the Middle Eastern region, located in a critical geographic position in the international maritime trade route between East and West. Their findings therefore have limited application and benefits to these countries. This is because these countries differ in terms of geographical position, economic level, and political issues. Evidence of a rigorous study on port efficiency of Middle Eastern region is scanty, despite its importance in the global supply chain network. The few available studies focused mostly on multipurpose ports, none has so far focused on container ports.

Since efficiency of container ports is an important indicator of a country's economic development and competitiveness. Therefore, monitoring and comparing one container port with other in terms of efficiency should become an essential part of container ports reform programmes in developing countries. It is obvious that performance level of container ports located in developing countries is low, with higher dwell time and cost when compared to developed countries. Thus, understanding the factors that influence container port efficiency becomes necessary for port authorities and operators.

Any evaluation procedure of container port efficiency therefore should take into account the role of exogenous factors; container port efficiency can be improved

when the factors and their significance are determined. Therefore, this thesis aims at examining critically the internal and external (exogenous) factors that affect container port efficiency in the Middle East region.

1.3 Research Aim and Objectives

The aim of the study is to determine and evaluate the influence of exogenous factors on the efficiency of container ports in the Middle Eastern region. In order to achieve the research aim, the following are the objectives:

1. To measure the technical efficiency of container ports.
2. To determine the relationship between the exogenous factors and technical efficiency of container ports.
3. To identify the significance and non-significance of the factors.

1.4 Research Questions

To address these objectives, the following are the research questions:

1. Which container port(s) are relatively efficient or inefficient?
2. To what extent could inefficient container ports be improved to become efficient?
3. What is the relationship between the exogenous factors and the technical efficiency of container ports?
4. What are the significant and non-significant factors?
   4.1 Is there a significant relationship between liner shipping connectivity and efficiency of container port?
   4.2 Is there a significant relationship between the efficiency of customs and border procedures and efficiency of container port?

4.3 Is there a significant relationship between trade openness and efficiency of container port?

1.5 Research Scope

This research is limited to container ports in the Middle Eastern region. It focuses on container ports only due to their homogeneity, as they specialize in handling container only. It covers twelve container ports from twelve countries in the region. These container ports are Jebel Ali in Emirates, Jeddah Islamic in Saudi Arabia, Salalah in Oman, Ambarli in Turkey, Suez Canal in Egypt, Shahid Rajaee in Iran, Haifa in Israel, Beirut in Lebanon, Aqaba in Jordan, Khalifa Bin Salman in Bahrain, Lattakiah in Syria, and Aden in Yemen.

1.6 Research Methodology

To achieve the research's objectives, two-stage methodological analysis was adopted. In the first stage, Data Envelopment Analysis (DEA) approach was used to measure the technical efficiency of individual decision-making units (DMUs) within a group. The most efficient DMUs represent the efficient frontier of the group relative to which the efficiencies of the remaining DMUs are measured. In addition, slack variable analysis (SVA) was used to provide a reference set of specific recommendations for each inefficient container port. This stage applied efficiency measurements rules suggested by Cook *et al.* (2014) who outlined a number of rules regarding the use of DEA approach. These rules contain model orientation, input and output variables selection and the number of inputs and outputs to use versus the number of DMUs. This stage, therefore, achieved the research objective 1, and answered the research questions 1 and 2. In this stage, MATLAB R2013a software with DEA-CCRI toolkit was used and the result validated by DEA frontier with

Excel solver version 2010 (http://www.deafrontier.net/deafree.html) to measure the technical efficiency of container ports.

In the second stage, the main interest is to discover which exogenous factors influence the container port efficiency. Therefore, the second stage seeks to relate such efficiency scores from the first stage for a given group of DMUs to a number of exogenous factors that may influence the level of efficiency. Therefore, Ordinary Least Squares (OLS) regression approach was used to examine the influence of exogenous factors on the efficiency of container ports that derived from the first stage. This stage, therefore, achieved the research objectives 2 and 3, and answered the research questions 3 and 4. In this stage, Statistical Package for the Social Sciences (SPSS) version 20 was used for the analysis in order to identify the significant and non-significant exogenous factors that influence container port efficiency.

1.7 Research Significance

Container ports constitute a key element of trade and growth of a country's economy. The enhancement of efficiency is critical for facilitating the role of container ports as drivers of economic success in the competitive environment. As competition for control of movement of commodities in the world market increases among container ports, efficiency in the ports has become necessary for port operators. Thus, conducting research to evaluate the efficiency and the driving factors that determine efficiency among the various container ports in the Middle Eastern region becomes imperative. The efficiency evaluation and the factors identify could help the port authorities and operators to know areas of strength and weakness, recognize the risks and opportunities that are likely to exist within the competitive environment and adopt appropriate response measures. It is important that the container ports authority and operators should conduct yearly comprehensive efficiency evaluations. This will not only support the management of container ports in the region in responding to the stress of international competition, but also act as a

basis for decision-making with respect to enhancement in port efficiency. In addition, the research provides a new frontier of knowledge on container port efficiency in the Middle East region where such a study is scanty.

1.8 Research Limitation

In conducting a research of this magnitude, time and funding are some of the major constraints researchers' face, which may put constraint in terms of data size to be used. In fact, most of previous studies that have been conducted on port efficiency were funded and supported by governments, ministry of transport, World Bank and some other international or national organisations. However, the present study was not funded or supported by any government or organization, hence, the data used were limited in terms of sample size and detailed data. Notwithstanding, the data collected and sample size used were adequate for the purpose of this study.

Another limitation is the non-availability of comprehensive data on port operations and management among the countries in the Middle East region were the study was conducted. This is one of the problems facing most developing nations with weak political and economic institutions. In addition, data of such nature are commercially and politically classified (confidential) by some governments, so researchers find it difficult assessing them.

1.9 Thesis Organization

The thesis is organized into six chapters. The first three chapters provide the background to study, review of existing literature and the methodological approach used in data collection and analysis. The remaining chapters outline the findings of

the study and general conclusion. A brief explanation of each chapter is presented in this section as follows:

Chapter 1 gives background information on the subject matter of the research. It highlights the existing problem and the significance of the research. The aim and objectives of the study were outlined. In addition, the scope of the study was identified and limitations faced.

Chapter 2 reviews the existing literature on port efficiency. In this regard, attention was focused on objectives of existing literature, efficiency measurement methodologies, sampling domain, and variables (i.e. both internal and exogenous) that measure container port efficiency. The two-stage analyses adopted in this study to measure technical efficiency and examine the effect of exogenous factors on efficiency were explained in detail in this chapter. The review done so far in this chapter provides the existing gap in knowledge, which the thesis tries to fill.

Chapter 3 provides the methodological base for the study. Specifically, this chapter highlights the method used for data collection and analysis. The various input and output variables and exogenous factors that were used in estimating container port efficiency were defined. The analytical technique used during the data analysis was equally highlighted.

Chapter 4 covers the first stage of the analysis, which presents the results of analysis on technical efficiency of 12 container ports in the study area applying DEA-CCR input-orientation model over a cross-sectional data. This result addresses the first objective of the study and answers research questions 1 and 2. It provides some specific guidelines on how to improve inefficient container ports in the study area.

Chapter 5 covers the second stage of the analysis, which discusses the influence of exogenous factors by applying ordinary least square (OLS) regression

approach on the technical efficiency of container ports obtained from first stage DEA discussed in Chapter 4. The main focus of this chapter is to achieve research objectives 2 and 3 and give answers to research questions 3 and 4.

Lastly, Chapter 6 concludes the study. The major findings of the study and contributions of the study are summarized. Areas of further research were highlighted and limitations of the study. The general structure of the thesis is shown in Figure 1.4.

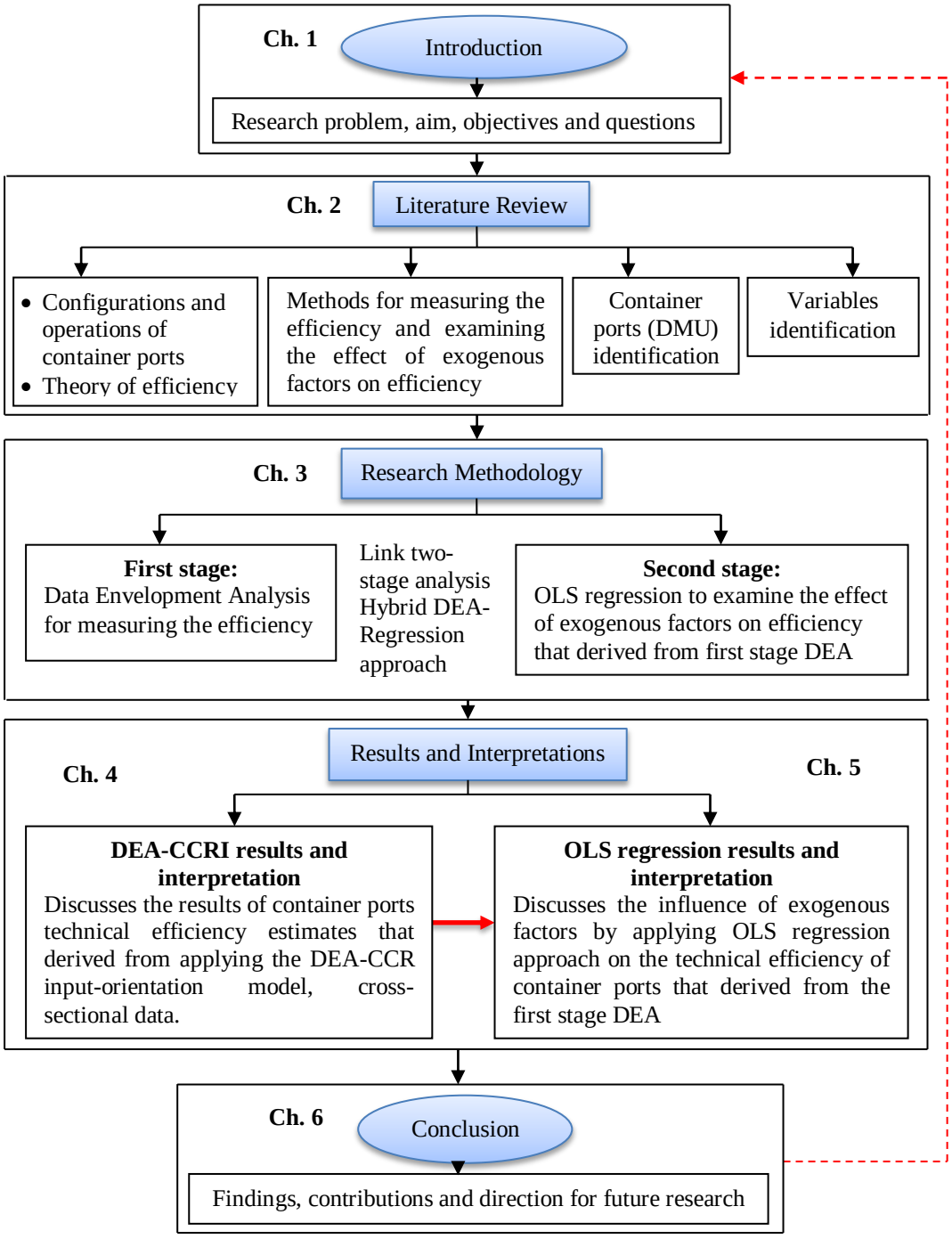


Figure 1.4 Structure of the Thesis

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