School of High Commercials Studies

EHEC

This dissertation submitted in partial fulfillment of the requirements for the degree of master in commercial sciences

Option: Logistics & Supply Chain Management

TOPIC:

AN ANALYSIS OF THE PORT PERFORMANCE MEASUREMENT SYSTEM AND ITS ROLE IN PORT COMPETITIVENESS

STUDY CASE: PORT OF ANNABA

Submitted by:

Mouna LAKHAL

Supervised by:

Dr. Imene HADDAD

Assistant professor EHEC

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باسم الله الرّحمن الرّحيم

الصّلاة والسّلام على رسوله محمّد ابن عبد الله

إلى جميع آباء هذا العالم الذين كرّسوا حياتهم لتعليم أبنائهم

إلى أمّي الحنون

إلى أبي العزيز

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Firstly, I thank God almighty for giving us faith in him and the strength to realize this work.

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My special honor is addressed to EHEC professors and friends, who have given me through the past three years the chance and challenge to follow this Master's degree program with fruitful academic cursus

My thanks should go to the Annaba Port Managers and employees who provided me with data and information which, I needed for the research. However, I would like to mention and extend my special thanks to a few of them. Special thanks should go to my dissertation advisor Mr. Ali OULED MERIEM, the Commercial Director of the port of Annaba for broadening my knowledge on shipping industry in general and port issues in particular and Mr. Mohammed Nazim NAAMOUN, Chief harbor master, for his devotion to go through my dissertation draft, advising and guiding me on various issues regarding the dissertation.

Above all, my deepest gratitude and appreciation to my lovely family for their unconditional love, support and prayers that have carried and sustained me on this journey.

الملخص:

لا يمكن المبالغة في التأكيد على أهمية الموانئ البحرية بالنسبة للنشاط الصناعي، تجارة البضائع، عمليات الإنتاج المعولمة والنمو الاقتصادي. يتم نقل أكثر من 80 بالمائة من تجارة البضائع العالمية من حيث الحجم وأكثر من ثلثي قيمتها عن طريق الموانئ. تعتبر هذه الأخيرة بمثابة نقاط رئيسية في سلاسل النقل العالمية التي توفر الوصول إلى الأسواق، دعم سلاسل التوريد وربط المستهلكين والمنتجين.

تؤكد القوى التنافسية المتزايدة التي تؤثر على الموانئ الحاجة إلى مستويات أداء أعلى. إن فهم أداء الموانئ يساعد على معرفة عمليات التخطيط وصنع القرار ذات الصلة بالميناء. وينبغي متابعة الجهود لتحسين قياسات أداء الموانئ، بما في ذلك عن طريق الاستثمار في إمكانيات جمع البيانات ودعم منصات تكنولوجيا المعلومات والاتصالات التي تخفض تكاليف جمع البيانات وتحليلها.

ومع ذلك، خلصت النتائج في الدراسات إلى أن أنظمة القياس المستخدمة محليا محدودة لأن التركيز ينصب على قياس الكفاءة، خاصةً بالنسبة للبضائع المنقولة بالحاويات. في كثير من الأحيان، تم تجاهل المتغيرات الرئيسية وهناك تركيز على تحسين الإنتاجية بدلاً من الأداء. يهدف هذا البحث إلى تحليل أنظمة قياس الأداء الحالية ومعالجة مسألة كيفية تطويرها لقياس أداء الموانئ بشكل أكثر فعالية.

الكلمات المفتاحية: الموانئ، سلاسل التوريد، القدرة التنافسية، قياس الأداء.

Résumé

L'importance des ports maritimes qui fonctionnent bien pour l'activité industrielle, le commerce des marchandises, les processus de production mondialisés et la croissance économique ne saurait être surestimée. Les ports mondiaux traitent plus de 80% du commerce mondial de marchandises en volume et plus des deux tiers de sa valeur. Les ports sont considérés comme des nœuds clés dans les chaînes de transport mondiales qui fournissent un accès aux marchés, soutiennent les chaînes d'approvisionnement et relient les consommateurs et les producteurs.

Les forces concurrentielles croissantes qui affectent les ports soulignent le besoin de niveaux de performance plus élevés. La compréhension des performances des ports permet d'informer les processus de planification et de prise de décision liés aux ports. Des efforts devraient être déployés pour affiner les mesures de la performance des ports, notamment en investissant dans des capacités de collecte de données et des plates-formes technologiques d'information et de communication qui réduisent les coûts de collecte et d'analyse des données.

Cependant, les conclusions de la littérature ont conclu que les systèmes de mesure utilisés localement sont limités parce que l'accent est mis sur la mesure de l'efficacité, en particulier pour les cargaisons et les terminaux conteneurisés. Souvent, les variables clés ont été ignorées et l'accent est mis sur l'amélioration de la productivité plutôt que sur la performance. L'objectif de cette recherche est d'analyser les systèmes de mesure de la performance actuels et de déterminer comment ils peuvent être développés pour mesurer plus efficacement la performance des ports.

Mots clés : ports, chaînes d'approvisionnement, compétitivité, mesure de la performance.

Abstract

The importance of well-functioning seaports for industrial activity, merchandise trade, globalized production processes and economic growth cannot be overemphasized. Global ports handle over 80 per cent of global merchandise trade in volume and more than two thirds of its value. Ports are considered as key nodes in global transport chains that provide access to markets, support supply chains, and link consumers and producers.

Growing competitive forces affecting ports emphasize the need for greater performance levels. Understanding the performance of ports helps inform relevant port-related planning and decision-making processes. Efforts should be pursued to refine port performance measurements, including by investing in data collection capabilities and supporting information and communications technology platforms that lower data collection and analysis costs.

However, Findings in the literature have concluded that the local measurement systems currently used are limited because the focus is on measuring efficiency, especially for containerized cargo and terminals. Often, key variables have been ignored and there is focus on improving productivity rather than performance. The aim of this research is to analyze current performance measurement systems and addresses the issue of how it can be developed to measure the performance of ports more effectively.

Key words: ports, supply chains, competitive, performance measurement.

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Abbreviations

3PL: Third-party logistics

APA: Annaba port authorities

APC: Annaba port company

ADB: African/American Development Bank

ETI: Ethical Trading Initiative

EBITDA: Earnings before interest, tax, depreciation and amortization

FDI: foreign direct investment

FTZ: The free trade zone

GDP: gross domestic product

GPO: Global port/terminal operator

GRI: Global Reporting Initiative

GVA: gross value added

HPH: Hutchison Port Holdings

ITOs: international terminal operators

ICT: information and communications technology

JIT: just in time

KPI: Key performance indicator

LSCI: Liner shipping connectivity index

LPI: logistics perception indicator

LSP: logistics service provider

MNC: multi-national company

PPI: port performance indicator

PSP: port service provider

VAL: value-added logistics

SCM: Supply chain management

TEU: twenty-foot equivalent unit

UNCTAD: United Nations Conference on Trade and Development

Summary

GENERAL INTRODUCTION

General introduction

Due to globalization of world's economy, shipping and seaborne liner industries have experienced huge and rapid growth in the past decade. Since the 1990s, more than 90% of international cargo moves through seaports, that's why, ports form a crucial link in the overall trading chain and therefore play a vital role in the supply chains.

One distinctive feature of port industry today is that the competition between ports has become much more intensive than ever before. Previously, port markets play a monopolistic role as a result of its exclusive and irreplaceable geographical location. However, in recent years, market structure has drastically changed due to the fast growth of intermodal and international transportation, resulting in port markets facing intense competition. The monopolistic nature of many ports become virtually non-existent and traditionally dominant ports are forced to compete regionally and globally.

Such intense competition between ports results in the interest of port operators to improve their efficiency. Port efficiency, which measures the utilization of port resources, is of importance to contribute a nation's international competitiveness. The analysis of port efficiency allows port operators to compare performance of different ports. This allows them to enhance operations and produce as much as outputs with limited resources. Also, port operators can use the information from performance analysis to improve their port planning and operations.

Performance measurement is important to organizational development and plays an essential role in evaluating production at its current and future state. By appropriately measuring performance, the system within an organization can be tweaked to move towards a desired direction through analyzing behavioral responses and understanding the impact of various performance measures on port efficiency. However, mis-specified performance measures will lead the organization to the wrong direction and will cause unintended negative consequences. A port with good performance provides satisfactory service for ships and efficient cargo operations and contributes to the economic development of a region. Inefficient. Analysis on port efficiency provides operators with clear ideas about the extent to which a port's resources are employed and helps them to compare their advantages and disadvantages. Measurement of port performance improves port development and maintains its competitiveness in an increasingly competitive commercial environment. Therefore, it is meaningful to first conduct a comprehensive study to identify port performance indicators relevant to the activities of vessels, cargo and terminals. Through the analysis of ports efficiency using identified

indicators, insights on port performance benchmarking on an international scale can be obtained.

That's why I prefer to choose performance measurement as the most suitable managerial tool in order to improve Port performance and competitiveness, especially for the port of Annaba which is considered one of the important Algerian ports. And as Peter Drucker said: *"what gets measured gets done"* and Frazelle said *"the world-class behaviors are incentivized by world-class measures"*.

This research addresses the need for port managers and planners to develop a reliable and effective performance measurement system. These systems can help port managers to predict, control and plan their port and, consequently, improve their competitiveness. The research problem has directly addressed the gap in knowledge and it has set the following problem to be investigated:

"How can the port performance measurement system affect the performance?"

This general problem can be divided into several investigative research questions:

1. What is the measurement system that is currently applied in measuring Annaba port performance?
2. Is measurement system currently applied in Annaba port effective?
3. what are the inefficiencies of the current performance measurement system of Annaba port?

The null and alternative hypotheses are hereby put forward as H_A and H_B:

H_A: The performance measurement system of Annaba port is not effective and does not lead to improved performance.

H_B: The performance measurement system of Annaba port is effective and leads to improved performance.

The scope of this research is to analyze the current performance measurement approach applied in the port of Annaba and to examine its effectiveness for the purpose of assessing a port's performance. In order to test the hypothesis, the research has the following aims:

1. To understand the imperative role of ports in the global logistics chains.
2. To discuss the current supply chain performance measurement systems and models applied to ports.
3. To investigate the effectiveness of the current performance measurement system in a port and to understand those variables that influence a port's performance.

The research methodology is a deductive methodology for two reasons:

- A deductive methodology helped to study a sample of population at Annaba port to test the hypothesis.
- A deductive methodology is more appropriate to fit the nature of operations in ports.

There are predictor variables that influence a port's performance. These predictors comprise complicated operations for different types of cargoes at different terminals.

A mixed methodology (quantitative and qualitative) is relevant to investigate the efficiency and productivity issues where operations can be quantified to evaluate port performance.
Various methods have been used in this research for the purpose of collecting reliable data to measure current Annaba port. Different methods of data collection, using both primary and secondary sources, have been applied. The research methods are discussed in detail in Chapter Three.

The above mentioned objectives are achieved through literature review, which followed by the analysis of Annaba port performance measurement system and finally the examination of its effectiveness.
The dissertation is structured in three chapters:

The first one provides the background of maritime supply chains and the changing role of ports in these chains, it continues with port generalities, with the aim of representing its services and assets, in order to understand and be more familiar with the topic. Then it follows with the new challenging trends in the maritime industry that face ports. This chapter analysis and highlights the objectives of the current research work.

The second chapter reviews the existing literature on the measures of port performance study. The concepts of performance metrics and index methods. Factors influencing the port competitiveness are described and the applications of classical operation strategies and logistic process simulation in the port industry are discussed. The needs of current research are highlighted based on the limitations of past studies and the scope of this research work is defined.

The last chapter is finding and discussions; it includes the back ground of Annaba port, as well as the practical methodology that is applied for this research purpose; and it followed by the analysis of Annaba port performance measurement system with the examination of its effectiveness and summarizes the main conclusions of this research and provides recommendations. Finally, the research ends with general conclusion, limitations and directions for further research.

CHAPTER I:

PORTS AND MARITIME LOGISTICS

Introduction

Increasing globalization and a growing degree of product customization have resulted in more complex supply chains that demand a more rapid response to order delivery and more effective movement of goods across the world, which makes logistics a new service sector crossing departments, industries and regions. How to make goods move more efficiently to satisfy international and national trading has thus become a key factor to drive the regional economy and its development, which cannot be separated from port efficiency.

Section 1: Maritime logistics and Supply Chains

1.1 Logistics and Supply chain management approach

Logistics had long been exclusively used by the military and was only integrated into operations and business management in the mid-1960s. There are almost as many definitions of logistics as the number of books and articles written on the subject. This, to some extent, reflects the underlying characteristics of logistics, which has been undergoing a constant evolution during the last three decades or so. The basis of logistics management is the integration and optimization of a firm's functions and processes for the dual purpose of overall cost reduction and customer satisfaction. Logistics seeks to deliver the right product or service, in the right quantity and condition, at the right price, to the right place and for the right customer. Typically, the logistics process encompasses inbound, in-house and outbound logistics and spans the flows of goods, services, people and information from point of origin until point of consumption (forward logistics) and vice versa (reverse logistics). Logistics functions are usually categorized into two main components: materials management and physical distribution, and may include a range of activities such as purchasing, planning, production control, inventory management, materials handling, storage and warehousing, transport and distribution and sales and marketing. Most concepts of logistics and SCM also apply to ports. They include the following[1].

1.1.1 Customer service

Much of the emphasis of business logistics is placed on effective customer service which, combined with the objective of cost reduction, opposes business logistics to military logistics. The concept of customer service associates many aspects of logistics closely with marketing. It can be broadly described as the measure of how well the logistics system satisfies

[1] Bichou, K. (2013) "Port Operations, Planning and Logistics"; Informa Law from Rutledge: New York, NY, USA, p 23

its customers and their expected levels of service. Customer service must be viewed as an integral part of the design and operation of any logistics system. In ports, much of the debate to date has been on how to perform efficient operations while still satisfying a wide range of port users and customers.

In SCM, the concept of customer service takes on another dimension since it assumes that the network of organizations in a port supply chain should work collaboratively in order to ensure superior customer service and competitive advantage vis-à-vis other supply chains. This means that port competition is moving to a further level: ports are not only competing against other ports on the basis of operational efficiency, price and location, but also, and more importantly, on the basis that they are embedded in quality supply chains that offer shippers, shipping lines and other customers a greater value than alternative ports, routes and supply chains. Today competitive advantage depends less on a port's internal capabilities but rather on its supply chain competitive potential whereas long-term success depends upon the competitiveness of the entire port supply network.

1.1.2 Value added

In logistics, the term value added is closely related to customer satisfaction. The most appropriate customer service level is the one that gives the customer the maximum value added. The performance of a logistics system is assessed based on how well it performs in creating value-added benefits to the customer in a cost-effective way. While the value of port services to shipping lines may be reduced to the aspects of operational efficiency and turnaround time, the value of port services to shippers may be extended to the aspects of product conversion, process decoupling, inventory management, market customization, postponed manufacturing, modal shift and regional distribution[1].

Value added also means the value newly created or added to traditional services. Logistics activities are key elements in the value chain, and thus contribute greatly in the creation of value added. Apart from their traditional function as a sea–land interface, ports are a good location for value-added logistics activities such as consolidation and break bulk, sequencing and order processing, packing and packaging, postponement and customization, promotion and market intelligence, facilitation of contacts and procedures, and so on. From a logistics approach, ports should be conceived of as logistics and distribution centers that not

[1] Ibid p 25

only optimize the movement of goods and services within the maritime and multimodal transport system, but also provide complementary services and add value to members of the larger logistics and supply chain network. The role of ports as logistics centers has been fully recognized in recent years with many ports worldwide expanding their activities into a wide range of logistics and value-added services. Thus, the port system not only serves as an integral component of the transport system, but is also a major sub-system of the broader logistics and supply chain systems.

1.1.3 Process and integrated approach

Much of the logistics philosophy is based on a process approach to business. This means that logistics is not an isolated activity, but rather a series of continuous and inter-related activities whereby planning, organization, operation and management apply. One of the main benefits of logistics is that it offers an integrated approach to a range of activities and functions (e.g. purchasing, production, transport, warehousing and so on), and enables manufacturers and other organizations to identify the total cost of the system, and balances (or trades off) one aspect against another.

Over the past two decades or so, the integration of the international logistics chain has become a focal issue in developing strategic plans and long-term objectives for 3PL, shipping lines and even port operators. Today, 3PL providers offer packages that include full coverage of logistics services from origin to destination. In a similar vein, advances in containerization, inter-modal integration and information technology have allowed shipping lines to extend the scope of their activities from traditional sea transport services to integrated door-to-door transport and logistics services including such activities as inland transportation, consolidation, freight forwarding and even cargo handling and port services. Yet, total logistics integration is achieved by few mega-carriers, while most shipping lines limit their services to sea transport and related shore based operations. In ports, the process of port privatization and deregulation being widely implemented during the last two decades or so has gradually lifted the barriers against logistics integration in the port industry. Nowadays, many port operators are capable of offering a range of logistics services beyond the traditional package of services to ships and cargo. There is also a growing trend on the part of ocean carriers, logistics service providers and even shippers towards port ownership and management. Recent strategies of vertical and horizontal integration evolving around port ownership and operations have produced new institutional port structures capable of offering integrated port and logistics services.

1.1.4 Total costs and cost trade-off analysis

A key element of integrated logistics is total cost analysis. The essence of logistics is to minimize the total cost rather than the cost of individual activities. Any change made in one aspect of an organization is likely to affect other aspects as well as the total cost of the entire logistics system. Cost trade-off analysis is a key feature of total logistics costs and consists of comparing different combinations of cost elements so as to achieve an overall optimal solution. Examples of cost trade-off analysis include transport costs against inventory costs, warehousing costs against transport costs and production costs against inventory costs. It is obvious that these costs are inherently inter-related with each other Cost trade-off analysis is also a useful tool for strategic decisions. A typical illustration is when a firm decides to move production to a cheaper place in order to reduce the cost per unit of the product at the factory, but the new production site would imply an increase in transport and other related costs.

While the objective of shipping lines is to minimize total door-to-door transport costs, including cargo handling and port costs, shippers seek to minimize total logistics costs, which include transportation costs, warehousing costs, order processing and information costs, lot quantity costs and inventory costs.

Despite this, the literature on port planning, choice and freight flow modelling often overlooks the costs of shippers and limits the analysis to a trade-off exercise between a cost-minimization for shipping lines versus a revenue-maximizing objective for ports[1].

1.2 Maritime logistics[2]

Maritime transportation, one of key components of a logistics system, is responsible for carrying and handling cargoes across the ocean and consequently connects widely dispersed transportation linkages between consigners and consignees. It also plays a bridging role in connecting all the entities in logistics (e.g. customers, suppliers, plants, warehouses and other channels). If maritime transport is not well integrated into the whole logistics flows, additional costs, unnecessary delays and accidents may arise, thus distorting the smooth flows of logistics. Hence, maritime transportation should handle cargoes in a highly integrated manner by keeping pace with other logistics components. Refining maritime operations so that they can be successfully integrated into the overall logistics system contributes to better outcomes for all

[1] Ibid p 26

[2] Song, D, W. Panayides, P, M. (2015). “Maritime logistics: a guide to contemporary shipping and port management”, Second edition, Koganpage, USA. p 54

logistics entities. In this respect, maritime transportation can be regarded as a strategically crucial part of the logistics integration system.

The integrated demand for maritime transport has delivered a 'maritime logistics' concept. Maritime logistics is referred to as the process of planning, implementing and managing the movement of goods and information which is involved in ocean carriage. Maritime logistics can be distinguished from maritime transportation in both its focus point and the managerial function. Table I.1. summarizes a comparison of maritime logistics and maritime transportation. With reference to the focus point, maritime transportation emphasizes individual functions relating to sea transportation and pursues its own competitiveness of transport terminal operators.

Table I.1 : Maritime logistics vs maritime transportation

	Maritime logistics	**Maritime transportation**
Concept	The process of planning, implementing and managing the movement of goods and information which is involved in the ocean carriage.	The process of carrying and handling cargoes across the ocean.
Focusing point	Maritime logistics is concerned with not only individual functions relating to sea transportation, but also an effective logistics flow as a systematic entity of the logistics integration system.	Maritime transportation emphasizes individual functions relating to sea transportation. Each function pursues its own aims or competitiveness.
Managerial Function	Sea transportation activities: e.g. contracting, shipping, sea voyage, moving cargo, and loading/unloading. Additional logistics services: e.g. stripping/stuffing,storage,warehousing, offering a distribution center, quality control, testing, assembly, packaging, repacking, repairing, inland connection, and reuse.	Sea transportation activities: eg contracting, shipping, sea voyage, moving cargo, and loading/ unloading.

Source : Song, D, W. Panayides, P, M. (2015). "Maritime logistics: a guide to contemporary shipping and port management", Second edition, Koganpage, USA. p 54

loading/unloading, but also other logistics services, e.g. stripping/stuffing, storage, warehousing, inventory management, offering a distribution center, quality control, testing, assembly, packaging, repacking, repairing, inland connection, and reuse.

As maritime logistics is a concept developed from the study of maritime transportation within the context of logistics, the following three key players of maritime transportation make up the maritime logistics system: shipping, port/terminal operating, and freight forwarding. **TableI.2** presents the main and supportive logistics functions that maritime operators should provide.

The major function of the shipping system is moving the goods of shippers from one port to another. Shipping also provides other logistics services in order to successfully support the shipping and logistics flow, e.g. pick-up service, delivery notification, a special handling service for customers who require particular services, inbound/outbound bill of lading (B/L), container tracking and information, and intermodal services[1].

Table I.2: main function and supportive activities of maritime logistics

	Shipping	**Port/Terminal operating**	**Freight forwarding**
Main function	Moving cargoes between ports.	Shipping reception; Loading/unloading Cargoes,Stevedoring; Connecting to inland transportation.	Booking vessels; Preparing for requisite documents for ocean carriage and trade, on behalf of shippers.
Supportive logistics activities	Documentation relating to sea trade; Container tracking and information; Intermodal service.	Warehousing; Offering a distribution center; Testing; Assembly; Repairing; Inland connection.	Inventory management; Packaging; Warehousing.

Source : Song, D, W. Panayides, P, M. (2015). "Maritime logistics: a guide to contemporary shipping and port management", Second edition, Koganpage, USA. p 57

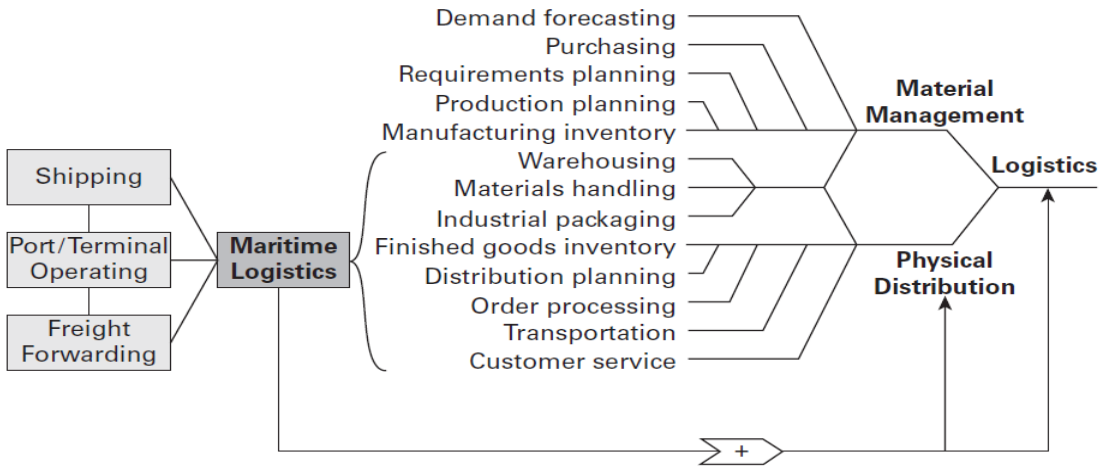
The key function of port/terminal operation is loading/discharging cargoes into/from a vessel, and making preparations for the cargoes to be ready to be delivered to the final destination of the consumer via inland transportation. In order to ensure that the cargoes be

[1] Ibid p 60

passed smoothly and quickly to the next stage of the logistics system, port/terminal operations in modern logistics systems involve not only loading/off-loading cargoes to/from a vessel, but also various value-adding services including warehousing, storage and packing and arranging inland transportation modes. Sometimes, a third intermediate party is engaged in the process of sea transportation for arranging the complex processes of international trade. For example, freight forwarders reserve a vessel on behalf of shippers, or prepare for requisite documents for ocean carriage (e.g. B/L) and other documents required for customs clearance and/or insurance requirements. They also arrange other logistics services, e.g. inventory management, packing and warehousing.

Figure I.1 shows the interaction of maritime logistics with other activities in a whole logistics chain. As indicated in **Table I.1**, maritime logistics is involved in sea transportation service as well as additional logistics services.

Figure I.1: Maritime logistics in the whole logistics system



Source : Song, D, W. Panayides, P, M. (2015). "Maritime logistics: a guide to contemporary shipping and port management", Second edition, Koganpage, USA. p 58

Those additional logistics services are a major part of physical distribution activities, eg warehousing, material handling, packaging, goods inventory, distribution planning, order processing, transportation, and customer service.

Therefore, the performance of maritime logistics activities does inevitably affect the overall performance of physical distribution management.

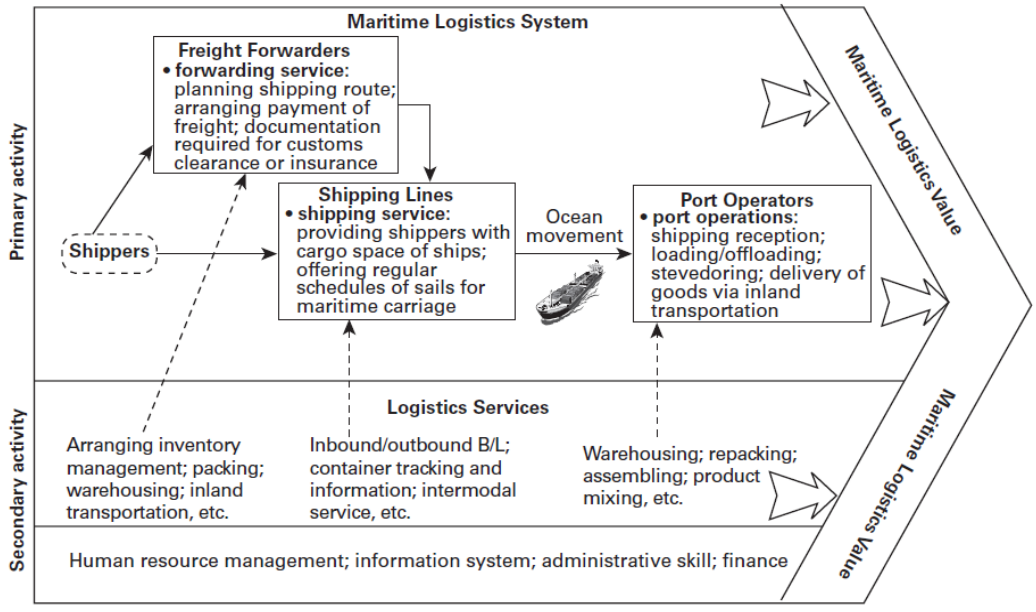
As physical distribution is one of the two pillars of the whole logistics chain, successful management of maritime logistics has a direct impact on the overall management and operations of both physical distribution and logistics management.

1.3 The process of maritime logistics

The concept and key activities of maritime logistics have been identified in the previous section. Figure II.2 shows the process of the maritime logistics system and its value creation. This model is built on from Porter's value chain model. The model disaggregates a maritime logistics system into primary and secondary activities. The primary activities consist of the major functions of the maritime operators (i.e. shipping lines, port/terminal operators and freight forwarders). The secondary activities are those which support the primary activities by helping them to run more effectively. Additional logistics services of the maritime operators and their organizational capability, i.e. human resource management, information systems, administrative skills and financial support, are essential in supporting the primary activities.

The primary activities which are performed by freight forwarders, shipping lines and port operators are inter linked with each other as suppliers or buyers. For example, shipping lines, who choose a port in which to anchor their vessels, are the main customers of port/terminal operators; freight forwarders, who work for shippers, are the customers of shipping lines. The maritime logistics system generated from these inter-linked primary activities can be reinforced by being supported by the additional logistics services of the secondary activities. The maritime logistics services can then be offered at a time when all the operators in the system are well coordinated as a single team. If the maritime logistics system can prove that the services are valuable enough for their customers to willingly purchase the services, the maritime logistics value is created.

Figure I.2: Process of maritime logistics



Source : Song, D, W. Panayides, P, M. (2015). "Maritime logistics: a guide to contemporary shipping and port management", Second edition, Koganpage, USA. p 59

The maritime logistics value would be increased by satisfying customers' needs with a higher quality of services. As a result, the highly valued maritime logistics service leads to the high performance of individual operators and the entire logistics system[1].

1.4 Changing roles of ports in logistics chains[2]

Ports have always been part of the maritime transport chain but their full integration in supply chains is a recent phenomenon. Earlier chains were highly fragmented, uncoordinated and inefficient. Ports were important but weak links in the chain. Individual firms in the chain including ports were internally rather than market-driven; their focus was on maximizing their own profit by being managed as stand-alone entities.

Accordingly, traditional thinking focuses on attributes of ports such as geographic location and service efficiencies, and considers them as weak links. However, since 1980, the market environment of ports has been continuously changing, and so has the traditional role of ports. The current literature widely accepts that ports are an integral part of supply chain and their positive effects on overall performance of logistics and supply chains. This leads to the idea that they should promote their respective supply chain's performance and efficiency, as well as improving their own internal efficiencies and performance. This demonstrates the competitive position of a port has also affected by its links to a supply chain, and it could not be inferred only from its internal strengths. The authors, further, indicate that the contemporary role of ports enhanced to become locations for value-added logistics, and locations where several trade partners could meet and interact. Similarly, ports are a part of a bunch of organizations which includes diverse logistics and transport operators in order to create value for the ultimate consumer. Accordingly, the altered role of ports has been conceptualized within three perspectives.

1- from a **logistics channel perspective**: ports serve as a node and operate as a logistics center.

2- From a **trade channel perspective**: ports are key locations that the control and ownership of the channel could be classified and/or traded.

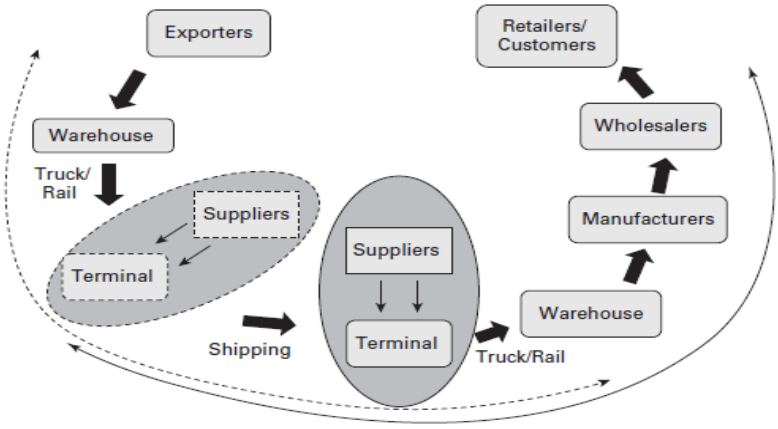
3- from a **supply channel perspective**: ports are links between outside flows and processes, and they also create patterns and processes on their own.

[1] Ibid p 58

[2]Song, D, W. Panayides, P, M. (2015). "Maritime logistics: a guide to contemporary shipping and port management", opcit p 346

This demonstrates, contemporary role of ports has enhanced to become networking sites, which gathers members of the chain.

Figure I.3: Ports in a supply chain



Source : Pettit,S.et al (2015)

Therefore, as the role of ports has changed, a need occurs for higher degree of coordination and cooperation in order to be successful. Thus, supply chain integration/orientation has become an interest in order to meet the needs and demands of customers, and to achieve port competitiveness.

Section 2: Port Generalities

2.1 Port terminology

De Langen defines a port as a collection of a diverse set of economic activities. Ports are the locations where road, rail and waterway start and end for cargo consolidation and distribution[1].

So Long defines a port as the intersection of different modes of transport. Seaports are hubs in worldwide transport to ensure interactions of domestic and international markets. They witness flows of goods and services between industries, consumers, and different countries. Many seaports and major inland river ports are critical ports as cargo transport centers, intermodal between road, rail, air and waterway[2]. Being pivotal places for sea/land transport interface, places where ships and cargoes are handled and services are given to them, nodes of

[1]De Langen, P. W., & Heij, C. (2014). Corporatisation and Performance: A Literature Review and an Analysis of the Performance Effects of the Corporatisation of Port of Rotterdam Authority. Transport Reviews, 34(3), 396-414.

shipping networks and elements in value-driven chain systems, ports have become elements and links in a global logistics and value chain.

Ports not only deliver value to shippers and third-party logistics (3PL) service providers, but also capture value for ports themselves; which involve the increased use of information and communications technology in the integrating SCM trend at ports; this indicates that ports are elements of the global supply chain.

2.2 Port generations

Ports are distinguished into four generations, with port roles and functions, institutional structuring, operational and management practices varying significantly from generation to generation, which is presented in TableI.3.

Table I.3: Port generations

Generations of port	Characteristics	Ports role in global supply chains
First generation Prior to 1960	• Exchange functions between two modes of transport • No development strategies for port development • No management of offered services and storages • Port activities are based on the quay • Authorities and agencies are overlapping • Supply dominates	• Provides low value-added • Limited hinterlands for most ports
Second generation After 1960	• Transport center for its environments' commercial and industrial activities • With transformation activities, services to the ships • Development and expansion strategies of the port area • Closer relations between port and its users • Relationships between the city and the port	• Cargo transformation and improved value-added services • Development of inland container deports (ICD)
Third generation Since 1980	• Integrated transport logistics platform for international trade with development strategies • Distribution center of goods and logistics activities • Implementation of information systems in the port (EDI) • Rational usage of port spaces • United and active port community, coordinating activities • Close relationships between the city and the port	• Development of distriparks • Integration of port with trade and transport chain • High value-added • Emergence of port clusters
Fourth generation Since 2000	• Network of physically separated ports linked through common operators (or common administration) • Internationalization strategies and variety of activities • Organization of logistics services by dockers • EDI network integrated into port areas • Search for port spaces distributed abroad • Cooperation between port communities	• Vertical integration of ports with global logistics services • Lean and agile logistics • Port centric logistics

Sources:(Adapted from Coto-Millan, Angel Pesquera & Castanedo, 2010, p. 251; Pettit & Beresford, 2009, p. 256)

It is worth acknowledging that although some ports have already entered the fourth generation, many ports are still in the first or second generation.

2.3 Port services[1]

A port can range from a small quay for berthing a ship to a very large scale center with many terminals and a cluster of industries and services. Ports need not necessarily be only seaports. In some countries, the term port denotes multimodal port facilities including seaports, airports and other intermodal facilities such as railway and road connections. In a similar vein, non-sea related activities can also fall under the wider definition of ports, for instance inland ports, intermodal terminals, inland clearance depots, dry ports, free ports, etc.

In the context of this study, the discussion is restricted to seaports, hereafter simply called ports. Ports that deviate from commercial ship and related cargo handling operations, e.g. fishing ports, military ports, and cruise ports are outside the scope of this study.

Ports may be classified according to the activities that take place in the port, such as:

- Multi cargo ports (handling more than one type of cargo)
- Container ports (handling foremost containerized cargo)
- Bulk ports (handling mainly dry or liquid bulk cargoes)
- Industrial ports (a port serving the requirements of a large industrial area)

Most ports systems can be divided into three main generic sub-systems:

1- The marine or nautical infrastructure (access channels, breakwaters, jetties, etc.),

2- The terminal infrastructure (quay walls, berths, yards, etc.),

3- Port superstructure (port equipment, vehicles, sheds, warehouses, gates, etc.).

Table I.4 provides a generic list of port services and charges ‘on the ship’

Table I.4: List of port services and charges

Description of service	Related port tariff	Authority involved
Maritime access: general facilities related to port access as far as outside the port area: • Provision of aids to navigation • Provision of port access	Conservancy dues Lighthouse dues, aids to navigation dues	Harbor Master

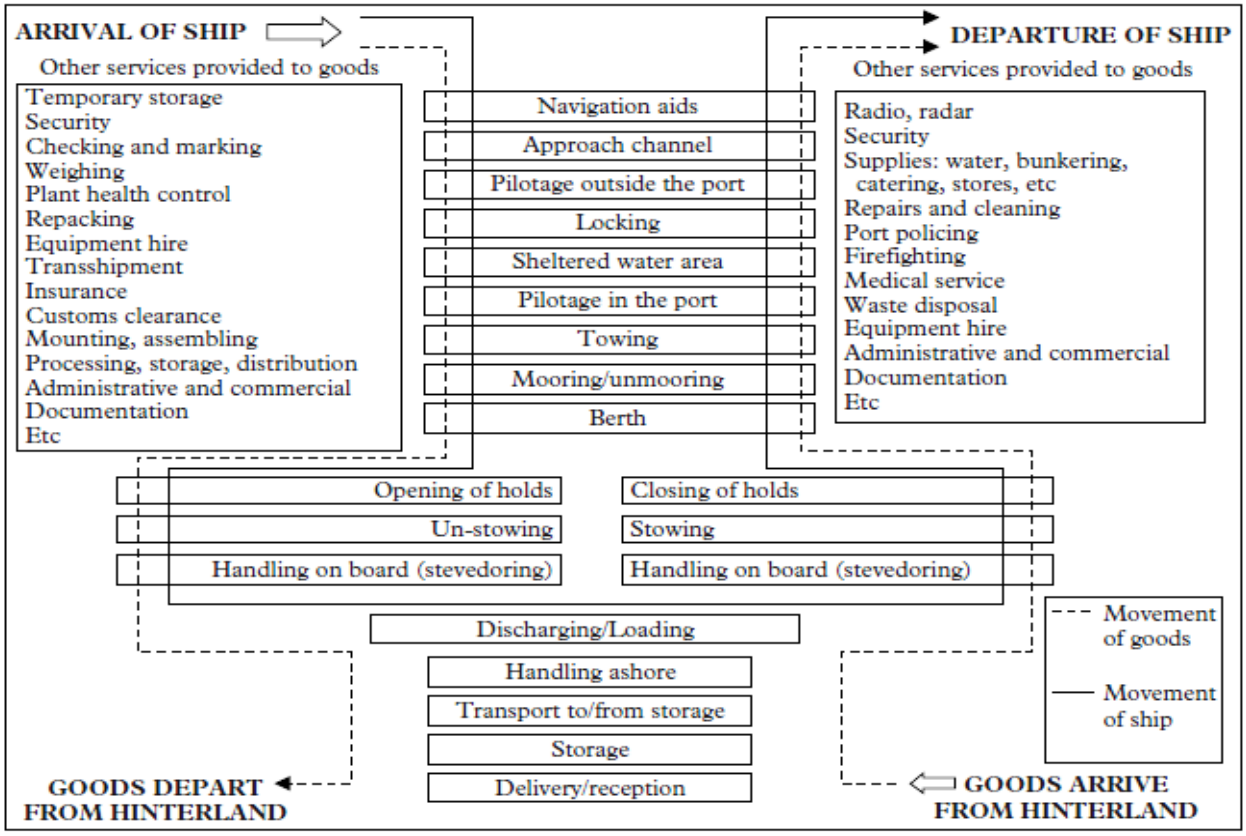
[1] Bichou,B, (2013). “Port operations, Planning and Logistics”, Informa Law from Routledge, USA, opcit p 31

Description of service	Related port tariff	Authority involved
General facilities and navigational services in the port comprising: • Navigational passages/VTS/necessary services of fight against fire/wave barriers/pollution control/maritime police	Port dues	Harbor Master
Pilotage services. Pilotage from the station outside the port to the berth or in opposite direction and also movements of ships from one berth to another within the port	Pilotage tariff	Pilotage company/ Harbor master
Connecting the ship cords and mooring on the quay or buoy and un-mooring	Mooring/un-mooring tariff	Pilotage company/ Mooring/unmooring company
Occupation by the ship of the assigned berth, whether quay,buoy or if mooring on the lock	Berth tariff	Port Administration
Shipping different merchandise (general merchandise/ solid/dry/liquid etc.) from the quay to the ship and unloading merchandise from the ship to the quay with use of cranes and ship equipment	Stevedoring Loading unloading tariff Cargo handling on board	Private or public stevedoring company
Providing additional services to load and unload the merchandise, which require special care, whether due to their special nature or the way they are shipped, e.g. for frozen merchandise refrigerating containers	Special cargo handling tariff Extra movement tariff	Specialized stevedoring company
General use by the passengers (incoming or travelling) of the facilities and services intended for them like (passenger rooms and stations/means of transport, etc.)	Passenger dues	Private companies Port Administration
Providing the ship with its needs. E.g. electrical current, water, fuel, telephone as well as providing assistance services (garbage collection/building cleaning)	Ancillary services tariff	Private companies Port Administration
General services to the goods provided by the general facilities and areas during the good's presence in the port and its circulation therein	Port due on cargo wharfage	Port Administration
Cargo handling on quay related to receiving and delivery of cargo Other handling of goods	Cargo handling tariff	Terminal handling operators/Port Authority
Transshipment of merchandise in the port stores and spaces of the port after the authorized period	Transshipment tariff	Port Administration
Storage of merchandise in the port stores and spaces of the port after the authorized period	Cargo storage tariff	Port Administration/Private or public companies
Providing the other services for the merchandise	Other cargo services tariff	Port Administration Free Zone Companies

Source: Worl Bank

The pilotage and towage services are generally provided by pilotage and towage companies, or by specialized companies, depending on the port. Figure I.5 summarizes port' functions.

Figure I.4: Main operational and administrative functions of a port



Source: UNCTAD

To complete the overview of port services, some other types of services offered by the Port authority. They cover the rent of forklift trucks, cranes and other equipment; the rent of trailers and launches; firefighting and rescue equipment and use of land, buildings, silos and other constructions.

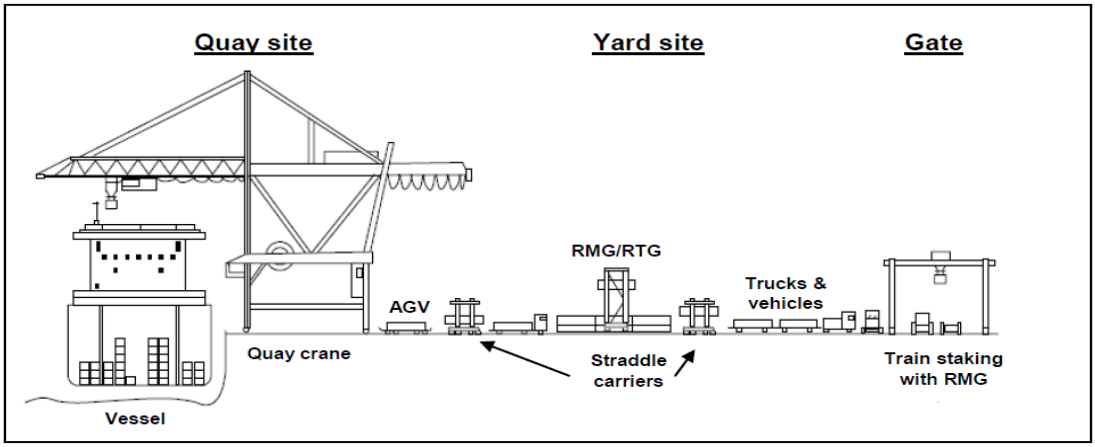
2.4 Terminal Operations[1]

Seaports must not be confused with terminals; the latter are specialized sometimes multi-purpose units within ports. Within a single port, different terminals can share the same nautical infrastructure such as access channels, jetties and breakwaters, piers and quay structures. Yet, each terminal may be decomposed into three main operating sites namely the

[1]Bichou,B, (2013). "Port operations, Planning and Logistics", opcit p 142

quay-site, the yard, and the gate (see Figure I.5). All such sites must operate jointly for efficient cargo handling and transfer operations.

Figure I.5: Container terminal sites and main handling equipment



Source : Bichou, K. (2013) "Port Operations, p 137

2.4.1 The physical infrastructure

The physical infrastructure of the quay site includes berth's length, draft and structure, which may differ according to the type of ship and cargo handled. In modern container ports, ship-to-shore (STS) cranes (also called portainers or transtainers) are mostly used for container loading and unloading. STS cranes come in different shapes, sizes, and technologies to keep up with increasing containership's size and the requirement for faster handling and higher intensity. Some ports still use mobile cranes to handle container traffic while small ports with limited containerized traffic or those which are under-equipped heavily rely on ship-mounted cranes (gears or derricks).

2.4.2 Terminal yard

Terminal yard is the area where cargo storage, stacking, and transfer takes place. Yard operations may be categorized into horizontal transport and storage-staking modules. In horizontal transport, the tractor-chassis system is widely used to move containers from/to yard. In the storage-stacking system, specialized equipment such as straddle carriers (SC), rubber-tired gantry cranes (RTG), and rail-mounted gantry cranes (RMG) are used to stack and retrieve containers in/from the yard. The total storage area of sheds and warehouses depends on a number of factors, in particular the cargo stowage factor, the average stacking height, and the floor space required for cargo handling and access by the relevant equipment in use. Containers are stacked and stored in the yard according to either segregation or scattering strategies, each

using a range of classification criteria such as destination (inbound, outbound, transshipped), status (full container load -FCL, less than full container load -LCL, empty), type (special, refrigerated, dangerous, etc.), and size (twenty foot equivalent units- TEUs, forty foot equivalent units- FEUs, non-standards).

2.4.3 Gate operations[1]

Gate operations are designed to efficiently control access into and out of a terminal or port facility through land interfaces, which may be further subdivided into train and truck interfaces (or interchange points). Components of gate planning and management include advance booking, arrival schedule, pick-up and delivery, cut-off times, validation check and control, and gate-in/ gate-out monitoring. Conventionally, the gate process is manual where a lane clerk identifies the import/export cargo and feeds information via radio or another hand device to the terminal's management system. Today, modern gate operations are implemented and managed using electronic and automated solutions for truck and container detection, size recognition and verification, congestion status, cut-off control, and other relevant operations. Available technologies include CCTV cameras, card readers, radio frequency identification (RFID) tags and sensors, and other mobile data and digital imaging technologies.

2.5 Port hinterland [2]

Spatially, the extent of the geographical market a port can serve is commonly called the hinterland. The size of the hinterland can vary considerably from one port to another due to several factors such as the scope of shipping services and port traffic, the quality of port facilities and services, the size and efficiency of the inland transport network, the number of competing ports for the same hinterland, etc. A port can therefore serve a local, a national, a regional or even an international hinterland. A good example of port competition for a shared hinterland can be found in the US Mid-West region, where cargo bound to this region is subject to an intense competition between East-coast and West-coast ports. Sometimes, ports can serve a far wider spatial market called the foreland. The latter is an area that a hub or a network port can serve through a series of feeder ports.

[1] Ibid p 144

Ports can also be categorized according to their logistical and locational status within international shipping and trade patterns. The following taxonomy is representative but not exhaustive of current port logistics:

2.5.1 Network ports:

provide high value-added services to both ships and cargo, and generate traffic from/to the port and its hinterland. Given their extensive facilities and channels of distribution, network ports are commercially attractive and offer low unit cost per ship.

2.5.2 Transshipment ports:

provide high value-added services to ships but low value-added services to cargo. They are mainly dedicated to ship-shore operations and are more suitable for cargo concentration and distribution. They also provide fast turnaround time for ships.

2.5.3 Direct call ports:

provide low value-added services to ships but higher value-added services to cargo. They are particularly attractive to tramp shipping and some forms of liner shipping.

2.5. 3 Direct call ports:

provide low value-added services to ships as they may not be economically suitable for direct call and may need to be linked to network or transshipment ports.

Ports act as maritime logistics centers when they provide logistics services at both sea and land interfaces. Typical logistics functions of ports include cargo handling and transfer operations, storage and warehousing, break bulk and consolidation, value added activities, information management, and other related services. Many ports have an established body of knowledge and experience in providing value-added logistics activities, yet not all ports can claim a logistics center status.

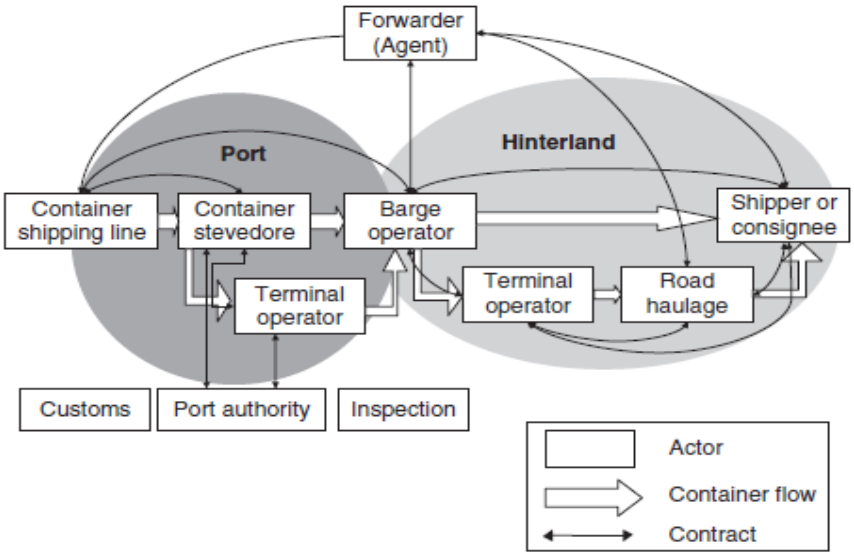
Table I.5: Terms used in relation to inland terminal facilities

Term	Definition
Inland Clearance Depot	A common-user inland facility, with public authority status, equipped with fixed installation, and offering services for handling and temporary storage of any kind of goods (including container) carried under customs transit by any applicable mode of inland surface transport, placed under customs control to clear goods for home use, warehousing, temporary admission, re-export, temporary storage for onward transit, and outright export.

Term	Definition
Inland Container Depot	A common-user facility with public authority status equipped with fixed installations and offering services for handling and temporary storage of import/export laden and empty containers carried under customs transit by any applicable mode of transport placed under customs control. All the activities related to clearance of goods for home use, warehousing, temporary admissions, re-export, temporary storage for onward transit and outright export, and transshipment take place from such stations.
Intermodal Freight Centre	A concentration of economically independent companies working in freight transport and supplementing services on a designated area where a change of transport units between traffic modes can take place.
Logistic Centre, Freight Village	Geographical grouping of independent companies and bodies that are dealing with freight transport (for example, freight forwarders, shippers, transport operators, customs) and with accompanying services (for example, storage, maintenance and repair), including at least a terminal.
Inland Freight Terminal	Any facility, other than a port or an airport, operated on a common-user basis, at which cargo in international trade is received or dispatched.
Inland Port	Located inland, generally far from seaport terminals; they supply regions with an intermodal terminal offering value added services or a merging point for different traffic modes involved in distributing merchandise that comes from ports.
Dry Port	An inland terminal which is directly linked to a maritime port.

Source : Song, D, W. Panayides, P, M. (2015). "Maritime logistics: a guide to contemporary shipping and port management", Second edition, Koganpage, USA. p 232

Figure I.6: Inland shipping hinterland chain



Source : Hercules E. Haralambides, (2013)," Port management '' Palgrave Macmillan,UK . p 61

Ports may also be seen as inland logistics centers when they operate as nodal and logistics interfaces intersecting the different segments of the inland transport system. In recent years, there has been a strong emphasis on the role and importance of inland ports, where all logistical operations not necessarily required to be carried out in the seaport area can take place. As a result, new concepts have emerged. Often though, there is no clear-cut separation between all such facilities in terms of their spatial or functional attributes. The following categorization may help underlining some of the differences between these concepts.

2.6 Port management models[1]

There are four main port management models: public service ports, tool ports, landlord ports and private service ports. These characteristics may vary, depending on differing public and private sector responsibilities. Each model has its own characteristics concerning the ownership of infrastructure, equipment, terminal operation and provision of port services to ships such as pilotage, towage and mooring. Service and tool ports mainly focus on the realization of public interests, whereas landlord ports aim to promote a balance between public interests (port authorities) and private interests (port industry). Fully privatized ports focus on private (shareholder) interests.

2.6.1 Public service port model

In this model, the Port Authority owns the land and the fixed and mobile assets, and performs all regulatory and port functions. The advantage is that development and operations are the responsibility of a single entity, which in principle makes for a cohesive approach, on condition that the Ministry does not exceed its controlling role. The lack of internal competition can lead to inefficient port administration, port operations and port maintenance. Moreover, there is often a lack of innovation and long delays in responding to the demands of the market. Finally, there is a heavy dependence on government funding which, if it cannot be accommodated, leads to underinvestment or a wasteful use of limited financial resources. The number of public service ports is declining.

2.6.2 Tool port model

In this model the Port Authority owns, develops and maintains the port infrastructure and superstructure, including the cargo handling equipment. The operation of the port's equipment is mainly done by the Port Authority labor, although small private cargo-handling firms can work on board the ships and on the quayside. While this model results in an avoidance of the

[1] Review of Maritime Transport 2017 Unctad/Rmt/2017 United Nations Publication p74

duplication of investments, the fragmentation in responsibility can lead to serious conflicts between the Port Authority and the operators if they both work as stevedores and/or quay operators. Also, the risk of underinvestment remains, as everything has to be funded by the Government or the Port Authority itself.

2.6.3 Landlord port model

The Port Authority retains the ownership of the port's infrastructure, but this is leased out (licensed) or given in concession to private operating companies. The private operating companies provide and maintain their own superstructures, their equipment and their information systems. The main benefit of this model is the fact that the private operator owns the cargo handling equipment and executes at the same time the operational activities, whereby planning is greatly improved and there is also a greater responsiveness to the needs and the changing conditions of the market. There may be both a risk of overcapacity (more than one operator for a similar type of facility) and under-capacity (one operator who does not want to invest in additional facilities for a specific type of cargo), although this can be solved through specific clauses in the concession agreement.

2.6.4 Private service port model

In this model, the public sector has no longer an interest in port activities, or it leaves port management and operations entirely to the private sector. Port land is owned or bought by the private sector and all operational activities are performed by the private sector. If there is regulation of the port it will be done by the private sector as well. The main advantage of this model is that port development and the tariff policies tend to be market-oriented.The main disadvantage of the private sector model is the risk of creating an abusive monopolistic system and the suppression of public involvement in the development of ports within a longer term economic policy.

Table I.6: Basic Port Management Models

Type	*Infra*	*Super*	*Labor*	*Other services*
Public service port	Public	Public	Public	Mostly public
Tool port	Public	Public	Private	Public/Private
Landlord port	Public	Private	Private	Public/Private
Private service port	Public	Private	Private	Mostly public

Source: World Bank - Port Reform Toolkit 2007

➢ **Issues in Developing a Unified Port Model**[1]

From the above categorization, it seems that the interactions between port missions, institutions and functions have resulted in a variety of approaches to port operations and management. Probably, the major obstacle against adopting a unified model for port development and strategy refers back to the complexity and diversity of the port business at more than one level, including:

• **Organizational differences:** issues of ownership (public versus private), institutional status (landlord/tool versus service), social arrangements (labor and manpower), etc.

• **Operational differences**: types of cargo handled, ships serviced, terminals operated, etc.

• **Physical and spatial differences:** location, access, connectivity, available capacity, etc.

• *Legal and regulatory differences*: trade and transport policy, administrative procedures, safety and security regulations, environment, etc.

Section 3: Trends in maritime transport supply

In this section, the Study highlights the main trends and future challenges faced by the port industry worldwide:

3.1 Up-scaling of vessel size [2]

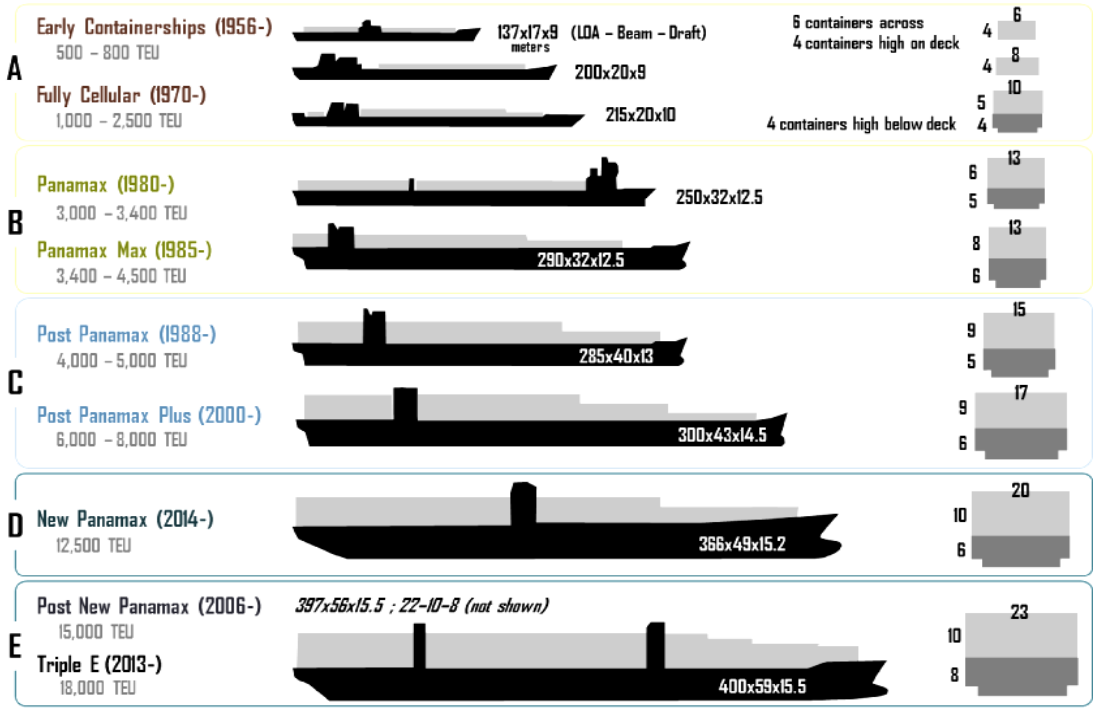
As shipping companies are no longer protected by the fixed conference prices, more emphasis has been placed on capturing size and network economies by increasing the scale of operations. In order to capture such scale advantages many shipping companies have invested heavily in new larger container ships. These vessels decrease operational costs by reducing fuel consumption, man hours and capital cost per transported container. However, the trend of acquiring larger ships has resulted in a large amount of overcapacity within the industry. In 2012 the world container fleet consisted of more than 5000 ships, with a combined capacity of 16 million TEUs. During the last fifteen years, the industry capacity has increased by over 400 percent, while the average container shipping volumes rate has grown approximately around 5 percent per year.

[1] Bichou,K, (2014). "Port operations, Planning and Logistics", opcit p 45

[2] Cullinane, K and Khanna, M., 2010, Economies of scale in large container ships, *Journal of transport economics and policy*, 33(2), 185-208

However, Larger ships require intensive port investment; longer and deeper berths, bigger cranes and handling equipment, and better technology and operation processes, this has led to a widening gap between few large efficient ports that can benefit from the economies of scale and hub and spoke networks against many small and inefficient ports that remain unsuited to modern and large ships and became heavily relying on feeder services.

Figure I.7: Vessel size and capacity



Source: Alphaliner

3.2 Supply chain consolidations

In a competitive, deregulated market, corporations try to simplify and control supply chains. As stated by the integration of modes, service and networks is crucial for successful transportation chains. In addition, firms try to 'seek advantage and value'.

In this manner, value is not only related to operating or technical efficiency. More precisely, the degree of integration of business processes and of the effectiveness of alliances and inter-firm arrangements is a contributor to a company's value chain. In summary, Robinson [1]identifies six key drivers that influence the value addition in an integrated supply chain:

[1] Robinson, R. (2002), "Ports as Elements in Value-driven Chain Systems: The New Paradigm." Maritime Policy and Management, Vol. 29, No.3: pp. 241-255.

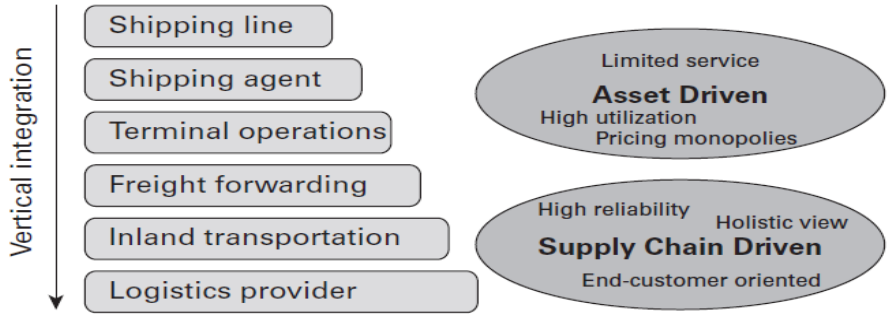
- operational efficiency and capacity matching (intra-firm);
- real-time information and the integration of business processes (intra-firm);
- alliances and coalitions (intra-firm);
- chain structures and value chain constellations (inter-firm);
- market settings (macro level);
- policy setting (macro level).

Especially at times of increased demand, integrated firms are able to take advantage of their own service portfolio. Externalities can be controlled more effectively, hence, volumes and transportation times are balanced more effectively. Inefficiencies might arise if core competencies are not developed in each field of business activity. Heaver [1]states that 'customers are reluctant to use a logistics service if they feel that logistics services are only offered as a means to feed another business'.

A widely described advantage for vertical integration refers to the reduction of transaction cost. Integrating logistics services may result in gained efficiency by realizing synergies. In this manner, information flow between different logistics services can be improved. An improved exchange of information and business knowledge enhances logistics service quality.

Better supply chain management enables the reduction of cycle times, inventories and improved flexibility, which especially holds for the competitive container shipping industry. It is widely recognized in the literature that the future of containerization will be shaped by inland transportation system. **FigureI.8.** illustrates potential steps for transport chain integration.

Figure I.8: Steps of supply chain integration



Source : Song, D, W. Panayides, P, M. (2015). "Maritime logistics: a guide to contemporary shipping and port management", Second edition, Koganpage, USA. p 155

[1] Heaver, TD (2005) Responding to shippers' supply chain requirements, in *International maritime transport – perspectives*, ed H Leggate, J McConville and A Morvillo, Routledge, New York, pp 202–14.

The scenario is developed from the shipping line perspective. The suggested steps of integration are not necessarily linear. Nonetheless, shipping liners implement those services into their business portfolios that are closely connected to their own services in the transportation chain. In this way, it is most beneficial for shipping lines to control terminal operations first. Following this, the connection to inland transportation can be worth considering.

3.3 Containerization, Automation and Technological Change[1]

As container transport becomes more affordable, both technically and economically, containerization has known a rise rate of propensity. While this is a positive trend, it also imposes additional challenges for countries to upgrade their port facilities, operating systems, cargo handling equipment, information and communication technologies (ICT), and related management processes. Modern terminal operations and processes are now largely automated with a high level of capital and technology resources.

3.4 Global port/terminal operators (GTOs) [2]

In 1990s, many major shipping lines or terminal operators bought terminals all over the world, while the number of smaller owners diminished. The term for a large scale of private terminal operator is global terminal operator (GTO). As the world trade volume considerably increased and larger ships have been introduced, there is a need for investment in terminal facilities and equipment. The rapid changes in terminal management environment require more innovative strategies from the leading terminal operators.

GTOs account for larger parts of supply chain in shipping industry, and offer integrated terminal systems with warehouse and distribution centers. Likewise, they develop the intermodal transport in order to enhance connectivity between ports and inlands. The efforts of operators for improving logistics facilitate the door-to-door movement and the efforts also contain the transformation of shipping companies into terminal operators.

[1] Tongzon, J. and Cheong, I.K. (2013), “The Challenges of Developing a Competitive Logistics Industry in ASEAN Countries”, International Journal of Logistics Research and Applications, 17(4), 323–38.

[2] Bichou, K. & Gray, R. (2005), "A critical review of conventional terminology for classifying seaports " Transportation Research Part A, Vol. 39, No.1: pp.75-92.

Table I.7: The busiest ports in the world

Ranking	Port	Country	Region	2016 annual throughput (teu)	2015 annual throughput (teu)	Annual % change
1	Shanghai	China	Asia	37,133,000	36,537,000	▲ 1.6%
2	Singapore	Singapore	Asia	30,903,600	30,922,300	▼ 0.1%
3	Shenzhen	China	Asia	23,979,300	24,204,000	▼ 0.9%
4	Ningbo-Zhoushan	China	Asia	21,560,000	20,620,000	▲ 4.6%
5 ▲ 1	Busan	South Korea	Asia	19,850,000	19,469,000	▲ 2.0%
6 ▼ 1	Hong Kong	China	Asia	19,813,000	20,073,000	▼ 1.3%
7	Guangzhou	China	Asia	18,857,700	17,624,900	▲ 7.0%
8	Qingdao	China	Asia	18,010,000	17,510,000	▲ 2.9%
9	Dubai	UAE	Middle East	14,772,000	15,592,000	▼ 5.3%
10	Tianjin	China	Asia	14,490,000	14,090,000	▲ 2.8%
11 ▲ 1	Port Klang	Malaysia	Asia	13,169,577	11,886,685	▲ 10.8%
12 ▼ 1	Rotterdam	Netherlands	N. Europe	12,385,168	12,234,535	▲ 1.2%
13	Kaohsiung	Taiwan	Asia	10,464,860	10,264,420	▲ 2.0%
14	Antwerp	Belgium	N. Europe	10,037,341	9,653,511	▲ 4.0%
15	Dalian	China	Asia	9,614,000	9,450,000	▲ 1.7%
16	Xiamen	China	Asia	9,613,679	9,182,815	▲ 4.7%
17 ▲ 1	Hamburg	Germany	N. Europe	8,910,000	8,821,481	▲ 1.0%
18 ▲ 1	Los Angeles	United States	North America	8,856,783	8,160,457	▲ 8.5%
19 ▼ 2	Tanjung Pelepas	Malaysia	Asia	8,280,661	9,120,000	▼ 9.2%
20 ▲ 1	Laem Chabang	Thailand	Asia	7,227,431	6,780,000	▲ 6.6%

Sources: Lloyds List Top 100 Ports 2017 Report, p16

The increasing trend in both tonnage volume and TEU throughput increase in the past 20 years shows that Asian, especially China ‘s freight, accounts for a large share. The ranking positions are also evidence that the dominant international trade is with Asia and China. This explains why GPOs concentrate their investment in China.

With the increasing global scale of operations, the large port operators are in a position of potential market domination, which may affect free choice and reduce competition. Other major regional port operators, such as ABP in UK and Dubai Port Authorities in the UAE, have also expanded their activities internationally with considerable specialization and international expertise in container terminal management and development.

It should also be noted that not all terminal operators are integrated by M&A. Effective network integration can be realized through better coordination with 3PL or other logistics service providers. The literature has paid much attention to vertical and horizontal integration including ports in the logistics chain, but it overlooks integration of the various activities in the port organization itself. This is mainly due to the complex organizational structure and management of ports, which has always been a central issue of port management and a major obstacle to the development of a comprehensive conceptual framework of port management[1].

[1] Ibid p 76

Table I.8: Global Container Operators capacity ranking

Ranking	Operator	Type of Operation	Million TEUs
1	Hutchison Port Holdings	Terminal operator	81.0
2	APM Terminals	Terminal operator	69.3
3	PSA International	Terminal operator	63.8
4	COSCO Group	Terminal operator	62.8
5	DP World	Terminal operator	60.5
6	Terminal Investment Limited	Terminal operator	36.2
7	CMHI	Terminal operator	27.2
8	China Shipping Terminal Development	Shipping company	26.3
9	Eurogate	Terminal operator	14.0
10	Hanjin	Shipping company	13.5
11	CMA CGM	Shipping company	11.3
12	SSA Marine / Carrix	Terminal operator	10.6
13	Evergreen	Shipping company	9.5
14	ICTSI	Terminal operator	7.8
15	**NYK Line**	**Shipping company**	**7.3**

Sources: Drewry Maritime Research, 2016a. maritime logistics p251

3.5 Port-centric logistics[1]

In contrast to the shift of port activities to in-land dry ports, with the role changing, port-centric logistics is emerging and being promoted.

Port-centric logistics is defined as "the provision of distribution and other value-adding logistics services at a port". A wider profit margins come from non-core port activities other than providing terminals, berths. Port-centric logistics has the advantage of being close to the port and provides logistics operations from the ports, rather than moving containers on roads to inland distribution centers. Hutchison, for example, announced that London Thames port provides integrated port-centric logistics as UK 's only automated port with 70,000 m² of warehousing space, good location, excellent facilities and good landside links by motorway and rail.

The port-centric logistics concept requires ports with deep-water capacity and spatial port-side land. The electronic data interchange (EDI) development, tracking and tracing system should be improved in response to the port-centric logistics. As port-centric logistics has enlarged the port activity area, it needs an advanced information and communication technology system to link different port stakeholders so that the communications between them are efficient.

[1] Mangan, J., Lalwani, C. & Butcher, T. (2008), *"Global Logistics and Supply Chain Management,"* Hoboken, NJ John Wiley & Sons.p 36

3.6 Emphasis on Port Safety and Security[1]

Over the past decade or so, there has been a greater emphasis on port security and most ports around the world must now have security plans, systems and procedures in line with international and local security regulations, most notably the ISPS Code (IMO International Ship and Port Facility Security Code). Even though, many trading nations and industry operators require further port security systems and procedures that go beyond the ISPS Code standards, for instance the Container Security Initiative (CSI) for ports with direct services to the USA and the ISO PAS 28,000 (specification for security management systems for the supply chain) for ports wanting to adhere to high security management systems and to establish global credibility. The adoption and implementation of those and other security measures would have direct implications on port operations and management, for instance in terms of secure terminal design and layout, security equipment and machinery, cargo integrity, electronic seals and scanning technology.

In port health and safety, there is no internationally enforceable port safety standard despite growing evidence of risks and incidents from ship's safety in ports, the quality of port pavement and pathways, the handling and storage of hazardous materials, port traffic hazards, and the operations and maintenance of port equipment and machinery, electrical and chemical installations. One major exception is in the area of container excess weight where verification of container weights for loading packed export containers aboard ships has become an IMO mandatory requirement in 2016.

3.7 Green and sustainability challenges[2]

Over the last few decades there has been an increasing concern on the negative effects of port development and operations in climate change, human health, eco-system and wider environmental sustainability (see **Figure I.9**), so the emergence of green and sustainability challenges represents a cutting-edge wave of change in the port and logistics industry.

Environmental factors associated with port development include land reclamation, dredging, construction, maintenance, and any related activity such as material's disposal, waste, and release of contaminants. Nautical and cargo handling operations can also create environmental concerns. Sources of environmental degradation caused by ships in port areas

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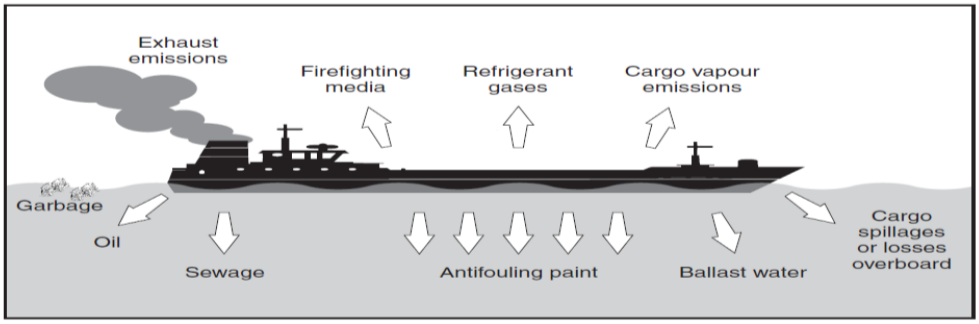
1 Bichou, B,Bell, M,G,H & Evans,A. (2007). "Risk management in port operations, logistics and supply-chain security", Informa Law from Routledge, USA, p 196

2 Lam, J. S. L., & Notteboom, T. (2014). The greening of ports: a comparison of port management tools used by leading ports in Asia and Europe. *Transport Reviews*, *34*(2), pp 169-189.

include ship stress and vibration, emissions and noise, waste production and disposal, storm and ballast waters' discharge, spill and leakage, and grounding and collision. For cargo handling operations, environmental risks include dust, toxic and hazardous materials from cargo, emissions, noise, and vibration from handling equipment and vehicles, spills and leakages from pipelines and storage tanks, and any adverse impact or accident during cargo handling, storage and distribution.

One area that has received particular attention in the past 5 years or so is the pollutant emissions in port areas. Several regulations and industry-led measures have been, or are currently being, introduced in order to improve the environmental performance of ports and reduce pollutant emissions generation. Among these, worth noting the introduction of limits on air pollutants from ships exhaust gas and on Sulphur's content allowed in marine fuel, the establishment of geographical emission control areas (ECAs), the launch of the world ports climate initiative (WPCI), and a number of other local and regional initiatives.

Figure I.9: Operational pollution from shipping



Source: Pinder,D, Slack,B,(2004), 'Shipping and Ports in the Twenty-first Century', Routledge, London,p 234

Another environmental concern for ports is the impact of climate change and extreme weather conditions on port systems. Climate change risks for ports include accelerated coastal erosion, port and coastal inundation and restrictions on access to docks, increased run-offs and situations requiring further dredging, and deterioration of conditions and problems with the structural integrity of pavements.

Chapter summary:

This chapter started with the definition of logistics and supply chain management. Then port activities, roles and functions, ownership, development and change were reviewed, which gave an overview of the port sector. This was followed by descriptions of the trends of maritime shipping industry to figure out where the current ports are going and how they should cope with the trends. The next chapter will focus on port selection and performance measurement.

CHAPTER 2:

MEASURING PORT PERFORMANCE AND FACTORS INFLUENCING PORT COMPETITIVENESS

Introduction

The main objective of this chapter is to review the relevant literature on port performance measurement and the factors that influence port performance.

The chapter consists of three main sections. The first section reviews the components of the logistics system for ports, namely, institutions, infrastructure, participants and logistics service providers. The second section reviews the literature on port performance measurement, including the importance of performance measurement and port performance indicators. The third section presents the port competition levels and presents potential factors that influence port choice and competitiveness.

Section 1: Components of a logistics system for ports[1]

For the port system, to what degree it can reduce the system cost and improve the service level depends on the efficiency of port operations and port authority management, which not only determines the efficiency of the whole port system, but also boosts the sustainable development of the port vicinity. For the port hinterland economy, port activities are of substantial importance, and the activities are geographically concentrated on a limited number of regions where the geographical conditions are favorable.

According to the Asian Development Bank, macro level logistics systems consist of four components, namely:

(1) Shippers, traders and consignees;

(2) Public and private service providers;

(3) Regional and national institutions, policies and rules;

(4) Transport and communications infrastructure.

Components (1) and (2) are the participants, component (3) provides conditions to support the regional logistics and component (4) offers the hard physical requirements for port performance. As ports need to work towards maintaining a competitive edge by developing an integrated approach to the logistics system, this section will introduce the four components.

1.1 Institutional framework

Government has a role to play by supporting small to medium-sized ports through policy work and other facilitative arrangements that would support the improvement of their services in their respective hinterlands, rather than competing for international trans-shipment hub status. To help secondary and smaller ports maintain their market position, steps should be

[1] Bichou, K and Gray, R, 2005a, A critical review of conventional terminology for classifying seaports, Transportation Research A, 39, 75–92

taken to clearly identify which strategy to follow to attract mainline or feeder service providers. Improving understanding of the determinants of cargo dwell time is crucial. Governments can help address inefficiencies and unlock the capacity constraints associated with ports through:

1.1.1 Preferential policies on customs, border inspection and tax [1]

As the port economy has a very close relationship with the neighboring countries, the port authority should provide special services of customs, salvage and admiralty court, apart from the general logistics services. Government support is important to port performance.
The government is in the right position for the strategic logistics scheme. They should put appropriate port governance structures in place to confront the challenges facing port-hinterlands development.

Preferential government policies will direct port development effectively. In international logistics, government plays a prominent role in the complex cross-border environment.

To improve port efficiency, the government should offer proactive policies to address the issues of wasteful transaction cost which due to operations between business companies and government agencies, reduce coordination failures, and build strong domestic constituencies to support reform. Government should offer preferential policies on customs and border inspection to simplify customs procedures and border inspection procedures to reduce transaction time and cost for cargo interests.

The free trade zone (FTZ) is one form of regional port development supported by government. FTZs are specialized areas for international trade, foreign investment, bonded warehouses, and export processing. They are considered as outside customs territory, to attract investment capital such as foreign direct investment (FDI) and create employment by providing a business friendly environment with incentives, good infrastructure and other advantages such as tax exemption. Almost all the key ports worldwide have set up FTZs, such as Klang in Malaysia, Rotterdam in Netherlands, Antwerp in Belgium, Hong Kong in China, Busan in Korea and Singapore. The preferential policies improve port services in customs clearance, and border cargo inspection, and benefit shippers with lower cost. FTZs should thus be promoted.

[1] Banomyong, R., Cook, P. & Kent, P. (2008), "Formulating regional logistics development policy: the case of ASEAN." *International Journal of Logistics: Research and Applications,* Vol. 11, No.5: pp. 359-379.

1.1.2 Investment in port development [1]

Government investments in port development include physical infrastructure, port technical infrastructure and ICT, which are all capital intensive. The investment will improve the transport quality and port efficiency. The ports ranked at the bottom by LPI are found to be usually underinvested with poor quality services. Government should help and invest in infrastructure as a public investor. On the one hand, it can share the risks with port operators; on the other hand, it can reduce the big financial burden on port authorities and operators.

E-government needs to be promoted to link the different governmental departments such as customs, border agencies, border cargo inspection, tax payment, and financial payment. The ICT system could improve the port quality service and reduce time and cost by paperless documents.

Government should also motivate openness to trade and provide assistance in local marketing and entry strategy alternatives. The banking policies/regulations for financial support ought to be provided to cargo interests. Port authorities can play an important role in the creation of core competencies and economies of scope by active engagement in the development of inland freight distribution, information systems and intermodality.

1.2 Transport and communications infrastructure [2]

infrastructure is included as a key attribute of the logistics system, as enlarging the hinterlands has much to do with the landside links to the hinterlands to enhance the idea of the port belonging to a system. The inland distribution is becoming a foremost important dimension of the globalization and maritime transportation paradigm. Infrastructure investment can have both a direct and a complementary effect on economic production. It may result in greater travel time reduction, transportation cost reduction and business expansion encouragement.

Containerization suggests that increasing cargoes are from the hinterlands. On the one hand, this has inevitably increased pressures on port and inland connections to the hinterlands and other allied systems. This has made the inland accessibility and port-hinterlands relationships a competitive factor in port improvement. The transport infrastructure has thus become more important to match port regionalization and expansion of port hinterlands. On the other hand, ports need to be linked to broader hinterlands for more cargo, which has stimulated

[1] Grainger, A. (2007), Trade Facilitation and Supply Chain Management: a case study at the interface between business and government, London, University of London.

[2] Notteboom, T. & Rodrigue, J. (2005), "Port regionalization: towards a new phase in port development." *Maritime Policy and Management,* Vol. 32, No.3: pp. 297-313.

the emergence of port regionalization to compete for a stronger hinterlands dimension with a greater geographical scope. Improving landside infrastructure can not only relieve container congestion, but also help with port regionalization to reach broader hinterlands. Consequently, inland accessibility has become a cornerstone in port competitiveness.

1.3 Cargo interests

Cargo interests refer to consignors and consignees. They need to expand the market and obtain more trading orders so that more cargoes are available for the logistics movement.
The economic status of the domestic hinterlands will decide whether there is sufficient cargo or demand to support port development, while the status of the international economy decides whether foreign countries have a strong demand for the cargo (see figure II.1), so development of both the hinterlands economy and world economy are critical for port development. They are the actual logistics demand with increasing importance, which include port city GDP, port hinterlands GDP, hinterlands foreign trade in terms of volume and value, hinterlands nearness, and port-urban relative concentration index.

The demand for cargo volume by cargo interests will determine the logistics demand, which increases port performance.

1.4 Public and private service providers [1]

Public and private service providers that provide port activities constitute another component of port logistics system as a system player. Services by LSPs include the services by shipping lines, the port authority, port operators, forwarders, warehousing operators and government agencies. All the services are related to port efficiency, which is critical for port performance. The service quality is highly related to their logistics skills, which are one critical factor to influence the performance of that sector.

Actors in the port context include:

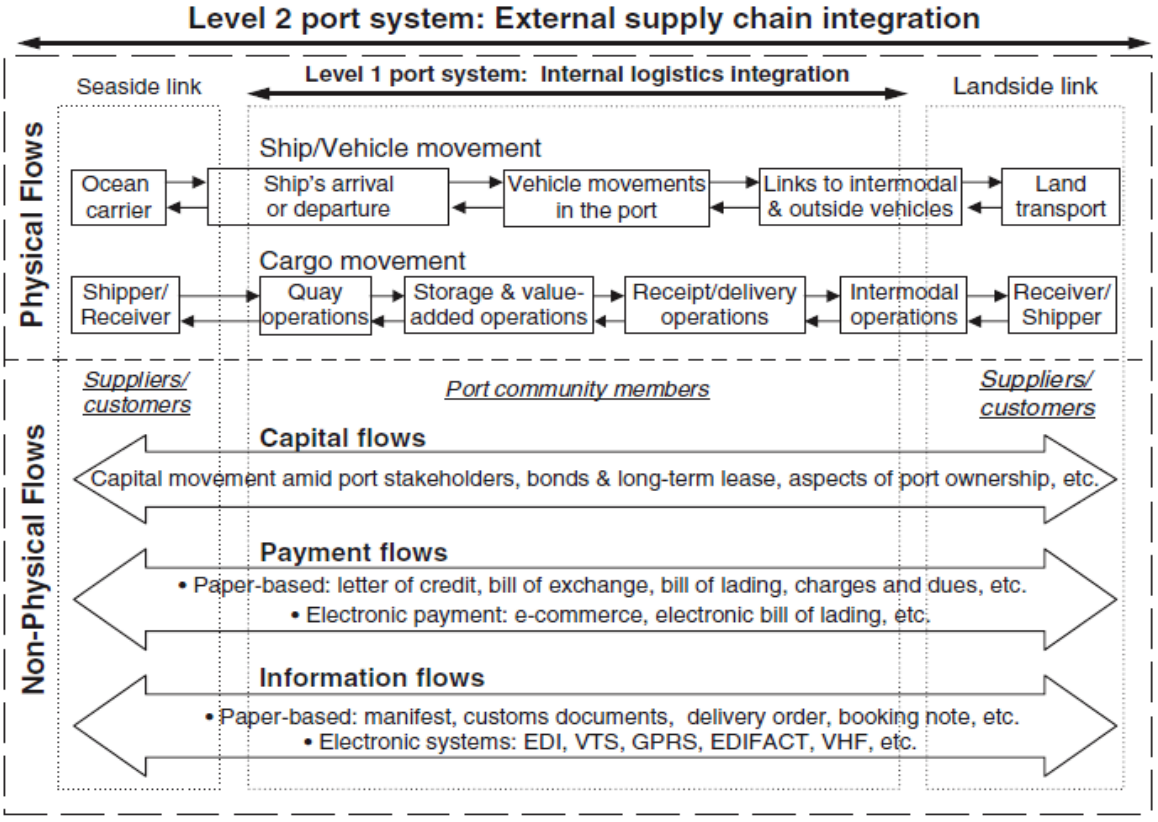
1. Those who directly transport the goods (ocean carriers, terminal operators, surface transporters, and labor),

2. Those who arrange goods movements (freight forwarders, shipping agents, and logistics providers),

[1] Gordon, J.R.M., Lee, P.M. & Lucas, H.C. (2005), "A resource-based view of competitive advantage at the Port of Singapore." *The Journal of Strategic Information Systems,* Vol. 14, No.1: pp. 69-86.

3. The owners of the goods (termed shippers), infrastructure providers, regulators, and local polities[1].

Figure II.1: port internal and external systems



Source : Hercules E. Haralambides, (2013)," Port management '' Palgrave Macmillan,UK . p 127

The conceptualization of the port business in terms of logistics and SCM translates various port operations into flows and processes related to a chain of activities of other supply chain members, so as to optimize the management of the entire chain rather than that of individual entities.

Section 2: Measuring port performance

"If you cannot measure it, you cannot improve it". (Lord Kelvin)

2.1 Measurement performance: the supply chain perspective

2.1.1 The meaning of performance[2]

The Oxford English Dictionary defines performance as: '*The accomplishment, execution, carrying out, working out of anything ordered or undertaken.*' This refers to outputs/outcomes

[1] Hall, P. V., Jacobs, W. (2010). "Shifting proximities: The maritime ports sector in an era of global supply chains. Regional Studies", 44(9), pp. 1103-1115.

[2] Armstrong, M. (2009), "Armstrong's Handbook of Performance Management", (4th edn.), London, Kogan Page, p 30

(accomplishment) but also states that performance is about doing the work as well as being about the results achieved. Performance could therefore be regarded as behavior – the way in which organizations, teams and individuals get work done.

$$\text{Performance} = \frac{\text{input}}{\text{output}}$$

If you can't define performance you can't measure or manage it. The 'Performance is a multi-dimensional construct, the measurement of which varies depending on a variety of factors.' it is important to determine whether the measurement objective is to assess performance outcomes or behavior.

2.1.2 The importance of Performance Measurement[1]

Performance measurement is important to the efficient and effective management of organizations. It reflects an organization's objectives, customer requirements and the external competitive environment. It can be used to assess the success of organizations. Understanding performance can also affect the behavior of managers and employees. Performance measurement can fill a number of functions, including transparency, learning, sanctioning, appraising and benchmarking between organizations and competitors.

Performance measurement helps decision makers through capturing performance data. Managers rely on measures as an integral element of planning and controlling processes. In a supply chain context, measuring performance is managerial tool that assists in planning and organizing activities, motivating workpeople, and controlling events within acceptable parameters. In any business enterprise, performance measurement becomes an important factor for effective planning and decision making. It can provide necessary feedback information to reveal progress, enhance communication and diagnose problems. Furthermore, it can help to understand the integration among the supply chain components.

In port studies, the performance of each element of the maritime industry influences seaborne trade, and consequently international trade. Measurement systems help in evaluating how existing capacity and port performance meet the requirements of the shippers and ship owners in terms of the waiting time of the ship, and how it can meet the consignees' expectations in terms of the dwelling time of cargo. An efficient performance measurement system helps to monitor the performance of operations and terminals in a port through providing a port with indicators that will assist in assessing port productivity and the management of complicated operations.

[1] Ibid p 231

Ports' managers, planners and authorities need a reliable performance measurement system to assess the efficiency and effectiveness of their actions. For this reason, optimization of facilities and operations is the common goal in most current measurement systems. Analytical methods such as queuing models, stochastic frontier, data envelopment analysis and simulation models have been the most common measurement approaches used in measuring port performance. A range of measurement systems are currently used in ports and terminals.

There are two requirements of performance measurement in the supply chain:

1) understanding and embedding the value and importance of measurement in a strategic framework for supply chain management; and 2) creating a predictive framework of supply chain risk[1].

2.1.3 Types of performances measures

Managing organizational performance means measuring and monitoring performance by the use of measures or metrics There is a choice of measures and these can be expressed and categorized as key performance indicators (KPIs), scorecards or the balanced scorecard, and communicated by means of dashboards.

2.1.3.1 Key performance indicators[2]

Key performance indicators (KPIs) are the results or outcomes that are identified as being crucial to the achievement of high performance and provide the basis for setting objectives and measuring performance. They must take account of the requirements of all stakeholders and should add social responsibility to the list of business objectives by including discretionary environmental initiatives, diversity and employee well-being in the set of KPIs.

A KPI is a special kind of metric. It measures something that is strategically important to the organization such as sales per square meter, added value per employee, rate of stock turnover, cost per unit of output, time to market and levels of employee engagement. In other words, 'A KPI is a metric that matters. You can have many metrics, but an organization needs only a handful of KPIs. Everything can't be considered "key," or nothing will stand out from the pack and get the attention it deserves.' The range of KPIs in different organizations is typically between six and 12, with potentially dozens of supporting metrics.

However, the number depends on the type of organization and can be as low as three or as

[1] Waters, D. (2007), "Global logistics: new directions in supply chain management", 5th ed.p. cm. Great Britain, p 253

[2] Ibid p 233

high as 24. KPIs provide the basis for defining the crucial goals for which individuals are accountable. The measurement system has to ensure that performance in relation to the KPIs is recorded and analyzed and that this information is passed on to accountable managers for action.

2.1.3.2 Scorecards[1]

Scorecards record performance related to a set of KPIs. In effect, they are report cards on the organization's performance. For example, they can show sales per square meter in a store, comparing actuals with targets and analyzing trends. As Dagan (2007) emphasizes: 'You should also not get carried away with trying to jam too many KPIs into your scorecard displays. Although the optimal number depends on your organization, a rule of thumb is that 6 to 10 KPIs are sufficient in most cases.' It should be possible to drill down into supporting tabular and graphical data to investigate any issues raised by the scorecard.

2.1.3.3 The balanced scorecard[2]

A balanced scorecard as originally formulated by Kaplan and Norton (1992, 1996) provides a picture of a business by combining financial measures with assessments for customer satisfaction, key internal processes and organizational learning and growth (see **Figure II.2**). It requires specific goals for customers in terms of time, quality, performance, service and cost as well as relationship, brand and product leadership. The internal perspective provides focus on the core competencies, processes, decisions, and actions that have the greatest impact on attaining customer satisfaction. The learning and growth perspective measures continual improvements to people, systems and processes. Sitting above this framework are the financial measures, which are essential for showing whether executives have correctly identified and constructed their measures in the three preceding areas.

Fundamentally a balanced scorecard should have a balance between output measures (financial and customer) and input measures (performance drivers, such as value proposition, internal processes, learning and growth). Every measure selected for a scorecard should be part of a link of cause-and-effect relationships, ending in financial objectives that represent a strategic theme for the business. Kaplan and Norton outline four key processes that the balanced scorecard relies on to connect short-term activities to long-term objectives:

1. **Translating the vision.** Managers are required to translate their vision into actual measurements linked directly to the people who will realize the vision.

[1] Ibid p 243

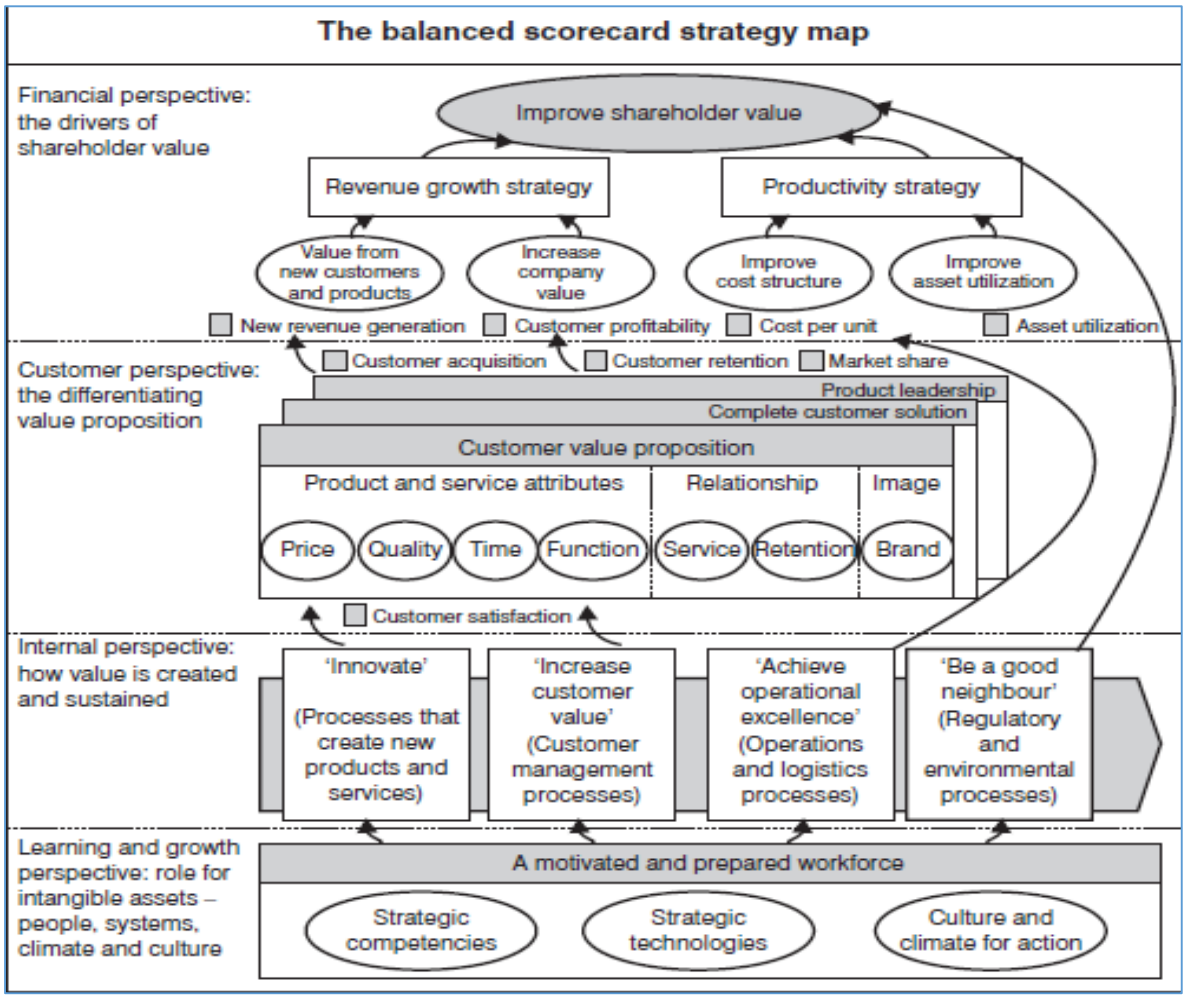
[2] Waters,D. (2007), opcit p 255

2. **Communicating and linking**. The scorecard indicates what the organization is trying to achieve for both shareholders and customers. The high-level strategy map is translated into business unit scorecards and eventually personal scorecards so that individuals understand how their personal goals and performance support the overall strategy.

3. *Business planning.* Once the performance measures for the four perspectives have been agreed, the company identifies the key drivers of the desired outcome and defines the milestones that mark progress towards achieving their strategic goal.

4. *Feedback and learning.* This allows for regular performance reviews to enable continuous improvement of the strategy and its execution.

Figure II.2: Kaplan and Norton's balanced scorecard framework



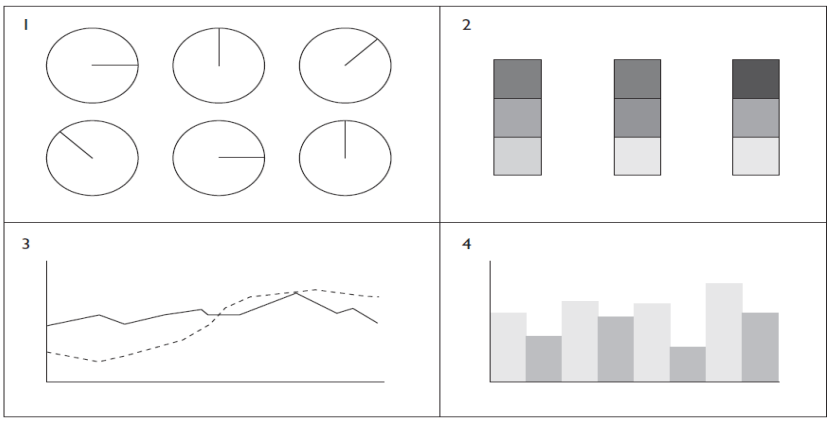
Source: ©Kaplan and Norton (1992)

In summary, the scorecard puts strategy and vision, not control, at the center. The measures are designed to pull people toward the overall vision. This methodology is consistent with the approach of supply chain management by helping managers overcome traditional functional barriers and ultimately leads to improved decision making and problem solving.

2.1.3.4 Dashboards[1]

A dashboard is a graphical display, designed to convey key performance measures on an organization's intranet system to a wide audience so that they can be assimilated and acted upon easily and swiftly. As Dover (2004) remarked: 'Dashboards are predominantly a data delivery vehicle.' Dashboards use dials, 'traffic light' displays and graphs to make performance information available as and when required. An example of a basic dashboard with just three dials is illustrated in Figure 17.4.

Figure II.3: Example of dashboard with: (1) dials, (2) traffic lights, (3 and 4) graphs



Source: Armstrong, M. (2009), "Armstrong's Handbook of Performance Management", p 246

dashboards provide a rapid and convenient way for people to assess how they are doing by reference to the business metrics critical to their place in the organization. They can thus initiate prompt corrective action as needed. Dashboards can be constructed using real-time or near real-time feeds from a data warehouse frontline system. Dashboard displays can be enhanced with charts, graphs or even tabular data. However, it is important not to make the entry screen too busy because this might divert attention away from the important metrics. An alternative is to provide facilities for obtaining supporting information. For example, if a traffi c light system shows a KPI that is red or yellow, then a click of the mouse should enable the user to drill down to pinpoint some of the underlying causes. Drill-down could be available to several layers with each layer providing even more details.

2.2 Port performance measurement approaches

The organizational structure of every port is unique, therefore it is far from being an easy task to measure and analyze the port performance efficiency according to one specific standard. The difficulty to determine a united standard is based on the fact that there is not a united method of how to summarize all the important aspects to measure the port's

[1] Armstrong, M. (2009), "Armstrong's Handbook of Performance Management", opcit p 236

performance. As shown in Table II.1, Bichou presents taxonomy of generic port performance measures as well as methodologies for implementing them. Three approaches for measuring port performance are distinguishable viz.

- performance metrics and productivity index methods,
- frontier methods,
- process approaches[1]

Table II.1. Taxonomy of port performance measures

Classification of Literature	Technique/Methodology	Disadvantages
Index methods		
•**Financial ratios**	Financial ratios: NPV, IRR, Gearing ratio, etc.	Financial ratios: Little correlation with the efficient use of resources, focus on short-term profitability, dissimilarity between various port costing and accounting systems, problems with price regulation and access to private equity
•**Snapshot indicators**	•Snapshot indicators: Throughput in TEU, total turnaround time, service time, cargo dwell time, etc.	Snapshot indicators: Provides an activity measure rather than a performance measure
•**SFP**	•SFP: Single output/single input	SFP/PFP: Provides average productivity but does not capture overall productivity. Non-statistical approach
• **PFP/MFP**	•PFP: Subset of outputs/subset of inputs	
• **TFP**	•TFP:	TFP: Requires estimation of cost, production or distance function (otherwise unable to separate scale effects from efficiency differences). Non-statistical approach
	• Törnqvist & Fisher (superlative) indexes	
	• Malmquist index: Does not require functional form, and can be decomposed into different sources of efficiency	
Frontier analysis		
•**Deterministic versus stochastic**	• COLS: deterministic/parametric	COLS: Requires functional form and dominated by the position of the frontier firm
•**Parametric versus non-parametric**	•DEA/FDH: deterministic/non-parametric	DEA: Sensitivity to choice of weights attached to input and output variables. No allowance for stochastic factors and measurement errors
	•SFA: stochastic/parametric	SFA: Requires functional form,specification of exact error terms and probability of their distribution
Process approaches		
• **Bottom-up approaches**	•Engineering economic analysis (EEA)	EEA: Data intensive, Relies on expert judgement and knowledge of the system
	•Enterprise modelling (ERP)	BPR/ERP: Expensive to build and maintain
•**Benchmarking toolkits**	• Process benchmarking (BSC, TQM)	Process benchmarking: Process approach, does not capture operational efficiency component and trends
• **Expert judgement**	• Business process modelling (BPR)	
•**Perception surveys**	•Action research, focus groups, etc.	
	•Statistical techniques for survey inquiry and hypothesis testing	

Source: Bichou, K. (2006), "Review of port performance approaches and a supply chain framework to port performance benchmarking." Research in Transportation Economics, Vol. 17, pp.567-598.

The stochastic frontiers approach (SFA) and the Data Envelopment Analysis (DEA) are mainly two econometric approaches using cross-sectional data used to measure efficiency. SFA

[1] Bichou, K. (2013) "Port Operations, Planning and Logistics"; Informa Law from Rutledge: New York, NY, USA, p 162

utilizes regression analysis to determine the inefficiency values and the factors which have an impact on efficiency. This unfortunately requires the functional form of the regression equation to be known in advance, which can result in biases introduced by subjective recognition.

2.2.1 Port performance indicators (PPIs)

The port performance indicators are tools being used for measuring different aspects of port operations. They are mainly used to compare the actual performance with the targeted one and to monitor the trend in performance level, so that they help port managers to take the right decision in the right time in order to enhance the port performance and services quality. The indicators can also be used as elements contributing in negotiation on port congestion surcharges, port development plans, port tariff determination and investment decisions,

Widely accepted performance measurements are unavailable, although there is a wide range of measures and indicators for port efficiency and performance, as ports are very dissimilar. UNVTAD defines the PPIs as the following.

Table II.2: Full scorecard of PPIs

Port entity only	Indicators (23)	N value (p x t)	Mean	Minimum	Maximum
Finance	EBITDA/revenue (operating margin)	44	38%	-75%	83%
	Vessel dues/revenue	42	18%	1%	32%
	Cargo dues/revenue	41	38%	10%	63%
	Rents/revenue	39	10%	1%	57%
	Labour/revenue	38	23%	7%	63%
	Fees and the like/revenue	30	6%	0.1%	23%
Human resources	Tons/employee	34	38 435	4 202	204 447
	Revenue/employee	38	$179 971	$138	$1 039 739
	EBITDA/ employee	33	$93 556	-$16 696	$555 835
	Labour cost/ employee	24	$23 863	$4 489	$93 589
	Training costs/wages	33	0.95%	0.03%	4.60%
Vessel operations	Average waiting time (hours)	62	17	0	89
	Average overall vessel length per vessel (m)	55	136	44	289
	Average draft per vessel (m)	55	8	2	22
	Average gross tonnage per vessel	66	14 260	552	43 216
Cargo operations	Average tonnage per arrival – all	41	4 739	201	20 510
	Tons per working hour, dry or solid bulk	28	116	20	350
	Box per hour, containers	46	18	8	35
	Twenty-foot equivalent unit dwell time (days)	29	7	3	18
	Tons per hour, liquid bulk	16	42	17	63
	Tons per hectare – all	41	173 986	75 772	425 800
	Tons per berth metre – all	41	3 920	890	7 439

Source: UNCTAD 2014

➢ **Financial indicators**[1]

- **Total revenue**: This is the total revenue for port dues and port related services provided to third parties. Excluded are any value added taxes.
- **Operating profit before interest, tax and depreciation (EBITDA):** This is a conventional measure known as earnings before interest, tax, depreciation, and amortization. This is a useful comparative measure as it excludes cost items that can vary in policy approaches cross nationally.
- **Port dues – vessels**: This is the total figure earned by the port authority on revenue headings associated with servicing vessels. They are various local charges against all seagoing vessels entering a harbor (or at anchor), to cover maintenance of channel depths, buoys, lights, etc. They are typically referred to as tonnage dues (wharf age) and charged on the vessel size e.g. GT (gross tonnage). They relate to the use of assets.
- **Port dues – cargo**: This is the total figure earned by the port authority on revenue headings associated with provision of cargo-handling infrastructure/facilities. Charges are raised typically based on cargo categorization using an international convention such as Standard International Trade Classification. The dues relate to the use of assets.
- **Port services revenue**: This is the revenue received for the provision of pilotage, towage, and crane services to port users by a port authority. The value is nil if the service is not provided by the port authority.
- **Property portfolio income**: In many port environments there can be substantial income earned from the wider port estate.
- **Concession fees**: This is a growing source of income where the private sector is involved in cargo handling, and other port services.
- **Labor costs**: This relates to direct port authority employees.

➢ **Vessel operations indicators**[2]

- **Number of arrivals for period**: This is the total vessel arrivals, excluding those smaller vessels that move within the port or to and from local destinations such as fishing and small local ferry operations.
- **Average waiting time for berth:** This is calculated from the time of first reporting at the port to the time of completion of the berthing process before working.

[1] UNCTAD port management series - volume 4 p 30

[2] Ibid p 31

- **Average time on berth (Hours plus part of as a decimal**): This is calculated from the time of completing the berthing process to the time of completion of the un-berthing process on final departure.
- **Average working time on berth (Hours plus part of as a decimal):** This is calculated from the time of starting the unloading process to the time of completion of the loading process before departure.
- **Down/idle time**: This is calculated as the total time work on the vessel actually comes to a stop. Future rounds will incorporate a reason code e.g. breakdown.
- **Number of pilots used (in/out = 2):** The number of vessel operations that require and use a pilot. An arrival, a shift if necessary, and a departure are separate operations.
- **Average gross tonnage (GT)** It is a volumetric measurement and replaced the GRT measure, thus standardizing measurement systems: The gross tonnage of a vessel is recorded on the ships tonnage certificate in accordance with the measurement rules of the International Convention on Tonnage Measurement of Ships adopted by the IMO in 1969 and fully implemented in 1982.
- **Berth occupancy ratio:** The high berth occupancy ratio indicates that the port suffers from congestion. The levels of berth occupancy that are considered healthy depend on the type of cargo, the number of berths available, and hence also on the expected service time of the vessels at berth.
    - **Cargo operations**[1]
- **Total cargo handled for period**: This is the total number of units handled in a period

ALL cargo	LoLo	Liquid Bulk	Dry Bulk	RoRo	Break bulk
Tons	TEU	Tons	Tons	Units	Tons

- **Average number of cranes per vessel on quay**: This is a simple measure based on the number of working cranes allocated to a vessel loading or unloading. The separate numbers reflect ports in the Network where cargo is also handled by on board cranes.
- **Average movement per hour**: Average movement per hour on and off the vessel - (tons for bulks, Box for LoLo)

[1] Ibid p 32

- **Average yard dwell time per box FOR LOLO ONLY**: The measure simply calculates the average time a container remains in the yard in the port.
- **Port cargo throughput capacity(Tons):** This is the volume capacity of the port and will be the lower of yard, berth or gate volume capacity
- **Total hectares**: A limiting factor in many ports is the availability of land for direct cargo handling. This measure is intended to capture the extent of land allocations to port operations.
- **Total berth meters**: A limiting factor for many ports is the availability of berth space for ship and cargo handling. This measure is intended to capture the extent of berth meters. crane
- **Total berth numbers**: A further measure of berth availability or otherwise is the number of berths.
- **Number of cargo-handling Operators**: From this a measure of intra port competitiveness is possible

➢ **Human resource indicators**[1]

- **Average employed by PA**: for period Full time equivalents (FTE) are the relevant measure for employees, especially if there is a strong element of part-time workers in the port authority.
- **Number of labor stoppages by PA employees**: Work stoppages are often a critical factor in explaining poor performance.
- **Average duration of PA labor stoppages**: The number of days lost due to work stoppages by PA employees is a useful comparator.
- **What percentage of Port Authority employees are female**? Gender distributions can vary significantly.
- **Training spend as proportion of total PA wages and salaries:** The total costs associated with training in proportion to the workforce labor costs
- **What is the dock worker hiring regime?** This is intended to capture the arrangements for dockworkers such as permanent, casual, and/or labor pool, private or public employers.

[1] Ibid p 33

2.3 Relevant external indicators on ports & supply chains[1]

An in depth analysis of relevant port / supply chain indicators was made. This analysis was based on:

- Available knowledge from all senior consortium partners.
- Analysis of reporting in industry magazines of port/supply chain performance indicators.
- Established contacts with international institutions active in ports & supply chains.

The most relevant externally provided indicators are:

1-The World Economic Forum (WEF) 'quality of port infrastructure' indicator, as well as other components of the WEF Global Competitiveness Report. Some of these indicators also appear in other WEF publications such as the Enabling Trade Report.

2. The UNCTAD Liner Shipping Connectivity Index (LSCI).

3. The World Bank's Logistics Performance index (LPI).

2.3.1 The World Economic Forum (WEF) 'quality of port infrastructure' indicator

The World Economic Forum (WEF) indicator provides an insight in the quality of port infrastructure in different countries. The ranking is based on survey results from industry leaders. The top-10 countries with the best port infrastructure for 2016-2017 are given in **Table II.3.** Note that some developing countries score very well (Panama), some advanced countries remarkably low (Italy) and many developing countries very low (Brazil). This directly impacts their competitiveness in a global market place.

Table II.3: Quality of port infrastructure: The World Economic Forum ranking (top-10 and selected countries)

country	Quality of port infrastructure, according to 2016-2017 WEF survey	
	Rank (From 140)	Score (1-7)
Netherland	1	6.8
Singapore	2	6.7
Hong Kong SAR	3	6.4
United Arab Emirates	4	6.4
Belgium	5	6.3
Panama	6	6.3
Finland	7	6.2
Iceland	8	5.9
Denmark	9	5.7
United States	10	5.7
Saudi Arabia	39	4.8
Morocco	41	4.8
Turquey	53	4.5
Egypt	55	4.3
Jordan	72	4.0

[1] De Langen, P. (2016), Deliverable 8.2 'Other port industry and supply chain indicators'', *Portopia, p8*

country	Quality of port infrastructure, according to 2016-2017 WEF survey	
	Rank (From 140)	Score (1-7)
Tunisia	92	3.6
Algeria	111	3.00

Source: World Economic Forum, Global Competitiveness Report (2016-2017)

Some countries traditionally have a high quality port infrastructure, but some 'rising stars' have seriously improved their ports in the past decade, while some others have lagged behind[1].

World Bank survey data on ports WEF is not the only institution to publish user perception based indicators. The World Bank (WB) has publicly available data that is expert based, i.e. generated through user surveys. The WB separately assesses the quality of port infrastructure and the level of port charges. Conceptually the WB approach is more appealing: while WEF only asks for an assessment of quality, WB asks for an assessment of quality and price. This is in line with standard economics where port users would be interested in the most attractive port in terms of price and quality, instead of being focused on quality alone. Indeed, one could argue price is the more important component, since empirical work on the price elasticity of long distance freight transport suggests that for the bulk of the transported volumes, this elasticity is low.

2.3.2 The UNCTAD Liner Shipping Connectivity Index (LSCI)[2].

The LSCI is a well-established index, published by UNCTAD and World Bank each year from 2004 onwards (see http://unctadstat.unctad.org/TableViewer/dimView.aspx). It is developed to measure countries' competitiveness in terms of access to regular and frequent liner services2. The LSCI is developed under the umbrella of the United Nations Conference on Trade and Development (UNCTAD). This index is the normalized average of five components that reflect the availability of container services to/from the assessed country:

1) The number of container ships on the liner services from and to country's ports,
2) The TEU carrying capacity of these ships,
3) Maximum vessel size,
4) The number of services,
5) The number of companies that deploy container ships on services from and to a country's ports.

[11] Ibid p11

[2] Ibid p 15

Table II.4: Top 3 countries with best LSCI scores and other elected countries

Country	2015	2016	2017
China	167.1	170.8	158.8
Singapore	117.1	119.5	115.1
Korea	113.2	112.6	109.9
Malaysa	110.6	102.5	98.1
United states	96.7	93.6	86.3
Germany	97.8	89.8	85.9
Netherlands	96.3	84.4	86.4
United Arab Emirates	70.4	73.1	73.7
Morrocco	68.3	59.9	67.0
Egypt	61.5	58.7	54.6
Algeria	5.9	10.9	7.3
Tunisia	5.7	6.6	6.6

Source:http://unctadstat.unctad.org/wds/TableViewer/tableView.aspx

2.3.3 The World Bank's Logistics Performance Index[1]

The World Bank's study "Logistics Performance Index" is broader than a study of ports alone, and measures logistics instead.

Yet the study is interesting as it includes port users' evaluations on specific factors dealing with logistics performance, as well as a framework on how to measure them. The Logistics Performance Index measures on-the-ground trade logistics performance based on six dimensions: 1) timeliness, 2) international shipments, 3) tracking and tracing 4) customs, 5) infrastructures and 6) services quality.

In doing so, in 2012, the World Bank developed two standardized questionnaires as a mean to gather the data needed. The first one is the international questionnaire which request for an assessment of six key areas of logistics performance and more specifically:

1) Efficiency of the clearance process by border control agencies (including customs).

2) Quality of trade-and transport-related infrastructure

3) Ease of arranging competitively priced shipments

4) Competence and quality of logistics services

5) Ability to track and trace consignments

6) Frequency with which shipments reach the consignee within the scheduled or expected delivery time.

[1] Vaggelas, G.K Pallis A.A, (2013), 'Port Performance: Criteria for measuring user's perceptions in different port markets', Research in Shipping and Ports (RESHIP) Laboratory, University of the Aegean, Greece p 6

Indicators 1, 2 and 4 are mainly areas related to policy regulation (input indicators) while indicators 3, 5 and 6 are related to the service delivery performance (outcome indicators). The responders proceed with an evaluation of the six performance factors for eight of the main overseas markets they deal with.

Apart from the international questionnaire there is also a domestic one, in which the respondents are requested to provide qualitative and quantitative data on the logistics environment in the countries they work. The respondent has to provide data for 5 major categories of factors related with quality, cost and efficiency. Each category has some sub-indicators.

Table II.5: Top 3 overall LPI countries with other selected ones (2016)

	Overall LPI		customs		infrastructure		International shipments		Logistics quality and competence		Tracking and tracing		Timeliness	
Country	rank	score	rank	score	rank	score	rank	score	rank	score	rank	score	rank	Score
Germany	1	4.23	2	4.12	1	4.44	8	3.86	1	4.28	3	4.27	2	4.45
Luxembourg	2	4.22	9	3.90	4	4.24	1	4.24	10	4.01	8	4.38	1	4.80
Sweden	3	4.20	8	3.92	3	4.27	4	4.0	2	4.25	1	4.38	3	4.45
Singapore	5	4.14	1	4.18	6	4.20	5	3.96	5	4.09	10	4.05	6	4.40
Hong Kong SAR, China	9	4.07	7	3.94	10	4.10	2	4.05	11	4.00	14	4.03	9	4.29
United States	10	3.99	16	3.75	8	4.15	19	3.65	8	4.01	5	4.20	11	4.25
United Arab Emirates	13	3.94	12	3.48	13	4.07	7	3.89	18	3.82	18	3.91	18	4.13
Turkey	34	3.42	36	3.18	31	3.49	35	3.41	36	3.31	43	3.39	40	3.75
Kenya	42	3.33	39	3.17	42	3.21	46	3.24	40	4.24	38	3.42	46	3.70
Egypt	49	3.18	65	2.75	50	3.07	45	3.27	43	3.20	54	3.15	48	3.63
Saudi Arabia	52	3.16	68	2.69	40	3.24	48	3.23	54	3.00	49	3.25	53	3.53
Jordan	67	2.96	83	2.55	62	2.77	49	3.17	61	2.89	62	2.96	71	3.34
Algeria	75	2.77	108	2.37	80	2.58	77	2.80	59	2.91	72	2.86	91	3.08
Morocco	86	2.67	124	2.22	90	2.46	54	3.09	91	2.59	122	2.34	83	3.20
Tunisia	110	2.50	147	1.96	93	2.44	133	2.33	90	2.95	84	2.67	99	3.00

Source: Consultant from World Bank

The LPI index is a multidimensional assessment of logistics performance, rated on a scale from 1 (worst) to 5 (best). The six core components captured by the LPI survey are rated by respondents on a scale of 1–5, where 1 is very low or very difficult and 5 is very high or very easy, except for question 15, where 1 is hardly ever and 5 is nearly always. The relative LPI score is obtained by normalizing the LPI score, where every component has a specific weight (0.41 for all the components except timeliness with 0.40).[1]

[1] Idid p 10

Section 3: Port competition and competitiveness

The world Bank stated that "The final aim of port competition is indeed not just getting more traffic, more tonnage, etc., but achieving a sustainable degree of generating added values in relation to the input and effort."

In this regard, it is necessary to understand basically the main idea that drives port competition and the factors that make the port more effective in terms of competition. A further question is can the port be managed in a good way with less time to achieve profits and avoid losing clients. Strong management is essential to overcome the problems or weaknesses in a port as results of the nature of the maritime sector as a competitive environment which becomes more challenging as global trade becomes more intensive, according to increase in freight volumes, and container traffic.

Development of port facilities and the quality of services is needed to attract clients and transform threats into opportunities.

3.1 Levels of port competition[1]

3.1.1 Inter-port competition

arises when two ports in the same or in different countries compete for the same cargo. The scale of inter-port competition often depends on the size of the hinterland of the concerned ports and how far these hinterlands become more and more extensive. A good example is the competition that exists between the ports of Hamburg, Rotterdam, Antwerp and Le Havre for cargoes destined to or coming from North and Central Europe.[2]

Competition with regard to container transshipment trades is specific for a whole region and often exclusively driven by the choices made by the main shipping lines or alliances. These choices are related to the lines' position with regard to transshipment traffic volumes, the lines' sailing schedules, the distances from the main shipping lanes, the equity share held by the lines in the container terminal operator's equity and so on. In the South Asian region, for example, container transshipment competition is considerable with the ports of Singapore, Colombo, Dubai, all vying for additional traffic and thus increased throughput levels. Governments or regulators should not get involved by interfering in transshipment competition, but leave these decisions to the shipping lines, the Port Authorities and of course the private terminal operators

[1] Reforming the Indian Ports Sector (2013); The International Bank for Reconstruction and Development/The World Bank p 56

engaged in this traffic segment, which concerns in the first place containerized flows (and which cannot be separated from the domestic traffic and throughput).

3.1.2 Intra-port competition refers to a situation where two or more terminal operators, within the same port area, compete for the same type of cargoes. Rotterdam will have three major container terminal operators with ECT, APMT and DPW. Antwerp has two major operators (PSA and DPW). Hamburg has also two operators.

3.1.3 Intra-terminal competition can also refer to two or more stevedoring or cargo-handling companies competing within the same terminal. This situation is rare and usually only exists within small ports operating under the public service port model with independent stevedores.

3.2 Criteria for port competitiveness and port choice

Revenue is vanity, profit is sanity, and cash is reality. (Anon)

The impacts of globalization, deregulation and privatization have enhanced port competition. Strong competition probably plays an important role to enable the maritime sector to grow fast. As Porter (1990) states, competitive advantages are created in the interplay between the rivalry, demanding customers, and the quality of related and supporting sectors.

It has long been recognized that port competition is not just between ports and transport carriers but also between the total logistics chains. The analysis of port competitiveness has mainly focused on port selection criteria[1].

3.2.1 Strategic location

To become a competitive port, a port must be strategically located. UNCTAD states that a port is strategically located, if it has at least one of the following three characteristics: situated on the main maritime routes; situated in or near production and /or consumption centers; with natural deep water harbors, natural breakwater and big waterfront and landside development possibilities. Moreover, a good geographical location should also be one where favorable climatic conditions prevail. Harsh weather can obstruct the daily operations at a port and hinder its development.

The world's top container ports are endowed with such locational attributes as centrality and intermediacy, in various and varying proportions. They are all central to something and on route to something else which is might except of any large seaport. The two top ranked ports Shanghai and Singapore, have been chosen by major container lines as interchange points

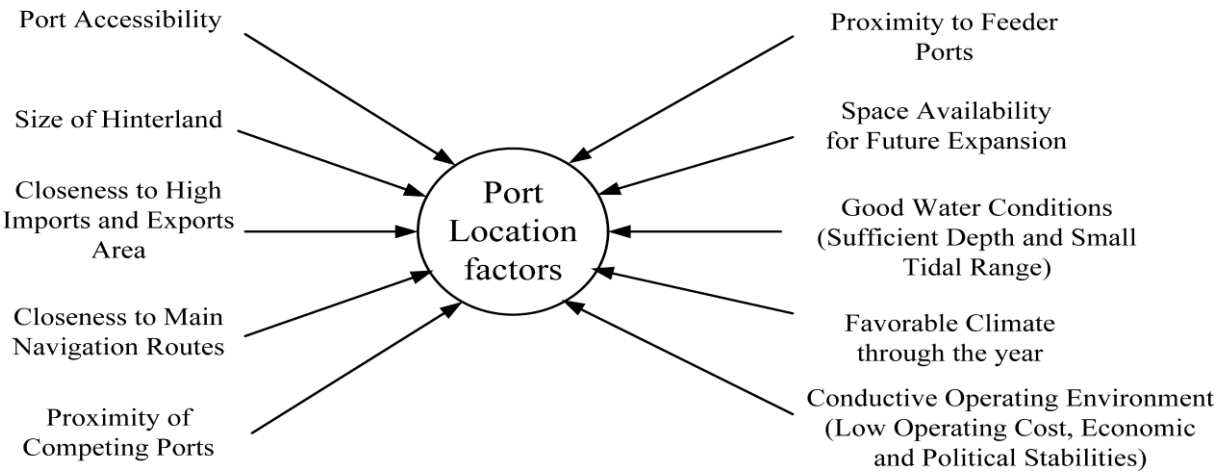
[1] Bichou, K., Gray, R. (2004) A logistics and supply chain management approach to port performance measurement. Maritime Policy & Management 31(1), p 47-67

between main lines and feeder services. Hong Kong's close connections with the Pearl River Delta and the booming southern province of China.

The port of Singapore is located along the straits of Malacca, which is a main shipping route between East and West. It was estimated that over 600 ships transit the straits every day. It is also fortunable to enjoy natural deep waters and harbors which allow it to serve ships with deeper draughts without necessarily resorting to extensive and expensive dredging operations. The waterways serving as entrants to Singapore allow even the largest ships to use them. Singapore does not have typhoons and other natural calamities, which make port operations and freight movement safe and reliable.

Singapore is located close to some of the world's dynamic economies. Even before rapid economic development of these economies started the port of Singapore has already played the role as an entrepot port serving as a gateway to Singapore's hinterland. The recent remarkable economic development and growing trade orientation of its close Asian neighbors have only heightened its role and entrepot port[1].

Figure II.4: Location factors affecting port attractiveness and competitions



Source: Chew,E,P & Lee,L,H & Tang,L,C (2011). "Advances in maritime logistics and supply chain systems". World Scientific Publishing. Singapore. p 35

3.2.2 Efficiency[2]

While the geographical location is a prime factor for a gateway status, it is worth nothing that many ports without such good natural conditions have obtained very big market shares by

[1] Guy, E. & Urli, B. (2006), "Port Selection and Multicriteria Analysis: An Application to the Montreal-New York Alternative." Maritime Economics & Logistics, Vol. 8, No.2: pp. 169-186.

[2] Heng, W., Tongzon, J. L. (2005). Port privatization, efficiency and competitiveness: some empirical evidence from container ports. *Transportation Research*, A (39), p 405- 424.

promoting other competitive factors. Tongzon defined competitiveness as the ability to get customers to choose a particular service over competing alternatives on a sustainable basis. In the context of sustainability, Ports should think long term and invest for the future, even at the expensive of short-term profits.

Efficiency often means speed and reliability of port services. In a survey conducted by UNCTAD, "on-time delivery" was cited to be a major concern by most shippers. In fast-paced industries where products must be moved to the position to guarantee shipping lines very reliable service levels. These include on-time berthing of vessels. Guaranteed turnaround time for vessels and guaranteed connection of containers.

Port efficiency can be reflected in the freight rates charged by shipping companies, turnaround time of ships and cargo dwelling time and efficiency of documentary processes.

The longer stays at berth, the higher is the cost that a ship will have to pay. this can be passed on to shippers in terms of higher fright charges and longer cargo dwelling time, and thus reducing the attractiveness for them to hub at a port.

Perceptions about port efficiency are also as important, if not more important, as the actual levels of port efficiency. A record of accomplishment based on number of awards received gives assurance to customers in terms of quality and reliability. The latter is eminent for influencing carrier's choice of hub port, as it is often the relative perception of customers (classified here as water carriers, freight forwarders, larger shippers and smaller shippers) that supersedes the actual port performance.

Port charges are a principal factor driving port choice, but its importance must be seen in the context of overall costs. Shippers are more concerned with indirect costs associated with delays, loss of markets/market share, loss of customer confidence and opportunities foregone due to inefficient service, than with port charges. Port users are actually willing to accept higher port costs in return for superior and more efficient service[1].

3.2.3 Adequate Infrastructure[2]

Infrastructure in its widest context refers not simply to the number of container berths, cranes, tugs and size of terminal area, but also to the quality of cranes, quality and effectiveness of information systems, availability of inter-modal transport (such as roads and railways), the approach channel provided and the preparedness or otherwise of the port management. If the

[1] Tongzon, J., Heng, W. (2005) Port privatization, efficiency and competitiveness: Some empirical evidence from container ports (terminals). Transportation Research A 39, p 405-424.

[2] Hercules E. Haralambides, (2015)," Port management '' Palgrave Macmillan,UK . p 180

volumes handled far exceed a port's cargo-handling capacity, this will result in port congestion and inefficiency, and thus can turn off port users. Furthermore, limited access to current information about shipment arrivals due to lack of adequate information system will slow the documentation process and thus the smooth functioning of a port. Without adequate inter-modal links, shipper cannot easily move cargo to and from the port, which could lead to congestion, delays and higher costs.

Infrastructure is generally divided into physical and soft elements. Physical infrastructure includes not only the operational facilities (such as the number of births, the number of cranes, yards and tugs, and the area of storage space) but also the inter-modal transport (such as roads and railways).

The soft infrastructure refers to the manpower employed. Maximum deployment of both types will assist in reducing vessel turnaround, thereby increasing the port's capacity to accommodate more vessels. Ships are continually increasing their carrying capacity and containers made for larger transport units in overseas container transport are under consideration. This scale enlargement requires new and capital-intensive transshipment facilities in gateway ports. In particular, inter-modality is essential for the speedy transport of cargoes into and out of a gateway port. Without proper linkages, the efficiency of a gateway port may decline due to congestion and delays. Notwithstanding the indirect costs incurred, the reputation of a gateway port is at stake. Additionally, it must be stressed that the quality of the hard infrastructure should not be neglected at the expense of quantity.

Along with hard infrastructure, human resource is of equal importance. Modern ports providing 24- hour service depend largely on the common efforts of the whole port community. Employees at different levels will have a role to play which ultimately contributes to the well-being of a port. Moreover, the intensive use of state-of-the-art technology would require more knowledge workers who specialize in information technology. An effective management of the human resource can tap the knowledge embedded in individuals; generating ideas and innovations that enhance the competitiveness of a port. Shipping lines are attracted to ports with adequate and superior infrastructure because they can entrust the entire task of container handling while paying more attention to other core activities. Moreover, they can also enjoy lower charges due to absence of bottlenecks at a port. With increased volumes handled at ports and the complexity of mother-feeder connections, there has to be faster conversion towards automation of all aspects of terminal operations from in/out gate to shipside. The use of IT domestically and between regional and gateway ports is essential as accurate and timely data exchange is critical to short transit and high frequency feeders.

Besides, the transparency of markets –and thus the power of customers- increases: for example, having access to information systems of carriers, customers can compare tariffs and recover causes of delay[1].

Likewise, information technology is applied increasingly in logistics. The management of logistics is becoming the management of information flows. By information technology, documents of shipments can be made to arrive before the arrival of the goods themselves, so that the goods flow can be processed more efficiently. The availability of almost real time information means that in-situ inventories and storage costs can be reduced. In a nutshell, operational and communication efficiency, accurate record of transactions and invoicing and minimum paper shuffling are necessary ingredients for future growth. Increasingly, vessels choose ports as their gateways with good telecommunication networks so that movements of cargo can be tracked and traced easily and documentation process shortened.

3.2.4 Connectivity[2]

A recent transshipment study by UNCTAD proposes that veritable grid networks assembled around transshipment ports where different trade routes intersect and interconnect have replaced traditional port-to-port routes. Big trans-oceanic shipping lines begin to take advantage of the flexibility and the scope for modulation allowed by the container technique to reorganize and restructure shipping services to regions of heavy traffic. A gateway port should, therefore, provide comprehensive connectivity to other ports.

Moreover, time is of essence. Containers awaiting transshipment at gateway ports are costly and counter-competitive in terms of transit time. Whenever possible, operators should strive for tight connection between feeder and mother vessels. Competitive ports should maintain the same objectives and encourage port users who support such initiatives with attractive incentives. To ensure fast connections, ports which employ single or common user terminal will have advantage over those that require inter terminal transfers.

As the trend towards large vessels continues, operators will require a network of connecting feeder vessels to aid in the transportation of cargo to and from other shallow-sea ports in the neighboring area. A port that provides exhaustive and fast connectivity to other ports is capable of assuming the role of gateway port for a defined region.

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[1] Ibid p 182

[2] Chew,E,P & Lee,L,H & Tang,L,C (2011). “Advances in maritime logistics and supply chain systems”. World Scientific Publishing. Singapore. p 100

Connectivity also implies frequency of ship visits. Greater frequency of ship visits translates into more choices for freight forwarders in selecting a shipping line for transportation of their cargoes, and hence more competitive carrier costs. Further, greater frequency of ship calls allows for greater flexibility and lower transit time. Thus, the more ship visits a port has, the more attractive it is to shippers.

3.2.5 Range of Port Services

Range of Port Services Statistics have shown that vessels are calling at a port for more than two purposes. It infers that ports should provide a range of services such as bunkering, pilotage, warehousing, cold storage and other value-adding services. Importantly, they should be integrated so that the port can be a one-time stop for ship owners. Besides choosing from a competitive supply, the present customer also wants to individualize his purchase.

The globalization of industries has resulted in flows of materials and information from a multitude of sourcing and manufacturing points to a diversity of markets with specific requirements of customer service. Consequently, the routing of logistic chains is getting more complex. The integral control of activities is becoming a critical factor for competition.

This supply chain management includes coordinating and streamlining activities of all firms in the chain. A precondition for effective chain integration is the existence of a channel captain, who can bind all parties and activities. With regards to the individualization of the location requirements of activities, the streamlining of operations in logistics chains can result in the spatial separation of activities to relocate every link of the chain at the optimal site. It necessitates the development of centralized warehousing and distribution which are sometimes linked to final assemblage and marketing.

Over time, high performance distribution systems will be required. The systems must be in line with and complement the rest of the shippers' logistic channels, including the material flow at manufacturing plants. Ports can experience synergistic benefits from distribution centers. A distribution center is advantageous because it attracts cargo that can be shipped through the port. There is a positive relationship between the cargo flow and the ships calling at the port: the cargo attracts the ships and the ships attract the cargo. From all this, the port earns revenue. Hence a port can profit not only from the distribution center itself but also from the increased flow of cargo through the port. Thus, an ideal port should provide a diverse range of services that are highly integrated. The increasing role of ports in logistic management should

be considered seriously. To provide logistic services, the port must have an efficient distribution system[1].

Chapter summary

This chapter firstly reviewed the components of a logistics system for ports. This was followed by reviewing logistics performance indicators. The PPIs were categorized. Then the factors resulting in some ports 'good performance were reviewed, and criteria for port competitiveness and choice were addressed. The literature came up with factors influencing port performances. As a port is a node in a supply chain to provide services to the shipping lines and shippers, the factors selected in Section 3 are all virtually related to port services from different perspectives. The next chapter will address the research methodology and how the empirical research was conducted.

[1] Tongzon, J. (2007), "Determinants of Competitiveness in Logistics: Implications for the ASEAN Region." Maritime Economics & Logistics, Vol. 9, No.1: pp.67-84.

CHAPTER 3

ANALYZING THE PERFORMANCE MEASUREMENT SYSTEM OF ANNABA PORT

Introduction

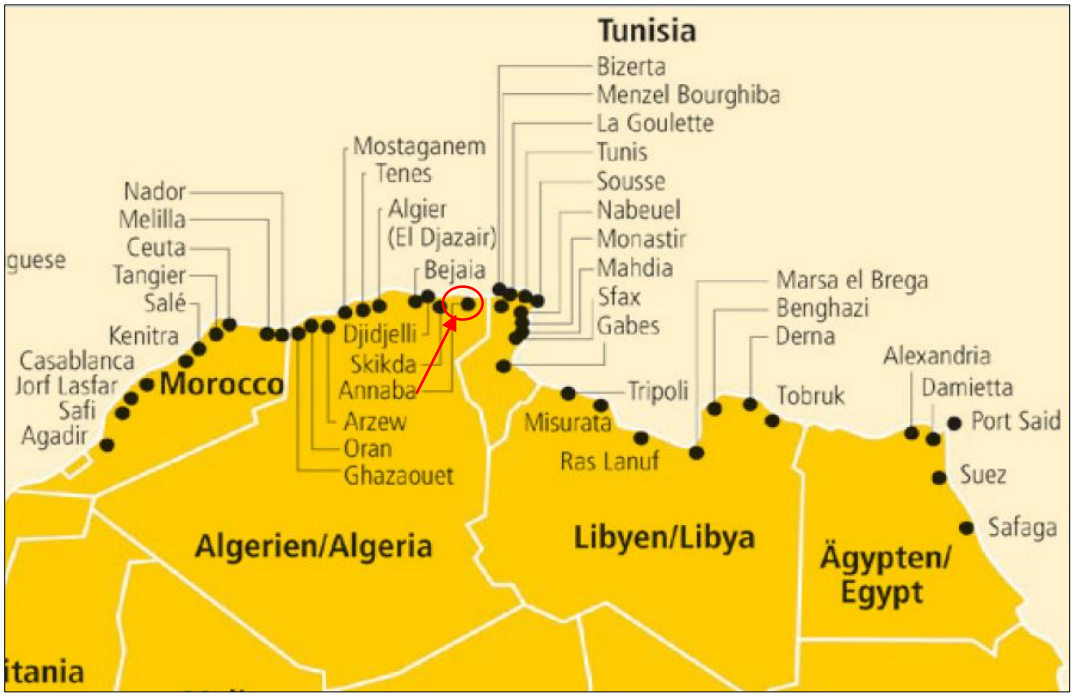
This part is divided into three sections. The first section provides the presentation of the port company, "Annaba port". Second section covers methodology research used in this study, lastly we are going to analyze the performance measurement in Annaba port in order to examine its effectiveness therefore if the performance measurement system affects the performance positively and can lead to port competitiveness.

Section 1: Overview of the host organization

1.1 General presentation of Annaba port company

The Port of Annaba is one of the most important and biggest ports in the Republic of Algeria. The Port of Annaba is a port of national interest opened to national and international public traffic; it is conveniently oriented toward the world's seaborne routes. The city of Annaba provides the shortest connection sea way between Europe and North Africa to overseas destinations and connected with the Mediterranean, the Suez Canal and the Strait of Gibraltar with the world seaports.

Figure III.1: Annaba port location



Source: DHL Global Forwarding Ocean Freight 'ports of the world' p 13

The port of Annaba is a service public economic company, joint stock company since February 28, 1989. Its share capital of three billion Algerian Dinars (3.000.000.000 DA) is totally owned by the Port Services Group - SERPORT.

Table III.1 Information about Annaba Port Company

• **Company name**	• Annaba port public economic company
• **Headquarters**	• Mole Stork, BP North platform: 1232 Annaba Algeria
• **Number phone** • **FAX**	• (213) 038 86 31 43 • (213) 038 86 54 15
• **Legal status**	• Joint Stock company
• **Share Capital (2016)**	• 3.000.000.000 AD
• **Services**	• Assistance to ships • Handling of goods • Stevedoring of goods
• **Staff**	• Total employees in March 2018: 1095 - Frames: **130** - Supervisors: **220** - Enforcement officers*:* **745**
• **Total revenue**	• **2015:** 4 817 460 453,37 AD • **2016:** 4 801 142 982,55 AD • **2017:** 3 902 023 708,56 AD

Source: adapted from internal documentations

1.1.1 Missions of port

The crucial mission of the port is management, operation and development of port infrastructure and superstructure, as well as the maintenance of the port domain.

1.1.2 Port hinterland

The field of influence of the port of Annaba spans 14 regions representing nearly a quarter of the total population of the country.

Thanks to its strategic position, the port of Annaba is one of the ten (10) key Commercial ports of Algeria. It ensures continuously the supply of industrial units with imported commodities:

- The carbon for the steel complex SIDER.

-Sulfur, potash for FERTIAL.

A. Channels of communication

• Annaba port is located at the intersection of important node with rail, road and air communications.

- The national road connecting Annaba - Guelma RN
- The national road connecting Annaba - Skikda RN

- The national road connecting Annaba - El Kala RN

• Port is attached to the railroad tracks that serve both mines of Djebel Onk with phosphates, national network and the Tunisia adjacent; the Tunisian border is 80 km from the port of Annaba.

• The length of the port railway network is 6200 m. the railway connects ISPAT and FERPHOS facilities, the grain elevators, the brown sugar handling facility, as well as to the national rail network container terminal.

• The region of Annaba has similarly a "Med Boudiaf" international airport located 12 km from the port.

B. Location:

-The port of Annaba is located:

-longitude East 07 ° 47' 03 "

-latitude North 36 ° 54' 11 "

-It is sheltered West by the the Edough mont, on the North by the promontory of Cape Garda, South by the dunes that extend East to Cape Rosa.

1.2 Port infrastructure and superstructures

1.2.1 Port infrastructure

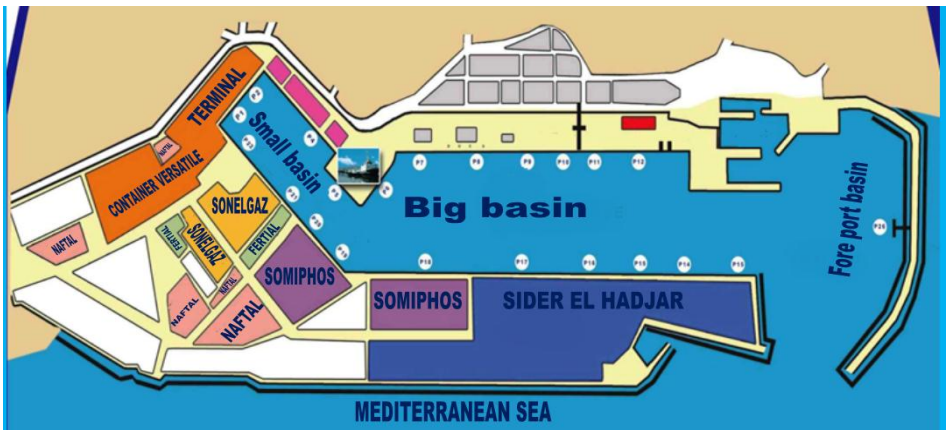
A. Access and Basins

TableIII.2: Port Access and basins

	Access to the port		Basins of the port	
	Long (m)	Deep (m)	Area (ha)	Deep (m)
Fore port basin	245	15	45	14
Big basin	230	13	40	10 to13.5
Small basin	183	12.5	9	7 to 12.5

Source: internal documentation of the company

Figure III.2: Plan of the port



Source: internal document

B. Protection Works: thrown 1380 ml which:

Pier of the Lion (North): 980 ml - guide blades as (South): 400 ml

C. Berthing facilities:

- They are composed of five commercial docks, the Stork mole used for gear of servitude of the Port and a position in Duke of Alba at the level of the North Pier or pier of the Lion.
- The infrastructure consists of 22 berths totaling 3 685 ml of linear dock with a medium draught of 9.75 ml and a maximum of 12.5 ml.

TableIII.3: Number of berths, their length and depth

Berth	Depth (m)	Length (m)	Assignment of positions	Operator
Quay 1		900		
07	9.80	165	General and various goods	Annaba port company
08	9.50	145		
09	9.50	145		
10	9.50	145		
11	9.50	145	Sugar in bulk + oil in bulk	
12	9.80	155	Grain (grain terminal)	
Quay2		350		
3	8.20	130	Containers and Ro/Ro ferries cars	
4	8.30	220	cars ferries	
Quay 3		240		
01	8.50	130	Containers, Ro/Ro	
02	8.50	110		
Quay 4		575		
19	9.10	220	Phosphates	FERPHOS
20	8.50	135	Potash and urea in bulk	FERTIAL
21	8.00	130	Phosphoric acid + various	FERTIAL
22	8.00	90	Ro/Ro	NAFTAL /APC
Quay 5		1360		
13	12.50	120	Coal/coke/ore	Sider
14	9.50	380	Steel products	
15	9.50	250		

Berth	Depth (m)	Length (m)	Assignment of positions	Operator
16	11.00	155	Phosphates	FERPHOS
17	11.00	130		
18	9.50	125	Ammonia/UAN tar / Fuel / oil	FERTIAL NAFTAL
Mole Stork		270		
05	6.00	100	Docking of the tugs	Annaba port company
06	6,20	170	General and various goods.	

Source: Internal document

Maximum and minimum draughts of the berths at the commercial harbor are 12.5 m and 8 m, respectively. Maximum Length Over All (LOA) of a ship that can be handled at the commercial harbor is 380 m.

1.2.2 Port superstructure

The port area has 76 ha of medians and water area of 94 ha.

A. Storage facilities:

The distribution of storage areas is as follows:

-50 000 m² covered (transit sheds)

-163 000 m² of quayside surfaces.

- Direct management by the Annaba port company
  - 7000 m² of transit sheds (06),
  - 82 000 m² of medians.
  - Grain elevator.
- Internal operators: 389 134 m² which:
  - Ferphos: 82 340 m²
  - Naftal: 54 765 m²
  - Sonelgaz: 43 977 m²
  - FERTIAL: 10 545 m
  - Sider: 2 361 m²
  - Other: 195 746 m²

B. Equipment

a) Marine equipments

- 4 Tugs: power: from 1000 to 4120CV.

-2 Pilot Boats: power: from 584 to 1410CV.

-3 Mooring boats: 03: from 127 to 140CV.

b) Handling equipment

-07 mobile cranes with capacity that varied between 30 and 104 tones

-68 forklifts with capacity that varies between 2 and 36 tones

-03 telescopic cranes with capacity that varied between 30 and 40 tones

-15 straddle carriers of 45 tones with automatic spreaders

-23 transfer sets (tractors + trailers)

-03 loading machines of 0.8 m^3

-05 VIGAN gantries for grain processing of 200 to 300 t/h

c) Berth and park equipment

- Post Linear docked 460 Ml.

- Capacity 10,000 DWT container.

- Ship Ro / Ro 4000 DWT.

-A shed (CFS) 2400 M2.

-202 volt electrical outlets for 380 refrigerated containers.

-A fire network.

-Two (02) Scanners we straight trucks.

1.3 Internal organization

In addition to the prerogatives that are assigned by the maritime code, the commercial code and its statutes, Annaba port company is administered by a Board of Directors. It is managed by an Executive Director who also has the quality of President of the Board of Directors.

Its activities are organized into eight (09) directorates; (04) four operational branches and five (05) directorate of support. These directorates are headed by directors who are placed under the authority of the Chief Executive Officer.

1.3.1 Operational directorates

1- Port Domain Directorate.

2- Handling and stevedoring Directorate.

3- Harbor Master Directorate.

4- Container terminal Directorate.

1.3.2 Support Directions

1- Maintenance Directorate.

2- Administration and Human Resources Directorate.

3- Finance and Accounting Directorate.

4- Commercial Directorate.

5- Development Directorate.

Section 2: Research methodology

Port managers need reliable and accurate information to make informed decisions to successfully deal with their complex daily operations. The information provided by the port managers and authorities for the purpose of measuring their port performance could be the result of a careful analysis of data gathered or of data that are already available. There are several types of data that should be collected and analyzed. This is because there are different terminals that handle different types of cargoes, and different operations, activities and services that are provided in ports. The robustness of the analysis depends very much on the quality of data used. Data should be collected for those predictor variables and operations that influence port performance. It helps to understand how performance can be improved through identifying the weaknesses in aspects of the operations. There is a need to understand the problem of optimizing the time for loading and unloading cargoes to and from a ship at a terminal, waiting time, total time a ship stays in port and clearance time.

2.1 Research questions

The research examines different measurement techniques applied in assessing supply chain performance. Following this, the research questions have been generated and selected accordingly concerning measurement techniques applied in Annaba port. The answer to these investigations and more specific questions helps to satisfactorily arrive at a conclusion about the research aims.

1. What is the measurement system that is currently applied in measuring Annaba port performance?

2. Is the measurement system applied in Annaba port effective?

3. what are the inefficiencies of the performance measurement system of Annaba port?

The answer to these questions requires an in-depth investigation to understand those inputs, outputs, internal factors and external factors that influence a port's performance

2.2 Research process

The purpose of this research as stated in general introduction is to analyze Annaba port performance measurement system and to examine its effectiveness. Accordingly, the research

is an explanatory study that explains the variables that should be included in the measuring performance of ports.

A performance measurement system is a managerial task where a required system should support the port in its current functions in a consistent way. A measurement system should be strategically oriented and use acceptable parameters rather than focusing on the actual output of the process. Measures should include financial and non-financial measures and should be simple, easy to use and provide fast feedback. Performance measures are a part of a system that can be used to quantify actions or a process.

The literature review helped to conceptualize the research process. The research process begins with defining the current performance measurement system applied in Annaba port. It helps to identify the current measures and indicators used to monitor port performance. The second stage of the process is to analyze the effectiveness of the current measurement system. The purpose is to verify the reliability and adequacy of current measures. This helps also to determine whether re-engineering for the current performance measures is needed or not. In the las process, proposing a more effective measures have taken place using three measurement categories: time, revenue and flexibility.

2.3 Data collection methods

Various data collection methods have been applied for gathering data and information about performance measurement systems in the supply chain context in ports and in the operating environment of Annaba port. Also, a mass of information has been collected through multiple techniques for each key performance variable.

2.3.1 Observation[1]

It is a technique that involves systematically selecting, watching and recording behavior and characteristics of Annaba port performance during port visits.

Observations provided additional and more accurate information on the behavior of Annaba port performance than interviews or questionnaires. It helped to check on the information collected through interviews.

Thirteen visits were conducted between January 2018 and May 2018. Each visit took up to three hours for observing port operations such as cargo loading and discharging at different terminals, berth occupancy, storage yards and warehouses, the traffic control bridge, logistics center, in-port transportation and waiting time at berths. All the observations have been recorded manually by the researcher. Conducting observation was useful because:

[1] Robson, C. (2016), "Real World Research". 4rd ed. John Wiley & Sons. U.K.p 319

1. It is one of the most direct research techniques.
2. It is used in combination with interviews. Hence, observation could therefore provide useful insights into the extent to which there is a correlation or discrepancy between what port managers say and what they actually do.
3. Observing Annaba port operations provided better and direct information.
4. It helped to understand the port managers' characteristics.
5. It allowed the researcher to describe the full complexity of the situation.
6. It helped to identify certain observed problems, such as cargo remaining for a long time at a certain terminal.

2.3.2 Interviewing

Unstructured and structured interviews were conducted to obtain information about the operating environment and to explain the cause-and-effect relationship between key variables in Annaba port. Appendix 1 shows a sample of the interviews conducted at Annaba port. This sample is incorporated into this research to explore the beneficial information obtained from the port's managers and to show how these interviews helped to understand their needs. Also, they helped to explore those external factors that cause poor performance.

Unstructured interviews aimed to identify some preliminary issues to determine which variables affect port performance and consequently which required further in-depth investigation. Interviewing the port director required unstructured interviews where there are no specific questions, nor order of topic to be discussed. After conducting unstructured interviews, there was a need to identify the variables that need greater focus and call for more in-depth information.

This required structured interviews with managers at several levels. Conducting unstructured interviews were beneficial because:

- It made interviewees more relaxed to present ideas.
- It permits full exploration of ideas and beliefs.
- It gives maximum flexibility to be to pursue questioning in whatever direction appears to be appropriate.

Structured interviews with the port personnel followed. Questions focused on those key variables that had surfaced during the unstructured interviews. Interviews involved oral questioning of respondents, and answers to the questions posed during an interview was recorded. Visual aids such as port maps and annual reports used to explain the important factors influencing port performance. conducting structured interviews were beneficial because:

- It allows for a wide topic area to be looked at.

- Quick and cost effective to get directly needed information.
- It allows for easy data analysis.

Managers at several levels were interviewed including the port commercial director, operations manager, logistics manager and operation supervisors. The commercial port director was firstly contacted to explain the purpose of this research and to get permission for conducting interviews with the port managers and employees. Also, he helped to select the interviewees. This was useful to avoid any unwillingness or inability of the interviewees to participate, to keep interviewees motivated to respond and to provide reliable information and to restrict bias. Table III.4. details the interviews that were held at the port managers' offices at Annaba port.

Table III.4: Interviews conducted at Annaba port

Interview	Interview date	Interviewee
Interview 01	05-02-2018	Commercial Director
Interview 02	28-02-2018	Chief harbor master
Interview 03	15-03- 2018	Container terminal Director
Interview 04	01-04-2018	Operation manager
Interview 05	24-04-2018	Cost control Director

Source: developed by student

Conducting interviews was useful because:

1. It provided an opportunity for the interviewee to give more detailed information.
2. The statistical data became richer and fuller with contextual information.
3. The data have been collected in a natural setting.
4. An interview was a particularly useful tool to understand the experiences and actions of each individual respondent.
5. It provided an opportunity to explore respondents' views.
6. It provided the researcher with an opportunity to observe and record the nonverbal behavior of the respondent.

2.3.3 Other data collection

Apart from interviews and observation, documents were used to collect secondary data. Documents include two categories: specific documents and contextual documents. Specific documents refer to those directly relevant to the topic of the research, such as publications and memoranda. Contextual documents encompass such multiple sources as company brochures, data from the internet, databases, documentation and reports of industrial associations, which provide an understanding of the company and port background.

The data gathered are statistically analyzed to determine if the hypotheses generated are supported. It helps to analyze the relationship between the port's performance and the total time cargo remains in the port. Different types of data were available from Annaba port. These data included:

1. General statistics such as total land area, total water area and total length of berths.
2. National fleet, such as classification according to type of ships, age classification according to type of ships and classification according to types of owner.
3. Ships registrations, such as registration in territorial water and registration in international water.
4. Port traffic, such as number of calls, berth occupancy, storage utilization, handling rates and total handled volumes, in-port transportation and equipment capacity.

Data have been collected according to the four types of cargoes handled in Annaba port, namely general cargo, dry bulk, liquid bulk and containers. Data were available and have been collected on a monthly basis. For each type of cargo, port's traffic data have been edited, keyed and a categorization scheme has been set up to cover those operations at a terminal. For this purpose, different categories of port operations have been placed into five categories. Each group comprises operations that have the same purpose. This helped to understand and analyze the data collected relating to the key variables. Port visits and interviews helped to access the port traffic and capacity archives that in turn helped to identify key operations that influence Annaba ports performance. Selected operations have been verified by the port managers and directors through interviews and observations. Data were keyed and checked to see whether there were unusual observations in certain months.

Data analysis helped to test the hypotheses developed for the research. Also, it helped the variance between the actual and estimated port performance. It indicated the reliability of the data collected.

Section 3: Data presentation, analysis and interpretation

The aim of this section is to analyze the current performance measurement approach applied in the port of Annaba and to examine its effectiveness. Different research methods have been applied for this purpose; including interviews, port records, port visits, observations, the internet and the literature review.

3.1 A Number of calling ships

The Annaba Port Authority takes into consideration that the number of ships calling into the port is the key prerequisite to measure the port performance. The port authority believes that determining the number of ships calling at the port helps to understand the streamline flow of all types of cargoes. It shows the inbound and outbound volumes of cargoes. Also, Annaba port believes that determining the number of calling ships will contribute to forecasting future volumes. The number of calling ships comprises two key performance indicators: number of calling ships and number of shipping lines.

3.1.1 Number of calling ships

Annaba port records the number of calling ships per month as a key performance indicator. Then, it compares total number of ships and total volumes handled in the port on a monthly and yearly basis to show if there is an increase or decrease in total number of ships calling. An increase or a decrease in the number of ship calls is being used as an important indicator to identify performance.

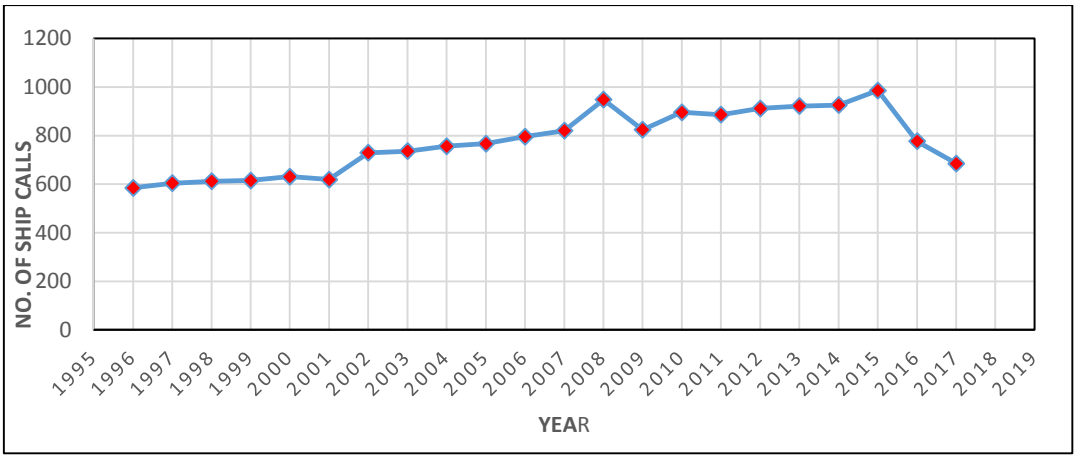
Tongzon (2009)[1] argued that the higher frequency of ship visits translates into more choices for freight forwarding and shipping agencies in selecting a port. He emphasized that increasing the number of calls gives more flexibility and lower transit time and transport costs. However, he did not evaluate the congestion and overbooking that may arise due to an increase in the number of calls, as well as the extra cost generated by this congestion.

The number of ships calling at Annaba port has increased significantly since its opening in 1963. The port received 986 ships in 2015 as shown in Figure III.1.

Interviews and the port records indicate that APA considers an increase or a decrease in a number of ships as an indicator for assessing the port's performance. From the interview with the port's directors, it was concluded that APA builds their decisions on this measure. For example, APA decided to expand the port facilities in 2005 following a 25 % increase between 2001 and 2005. It is important to highlight that the number of calls incorporate the total number of all types of ships calling at the different terminals.

[1] Tongzon, J. (2009) „Port Choice and Freight Forwarders". *Transportation Research Part E.* 45, pp.186-195.

Figure III.3: Total Numbers of Ships Calling Annaba Port from 1996 to 2017



Source: adapted from different internal documents

APA categorizes the ships calling at the port into two categories: container ships and general cargo ships. In this way, APA sets a strategic plan for future forecasting and expansion at certain terminals. However, the port's records, governmental publications and interviews with terminal managers revealed that the port records the number of ships for other types of cargoes such as liquid bulk and dry bulk. Little attention has been given towards these types of cargo by the port managers in the process of evaluating the performance. Dry bulk ships constituted about 33 % and liquid bulk ships represented about 9 % of total ships called at Annaba port in 2017. From the port managers' perspective, interviews showed that improvement in port performance occurs normally when the number of container and general cargo ships increases. They believe that any increase or decrease in the number of ships of both types will, in turn, affect total volumes handled at the port.

As discussed in the literature, most current performance measures focus on containerization rather than generalized cargoes. Interviews denoted that containerization measurement is easier, where containers can be easily classified into standard sizes or dimensions. Standardization facilitates quantifying the number of handled containers, and the number of stacks and trucks can determine how many containers can be carried.

However, APA (2017) announced that general cargo ships account for between 50% and 58% of total ships called at the port. Also, liquid bulk ships account about 11% and dry bulk ships account about 33% of total ships. Therefore, relying solely on the number of container ships is not appropriate for measuring the port's performance.

Measuring Annaba port performance in terms of the total number of calling ships, either container or general cargo ships, is inadequate and it does not reflect port performance. This is because many container ships, for example, may call at the port carrying only a small number

of containers whilst some general cargo ships may only carry light cargo. This means that there are other indispensable variables that should be taken into consideration in measuring the port performance in addition to the number of ships.

3.1.2 Shipping Lines

The liner trade plays a major role in providing efficient and cost-effective movement of cargoes in modern logistics systems, particularly in ports. Liner shipping is a major link in global supply chains and in ports, as it involves the transportation of high value and more time sensitive cargoes. Shipping lines are more important than the tramp industry as the port will receive benefits from liner ship calls in terms of regular stevedoring operations, larger quantities and optimum utilization of the port facilities.

Shipping lines are used by APA as a key indicator for measuring port performance. This is because shipping lines are considered as one of the main port clients. Each shipping line possesses a number of ships, which call regularly and frequently at the port on a scheduled basis. Thus, when a shipping line moves its ships from one port to another, this negatively affects port performance by reducing the number of ship calls. In Annaba Port, the number of container ships decreased between 2013 and 2014 by 115 ships. The port operations manager explained that the reason behind this decrease was due to:

1. The Maersk shipping line moved its ships to Oran Port.
2. The Maersk shipping line recently took over P&O and NED Lloyd, and then redirected all their ships from Annaba port into Oran port.
3. C.M.A shipping line has moved 30% of its container ships to Tangier Port, Morocco, due to inadequate depth in Annaba for its new ships.

However, the researcher argues that the movement of some shipping lines from Annaba to other ports has not necessarily had a negative effect as other new shipping lines have begun to call at the port. It is observed that some shipping lines moved from Annaba port, while other new shipping lines called at the port. Between 2003 and 2006, the port records displayed that some shipping lines moved their ships to other ports as discussed above, and four new Chinese shipping lines have started to call at the port.

On the other hand, observation and port visits showed that Annaba port suffers from a lack of feeder ships. Shipping lines are competing in the Mediterranean basin through sailing mother ships to serve North Africa markets. Mother ships are normally being served by feeder ships. A small feeder ship is a small container ship normally operated by independent operators to serve between a hub port and other smaller ports nearby. A lack of feeder ships causes some shipping lines to direct their mother ships to other ports. This may explain why those shipping

lines left Annaba port. Generally, the number of shipping lines visiting Algerian ports is affected by infrastructure which is in poor condition due to lack of quays, equipment, facilities and maintenance.

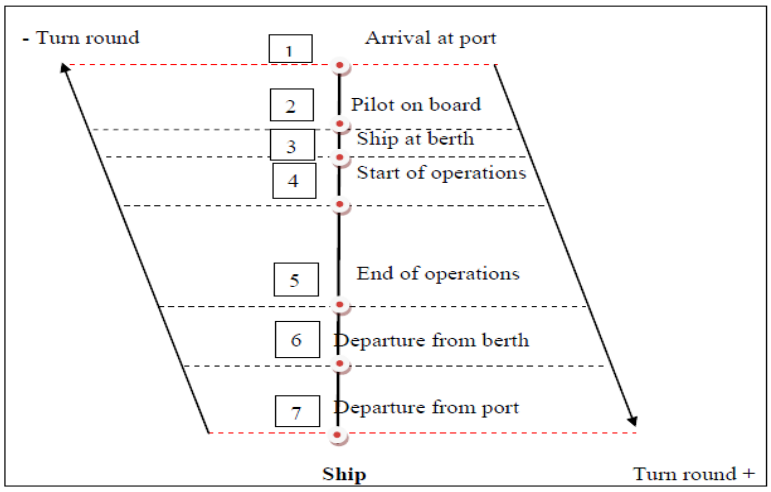
It is concluded that APA measure their port performance according to how many ships call at the port and how many shipping lines currently call at the port. A more effective measurement system is needed to assist in the identification of problems.

3.2 Time measures

The value of time is very important in ports. Any delay in loading and discharging cargoes would lead ships to spend more time at berth, and other ships will have a longer waiting time in anchorage areas. In addition, ship owners will be dissatisfied due to an increase in the ship turn-around time. In Annaba port, berth occupancy is used as a performance measure. However, higher berth occupancy may result from operational delays resulting in a ship spending longer at berth. Hence, high berth occupancy might be due to longer occupancy by fewer ships. Thus, berth occupancy is not an appropriate performance measure.

Port records and interviews showed that APA has records for standing times, berthing times, un-berthing times, berth occupancy time and clearance time. But the interviews showed that the port managers use only berth occupancy in measuring performance, with no regard to other measures. **Figure III.4.** displays the ship turn-around time in the port of Annaba. The line from point 1 to point 7 presents ship turn-around time as the total time that a ship stays in port. An increase occurring at any stage on the line between 1 and 7 will raise the ship turn-around time, and vice versa.

FigureIII.4: Ship-Turn-around Time in the port of Annaba



Source: adapted

Increasing a ship turn-around time might be due to a delay in operations. **FigureIII.2**

divides the operations into seven parts. The delay could be due to unavailability of berths, unavailability of required storage areas, inadequate of cargo handling equipment, or limited port productivity to meet the increasing number of ships. The seven parts are determined in **TableIII.5.**

TableIII.5: The seven Parts of Ship Turn-around Time

Time Operation	Time	Description
Ship turn-around time	Time between 7 and 1	Refers to the total elapsed time that a ship stays in port from arrival until departure
Service time	Time between 6 and 2	Refers to the total elapsed time of provided pilot until departure date
Time at berth	Time between 6 and 3	Refers to the total elapsed time of a ship at berth until leaving berth
Operating time at berth	Time between 5 and 4	Refers to the total elapsed time of starting the operations until terminate the operations
Preparing for operations	Time between 4 and 3	Refers to the total elapsed time of a ship at berth until starting operations
Time elapsed to arrange documents	Time between 6 and 5	Refers to the total elapsed time from the termination of the terminal operations until departure date

Source: adapted

APA collects time-related data to inform Dockers. This helps shipping agencies and middlemen to prepare adequate and proper handling equipment. These data are waiting time in port and in anchorage areas, and they are used to evaluate berth performance only.

3.2.1 Ships waiting time

TablesIII.6: Total waiting time in port U: days

	2013	2014	2015	2016	2017
Nbr of calls	922	926	986	777	685
Ships Waiting Times in Anchorage Area	1.92	1.97	2.05	1.41	0.87
Ships Times at births	3.80	3.84	3.68	3.37	3.16

Source: Commercial department

Table III.6. shows that the ships time at births has increased from 3.80 days per ship in 2013 to 3.84 days per ship in 2014 which lead to an increase of ships waiting times in the

anchorage areas from 1.92 day per ship in 2013 to 2.05 days per ship in 2015. An increase in waiting time in the anchorage area resulted in an increase in the waiting time in port. This was due to increased handling rates, unavailability of storage areas or to the limited number of berths (or their lengths).

This means that there are other predictor variables which influence waiting times in port and at berths. These factors should also be determined and incorporated into the design of a measurement system. Also, it has been observed that APA ignores other important factors such as standing time. It is not efficient to use waiting time in port or at berth in correlation only berth with occupancy. Other factors should be considered, such as berthing time, un-berthing time, standing time and clearance time. Also, waiting time and standing times should be considered in a different way to measure performance.

It is observed during the port visits that work at the container terminal proceeds very lowly. APA claims that this slowness is because the operations managers apply two different systems for loading and discharging containers in a single terminal: Rubber Tire Gantry (RTG) system and reach stackers system. This results in handling containers slowly. However, the researcher argued that the RTG system can be used in high-density operations for handling full containers, while the reach stackers system can be used in low-density operations for handling empty containers. Hence, using two handling systems in a single terminal do not necessary lead to slow operations.

Observations found out that increasing general cargo berth occupancy was not solely due to increasing the number of calling ships, but was due to misusing cargos handling equipment on berths, improper planning of the transportation network inside and outside the port and the improper planning applied in the storage areas to meet the increase in demand. Operators at Annaba port are usually bagging grains, sugar, and cement using bagging units at the general cargo berths, and then they load bags into trucks. They claimed that this handling method triples the time to discharge a ship.

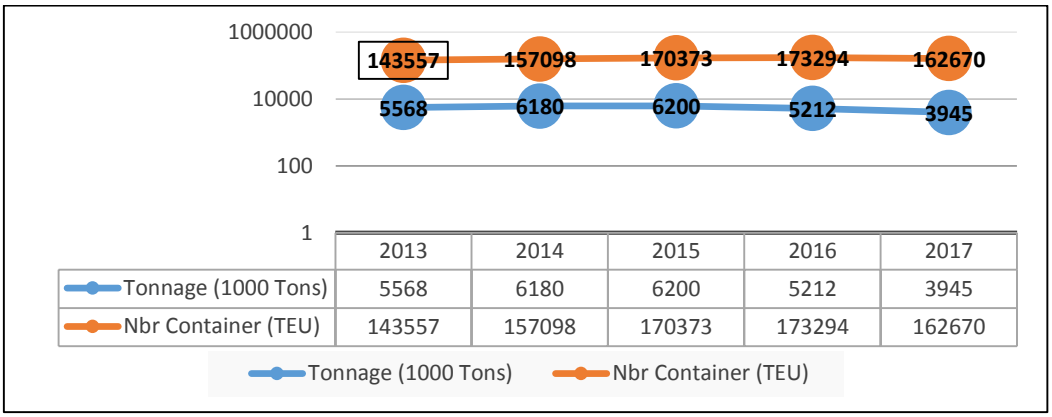
3.3 Total tons handled at the port

APA focuses their measurement on sea access. It applies the economic and financial indicators which are usually related to the maritime side. The commercial port director argues that those indicators can help in determining the actual port performance. These indicators are gross tonnage (GRT) and twenty-foot equivalent unit (TEU).

However, the focus is on containers where calculations are easier than for other types of cargoes. Thus, managers record total imports and exports to provide a total number of TEUs

handled at the port on a monthly basis. TEUs have always been used as a measurement of productivity for container terminal output.

FigureIII.5: Total Containers and Gross Tonnage Handled in Annaba Port



Source: adapted from annual documents.

FigureIII.5. shows that there was a decline in total gross tonnage between 2015 and 2017, while there was a decline in number of containers in the year 2017. Usually, SERPORT applies this indicator (total tons handled) to measure the overall performance of all Algerian ports and the Algerian maritime sector. Containers are usually handled in special terminals in ports, which are known as container terminals. The container terminal is the interface between sea and land and thus it is a critical link in the supply chain by means of which containers are delivered to final port clients. A container terminal is a special facility that provides a package of services and activities to handle and control the flows of containers from ships to the port and vice versa. As a result of its importance, the performance of container terminals is often used as a proxy for overall port performance.

The efficiency of the container terminal system occurs in case of coordination, cooperation and integration between all these participants. In Annaba port, managers claimed that the performance of the container terminal decreased between 2016 and 2017. It seems apparent that the reason for this decrease was caused by moving some shipping lines to other ports such as Oran Port.

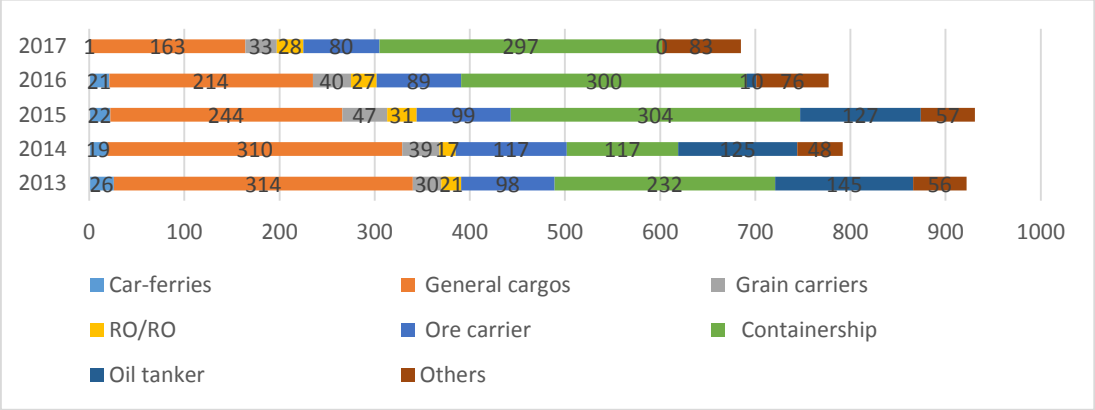
However, observation and port visits revealed that the reason for this decrease was due to non-integration between all participants in the containerization system in Annaba's port. But the question is *why is there no integration between all participants*? The researcher argued that every participant in Annaba container terminal has a different goal. From the standpoint of terminal performance, the terminal operators have a goal to focus on minimizing handling cost per container and maximizing profit; for the port authority, the main goal is to increase the annual throughputs and to ensure that all facilities are fully utilized; for the stevedores, the main

goal is to increase total containers handled; and for shipping lines, the main goal is to minimize the waiting time for container ships in the port. Therefore, they have different goals where each party tries to accomplish his own goals, regardless of other participants 'goals.

In order to measure the performance of the terminal, it is important to quantify all activities that are provided within the terminal. These activities comprise storage area, transportation infrastructure, handling equipment availability, layout, container freight station, custom regulations, safety rules, environmental laws, and intermodal scheduling. Actually, APA does not consider all of these activities. It focuses only on how many containers are handled at the terminal with no regard to other activities. This makes this indicator inefficient in measuring the terminal and port performances. Hence, the current performance measures that are being applied in Annaba port are not sufficient as they do not consider relevant variables and focusing on containers.

As mentioned earlier, the port managers take into consideration the total tons handled of containers and general cargo in measuring the port performance, with no regards to other types of cargo. However, port records show that a decrease or an increase in the number of ships and volumes of other types of cargo can affect the port's performance.

FigureIII.6: Traffic by cargo type



Source: adapted from annual documents

Figure III.6. shows that there was a decrease in the number of grain ships in the year 2017 by 7 ships comparing to 2016, consequently the quantity handled of the grain reduced by 209 481tons, (1 101 054 tons of grains in 2016 and 891 573 tons in 2017)[1].

[1]Management report for 2017 p 11

Interviews displayed that there were two sectors owning and distributing grains; public and private sectors. It was observed that these sectors were the cause of the decreasing number of grain ships in Annaba.

The public sector owns a higher quantity of grains than the private sector. Hence, when the public sector reduced the quantity that was planned to be distributed according to the proper schedule that has been set by the purveyance association, this caused a delay in the discharge rate. Consequently, it caused a commutation at the grain terminal inside the port. This commutation of wheat results in reducing the efficiency of cargo handling equipment in the grain terminal, making congestion in storage areas and yards in the port, and affecting the flow of grains from ships to the storage areas. Therefore, two indicators can be concluded here. The first indicator is the distribution program of wheat from grain terminal in Annaba that do not fit the capability of equipment in term of discharge rate. The second indicator is the transport network that links the grain terminal with the rest of the country. APA records showed that the average number of trains that have been used to carry wheat is two trains per day, while the average number of vehicles in road transport that have been used to carry wheat is 58 vehicles per day.

On the other hand, it was found that the port managers rely on experimental and qualitative methods rather than quantitative methods in measuring the performance of such cargoes and the optimum capacity that can be carried by means of transport. In other words, there is an improper plan in place for total cargoes at the terminal, handling rates of equipment and capacities carried by different modes of transport.

In addition, there was a decrease in total quantities of agricultural products that were handled in the year 2017 by 165 111tons than in the year 2016[1]. This was due to:

- The government:
  - sets quotas for importers according to demand level for each region;
  - sets a price threshold for resale products.
- Limitation of imports of resale products;
- The balance between demand and supply and the market price;
- Facilitation of exports of agro-food products;
- Economic crisis;
- unavailability of efficient handling equipment

[1]Ibid p 11

in 2017, Annaba port was received only one car-ferry ship with a movement of 546 passengers (inbound + outbound); the rest of the stopovers were transferred to the port of Skikda because of the allocation of the premises located at quay warner levels, of which the canal station is considered, to the project of realization of the port terraces entrusted to the concessionaires Hotel Industry Companies.

It can be concluded that APA measures their performance in terms of the total number of ship calls and total volume handled per month, regardless of other factors and variables which have great effects on port performance such as inefficient handling rates that can lead to an increase in berth occupancy rates and harbor congestion.

As a performance measure, berth occupancy is being applied to avoid over-booking.

Tongzon[1] claimed that calculating berth occupancy does not help to identify weaknesses at berths. It is obvious that the port has no formal performance measurement system. Current performance measures and indicators are insufficient and unreliable, and designed for containers and general cargo, nor for other types of cargoes.

Talley[2] argued that a port should not only be concerned with the physical handling of cargo, but also whether it can compete for attracting more volumes and clients.

3.4 Equipment and storage measures

Loading and unloading ships can improve the efficiency of quay cranes and improve the performance of the container terminal and all other terminals, which in turn affects the port's performance. The gross number of crane hours is the total time during which the cranes have been used, irrespective of the delays, whether due to breakdowns, operational delays or external factors such as rain.

Quay cranes are the most expensive single unit of handling equipment in port container terminals, and because of this, one of the key operational bottlenecks at ports is quay crane availability. By improving quay crane utilization, ports can reduce ship turn-around time, improve port productivity and improve throughput of freight transportation**.** For improving crane efficiency, ports have undertaken various projects such as renovating and adding terminals, constructing and expanding intermodal facilities and implementing new IT infrastructure.

Because crane productivity is so important, ports have also invested in various crane utilization improvement strategies. There has been little academic research that addressed

[1] Tongzon, J. and Sawant, L. (2007); opcit pp.477-492.

[2] Talley, W. (2007) „Port performance: an economics perspective", Research in Transportation Economics. 17, pp. 499-516.

the problem of double cycling, or measuring crane performance in ports. Port research typically focused on strategic design planning issues, such as the number of births, the size of storage space and the number of various types of equipment to install.

Other operational planning and control problems have been addressed including berth scheduling, quay-crane scheduling, stowage planning and sequencing, storage space planning, and dispatching of yard cranes and prime movers. To date, most of this work utilizes queuing theory and stochastic models, simulation, and classical operations research techniques such as routing, network, and scheduling problems.

The degree of efficiency of cargo handling equipment can also affect cargo throughput at a berth, cargo handling cost, and the distribution cost. Port managers and authorities select the most suitable types of cargo handling equipment that can attract tonnage. Branch[1]identified these factors that influence the determination of suitable types of equipment as follow:

1. The nature of cargo
2. Weather and tidal conditions
3. Type of vessel
4. Handling cost and general safety
5. Competitive situation with other ports
6. International trade
7. Resources available at ports
8. Maintenance costs

In Annaba Port, a private company is responsible to operate these cranes and equipment that are currently used in handling, loading and discharging cargoes. ARKAS Algeria started operation on 06 August 2017. It deals with international shipping lines for loading and discharging cargoes, such as CMA, MSC and Maersk,

Table III.7: Time sheet

Name of the ship:	**PINARA.**	
Type of vessel:	**Containership**	
Post alongside:	**01.**	
Date start of the O/C:	**01/03/2018**	**19:30**
Date end of O/C:	**04/03/2018**	**16:10**
Nature of goods	**Containers.**	
Type of container:	**Containers.**	

[1] Branch, A. (1997) Elements of Port Operation and Management. U.K.: Chapman and Hall.

Crane		**Winch**		**Total**
NBR overall Cts inbound:	107	NBR overall Cts inbound:	37	144
Tonnage Global inb:	2 408 T	Tonnage Global inb:	833 T	3 240 T
NBR overall Cts outb:	37	NBR overall Cts outb:	5	42
Tonnage Global outb:	163 T	Tonnage Global outb:	22 T	185 T
NBR overall Cts inb/outb:	144	NBR overall Cts inb/outb::	42	186
Tonnage Global inb/outb::	2 570 T	Tonnage Global Cts inb/outb::	855 T	3 425 T
Number of employed team:	3	Number of employed team:	2	5
Total hours gross:	18:30:00	Total hours gross:	12:20:00	30:50:00
Loss of time crane:	**7:55:00**	**Loss of time winch:**	**6:40:00**	
Total Global losses of time:				14:35:00
Total hours worked crane		Total hours worked winch		Total
Crane	10:35:00	Winch	5:40:00	16:15:00
Means employees cranes:	3	Means winches:	2	
Performance by/team/hours				Total
Crane	14.4	Winch	8.4	22.8

Source: Handling department

Table III.7. shows an example of how the performance by team/hour is calculated in Annaba port.

However, ARKAS ignores other important factors such as storage areas. Whilst the total number of ships and total volumes have increased over the years, the port capacity is fixed at 19 million tons a year. More storage areas, yards and warehouses are required.

Also, less attention has been given to the equipment capabilities at other terminals. APA should focus on investing on dredging more depth at certain terminal, regardless of replacing existing cranes and handling equipment. It is inefficient to ignore storage capacities in any measurement approach.

3.5 The Effectiveness of Annaba port measurement approach

Interviews with general managers proved that the port does not consider storage measures in measuring the port performance. APA argues that the port has huge storage areas and warehouses, and any increase in demand in future will not cause a real problem.

It is obvious that Annaba port managers focus on productivity measures more than performance measures in assessing their port performance. Other managers misunderstand the difference between these two concepts. It is very important to distinguish between port productivity and port performance. *Productivity is a measurement of the effective use of port resources. It refers*

to amount handled per terminal, while *performance refers to how to improve the understanding of the factors of productivity and how they are related to each other.*

Observationally, every manager and participant in Annaba port has a primary responsibility in achieving a productive use of resources in different activities. But no integrated performance measurement system has been applied to measure the port performance. Partial measures are currently used in Annaba port. As in other African developing countries, managers usually apply partial measures and focus on productivity rather than performance.

As discussed earlier, the port authority and managers take decisions based on how many ships call at the port and how many tons are handled in the port, as mentioned in **Figure III.3.** Following the traditional approach of measurement, Annaba port performance is evaluated relative to its performance by comparing its actual throughputs over time in terms of tonnage and number of container.

Current system represents the performance of the terminal rather than the performance of the port and consider cargo handling as the main activity, with little regard to other activities which play an important role in the port operations, such as:

- Storing,
- The waiting time factor,
- Loading and discharging rates of cargo handling equipment.

Considering the external factors, there is a deficiency in current measurement system towards the landside operations. For internal factors, ship turn-around time, berth occupancy and dwell times have not been considered.

It can be concluded that the port's managers apply a single-port approach and interviews with the port's operations managers addressed the following problems at Annaba port:

1. High berths occupancy that leads to traffic congestion and lower berth productivity.
2. Low handling rates at different terminals.
3. Improper handling methods, particularly in the general cargo berths.
4. Poor infrastructure of roads and rails inside the port.
5. Insufficient storage areas.

3.6 Recommendations

Currently, Annaba port has no formal measurement system and the port managers rely on a limited number of measures to control and manage the performance. So; we propose for the APA to invest heavily in data collection capabilities and supporting information and communications technology platforms that lower data collection and analysis costs.

In order to implement an adequate port performance measurement system that can provide for port managers a high quality tool for making the right decision, through:

3.6.1 Consideration of a ship turn-around time

The port performance measurement system should take ship turn-around time into account. The literature showed that current measurement system excludes the total time a ship stays in port. It is obvious that this measure has previously been used for different purposes, such as ship output. The contribution was to examine the impacts of the ship turn-around time on how long cargo stays in port. It is argued that the time a ship spends in port or at berth is important to be considered as it carries cargoes and it cannot be discharged until a ship is at berth and starting discharging operations.

Within time measures, the port performance is determined by how much time cargoes remain at ports, average vessel time at berth, average waiting (idle) time, tons per gang hour, TEUs per crane/hook hour, and dwell time. It helps Annaba port to control the port users' response time. It also aims to help the port managers by completing operations faster and to meet promised delivery dates reliably.

3.6.2 Revenue and cost measures

Hence, there is a need to integrate more financial measures, Such as:

- Total cost for a trade transaction port & terminal charges per throughput ton
- Port charge and port dues of ship
- The charge per TEU
- Document processing cost
- Customs cost
- Expenditure
- Inland freight
- Total logistics cost
- Pilotage fees, storage cost, rental of port property and land
- Tax revenue/ customs revenue

Revenue measures need to be considered in the port performance measurement system for the following reasons:

1. Any operation at ports generates costs which need to be passed on to the customers to create revenue for the port. This information can help in determining a port tariff system. The performance measurement system should be inclusive. Time refers to how

long it takes to move cargo, while cost and revenue measures refer to how much it costs to use the required facilities to move cargo and the estimated total revenues and income.

2. A system needs to use a set of balanced measures that present financial and non-financial indicators. Bichou[1] (2007) argued that quality and time measures present non-financial information for port managers. Hence. Revenue measures should be integrated into the system for providing financial information for the port managers.
3. Providing reliable quantitative information for productivity, cost and revenue performance helps managers to improve their port performance.
4. As discussed previously in the literature, current measurement systems rely on financial principles which are considered as a sole measure in most systems.
5. In Annaba port, financial gains can be achieved through reducing time. Cost which can be saved due to reducing times can be used as a performance indicator in determining the port performance. It is commonly known as dispatch money.
6. Financial principles help the port managers track port performance on the chosen key performance variables.
7. In ports, demand is differentiated by time of day, day of week, type of cargo, speed, and so on. It makes it more difficult to analyses and forecast demand using only time measures. There is a need to understand the way in which facilities satisfy these needs in term of revenue.
8. Efficient and cost-effective infrastructure is a critical determinant of a port's competitive advantage. There is a need to understand and analyze the sources of port costs and revenues.
9. APA has no formal system to determine total costs and revenues. Ports have to submit all revenues to the Financial Ministry and receive all their expenditures from the Ministry of Transport. Hence, efficient port performance system aims to add visibility to revenues created by the port.

3.6.3 Flexibility measures

Flexibility measures need to be considered in the port performance measurement system by calculating port utilization and capacity (berth, facilities, etc.) for the following reasons:

1. It helps ports' managers and directors in choosing a suitable port strategy

[1] Bichou, K. (2007) „Review of Port Performance Approaches and A Supply Chain Framework to Port Performance Benchmarking", *Transportation Economics*. 17, pp. 567- 598.

2. It helps to cope with any handling technique. The purpose is to handle a fluctuating traffic demand.
3. Flexibility measures helps to provide a contingency plan in ports.
4. It helps to introduce new philosophies in managing ports' operations, such as partnerships and strategic alliances.
5. Port infrastructure design and port planning requires to consider flexibility measures. It aims to reflect the strategic objectives of the port authority that should be considered in the master plan.

Chapter Summary

Currently, APA applies certain indicators and measures for evaluating port performance. Current measures are useful in measuring containerization and container terminal, but, it does not reflect performances of other terminals where TEU's are not relevant. Also, the performance measurement of other terminals and cargoes is monitored by the total number of ships and the tonnage of cargo handled. Since the main assets of the port are its berths, APA measures the performance of the berths in terms of the throughput handled per berth; berth occupancy. Many operations have been ignored in current measurement approach, such as berthing time, un-berthing time and standing time.

Two key indicators have received greater attention by the port managers, with no regard to the measures and predictor variables that influence the port. These two indicators are: the number of ships and total tons handled. Therefore, the current measurement approach is inefficient as it does not provide feedback about weaknesses at the port, nor does it determine port performance.

GENERAL CONCLUSION

General conclusion

The final part of this research will cover the conclusion and limitation of the study. It is divided in three parts. The first part is conclusions, second part covers the limitations of the study, and final part includes further areas for research.

The growth of international trade between countries has expanded the derived demand for the maritime transport industry, especially ports. Port managers face difficulties in assessing their port's performance as they work in a dynamic environment. In the supply chain context, it was found that many earlier studies measured the organization's performance using financial principles. Later, attention was shifted towards combining non-financial measures in parallel with financial measures.

Different approaches and frameworks were developed for assessing the performance of ports for different purposes, through using a range of techniques including, econometric techniques, engineering techniques, operations research techniques, mathematical techniques and simulation and other different techniques. It was found that no formal measurement system has been recommended in ports.

Contributing to the knowledge regarding this gap, this research was to analyze the performance measurement system in Annaba port undertaken with the general aim of examining its effectiveness, this research sought to answer the following question: "*how can performance measurement systems affect the port performance?".* Thereby, the research was designed to answer the research question. It began by reviewing current supply chain performance measurement systems, designs and categories. This then led to a comprehensive discussion of these measurement systems and frameworks applied in ports.

The research findings can answer the question that current measurement approach applied in Annaba port was inadequate because these measures:

- Aim to maximize productivity through maximizing outputs or through minimizing inputs for given outputs.
- Focus on measuring productivity for a certain terminal or terminals rather than for the port as a whole. They emphasize terminal operations rather than port operations because a port has many terminals and normally handles more than one type of cargo and measuring just one type of cargo is not considered sufficient to reflect a port's performance.

- do not meet a strategic focus, by relying heavily on cost measures and financial principles.

That's why, developing new effective performance measurement system is recommended by applying appropriate measures and reliable key performance variables that influence port performance and present the port's operations at all terminals for all types of cargoes handled, which can help the port managers to assess and control the performance of their port.

Feedback received from the port's operations managers has proved the hypothesis which stated that *The performance measurement system of Annaba port is not effective and does not lead to improved performance*. The null hypothesis (H_A) is accepted as the research hypothesis is true. The port's operations managers indicated that they would gain benefits from using new performance measures in terms of getting detailed information for the port's operations, hence enabling them to assess performance, monitor monthly operations and acquire visibility concerning the port's revenue. The alternative hypothesis (H_B) is rejected.

These are some of the limitations that were identified during the research:

- There were limitations of port management resources in the library; this is because port performance measurement is relatively new area of research.
- This research was based in Port Company, which was difficult for me as business student, to understand some terms and processes, which were relevant particularly to seaside transport thus, this required longer time to understand and translate them from French to English language.
- Another challenge was difficulty managing time. A tight schedule was created for the research, so, it was therefore a challenge to finish the dissertation on time.

The following areas of research require further investigation:

1. Future research could be considered on using regression analysis to examine the relationships between key variables, operations time and cost related variables.
2. It is proposed to collect qualitative data, such as managers' behavior and attitudes. This will help to understand how the managers at Annaba port deal with changes in demand, the decision-making process and their plans for future development. Currently, there are no qualitative data available due to confidentiality.
3. Future research should investigate the incorporation of safety, cost, environmental and security measures into the port performance measurement system. Safety measures aim to reduce the number of accidents at ports and to provide workers protection.

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Appendices

Appendix 01: A Sample of Interviews Conducted at Annaba Port

Interviewee: Port Container Terminal Director – Annaba port authority

Date: 15th March, 2018 Place: Annaba Port

- Define yourself? And define your job description?

It's a great honor to me to be a Container Terminal Director by a promising port like Annaba port. This was after the term of almost three years I spent as Commercial Director of Annaba port. I experienced the finer details of the port development stage and I was one of the participants in the mechanization of the port system.

- How do you see the port of Annaba from the strategic point of view?

I see Annaba port is characterized by its unique location near the Europe and it is close to the international coastal road. Also, the port is connected by different means of transport, namely road, railway and air.

Q1: how do you calculate and measure the port performance of Annaba? Do you have a performance measurement system, either applied by the port or by the Ministry of Transport and the Maritime Transport Sector?

There is no system in the sense measurement system, whether electronic or manual, but we use of so-called performance indicators, which help to take decisions.

Q2: how is this done? Can you explain it in detail, please?

First, the focus is on the number of vessel calling the port and the total volumes handled, which are currently used in measuring performance of both terminals and the port as a whole. We review a number of ships and total volumes handled over the years and measure any increase or decrease as an indicator to assess the performance of the port. For example, the performance of the port declined in the year 2017 due to 685 vessels calling compared to 777 vessel calling in 2016, with decreasing rate by 12%.

Q3: does this mean that you rely on these indicators (a number of calls and total volume handled) in measuring a port performance?

Yes, decisions have been taken according to any increase or decrease in these indicators.

Q4: but there are other factors that influence port performance?

Yes, in 2016 the amount of ships decreased by 209ships and then there was a sharp drop in 2017 by 92 ships. This was for the following reasons:

- The withdrawal of Maersk line of Annaba port calling Oran port.

- Maersk line has taken all shares of P&O line and NED Lloyd line and directed all their ships to Oran Port

- Re-directing 30% of ships owned by CMA line to Tangier Port due to inadequate depth in Annaba port for its new ships

Q5: this means that the current indicators for measuring performance are not suitable or inadequate?

That's true. This is because there is no formal performance measurement system in place applied in Algerian ports. This required looking at other indicators. We look at the capacity of handling equipment and storage yards, for example, next to the number of calls and total volume handled. However, a number of calls and total volumes are only being considered as the most important criteria in measuring performance because these indicators are being used by port clients in their selection of which port to call.

Q6: is there a need to performance measurement system?

Certainly, the existence of a system helps to measure performance will contribute significantly in strategic decision making this is what we need.

Q7: how do you calculate the actual capacity of the equipment?

The productivity of equipment equivalent is 25 containers per hour and how many TEU handled is used in measuring the productivity of the container terminal as well as the occupancy rate of berths.

Q8: why the focus in always on container and general cargo?

Because they are the most cargo handled in the port and any increase or decrease, of course, will affect a port performance.

Q9: but the focus on one type of cargo does not reflect performance of port as a whole?

True, I agree with you

Q10: can we say that there is a need for a performance measurement system that can be used to assess port performance as a whole for all types of cargo at different terminals, rather than focusing only on specific types of cargo? There is also a need to increase performance indicators to include those factors affecting performance?

Yes, it is true and this will help to understand some phenomena such as why some shipping lines have left Annaba port like Maersk line, which led to lower number of calls. Also, we found that one of our problems is the capacity of the port. So, we increased the number of docks and storage areas. However, the port harbor entrance is narrow for some types of ships and it is one way. There are many variables that need to be studies and examined to see how they affect port performance.

Appendix 02 :Ship's particulars

	FICHE DE RENSEIGNEMENT	Référence :
		Date :
		Page : 1/1

ENTREPRISE PORTUAIRE D'ANNABA

DIRECTION CAPITAINERIE

FICHE DE RENSEIGNEMENT

SHIP'S PARTICULARS

M/V :.....Agent Consignataire.....

Type du navire.....

Date et heure de mouillage :.....Date et heure d'accostage :.....

Pavillon/flag :.....

Port d'attache/Port of registry: .....

Indicative d'appel/Call signe: .....

Provenance/Last port of call: .....

Jauge brute/Gross tonnage:.....Jauge net/Net tonnage :.....Port en lourd/Deadweight capacity :.....

Longueur/Lenght overall: .....Largeur/Breadth: .....

Tirant d'eau Max à larrivée:Max draft on arrival.....

Marchandise /Cargo: .....Tonnage a bord/Tonnage on board: .....

Armateur/ship's owner :.....

Date de construction/Building date: .....

Numero O.M.I/I.M.O number: .....

Numero M.M.S.I/M.M.S.I number: .....

Observation.....

.....

.....

L'officier RADIO

Appendix 03: Ships' situation in the port

ANNABA PORT

Situation des navires
(navires à quai, navires en rade, mouvements des navires)

Date 15.02.2018
Page : 2/4

ENTREPRISE PORTUAIRE D'ANNABA
DIRECTION CAPITAINERIE

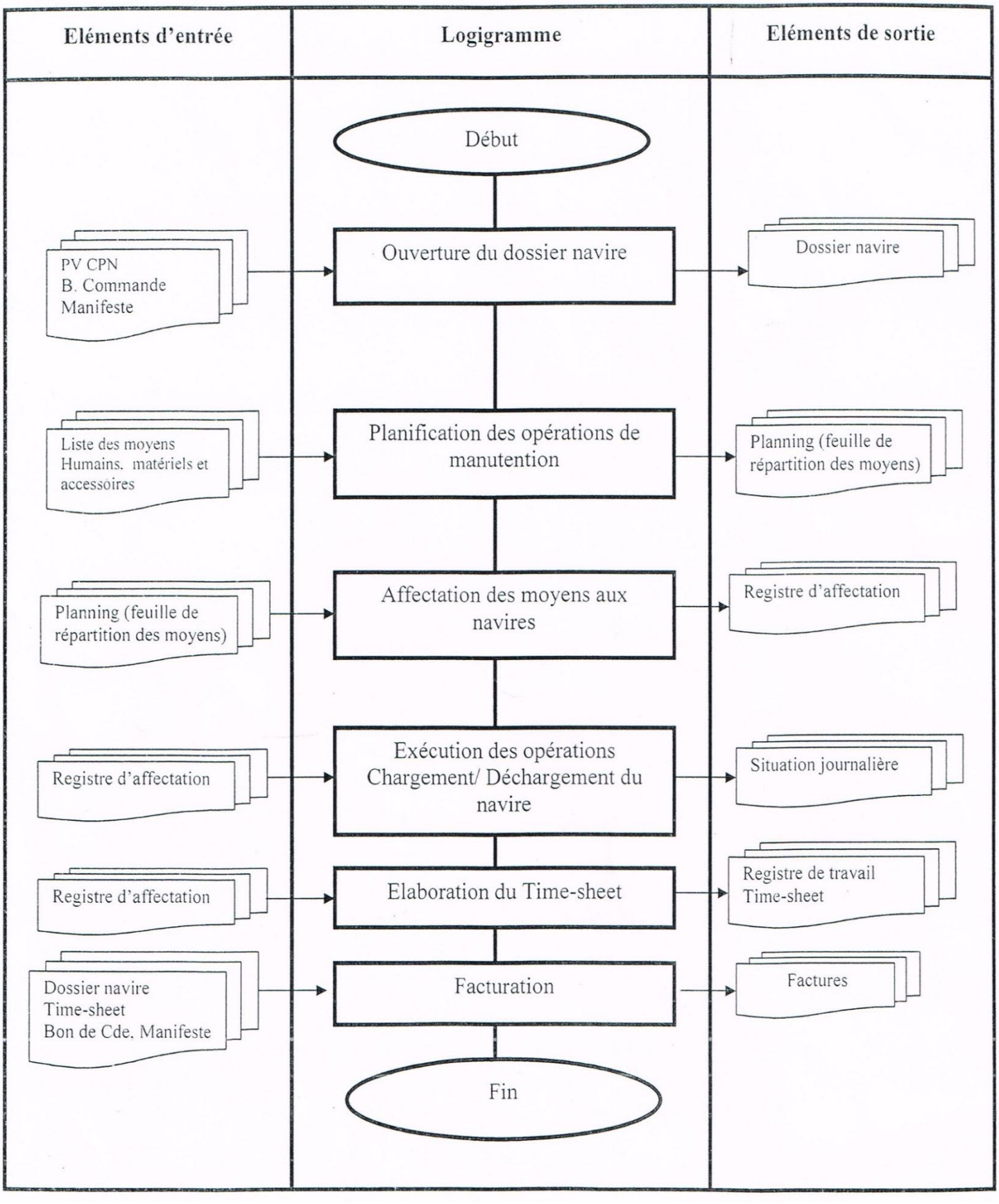
JOURNEE DU 15.02.2018

NAVIRES A QUAI : 11

POSTE A QUAI	NO	NAVIRE	AGENT	COMPAGNIE	PAVILLON	PROVENANCE	CARGAISON / TONNAGE	L	DATE D'ARRIVEE EN RADE	DATE ET HEURE D'ACCOSTAGE	PREVISION DE SORTIE
01	D	CIELO DI AGADIR	CMA CGM	DAME CO	MAROC	SKIKDA	373 CONTENEURS 7952 T	184	-	12.02.2018 20H10	15.02.2018
06	A	GULF EXPRES	MARMEDSA BEMARINE	PACIFIC GROUP	ANTIGUA	ESPAGNE	CIMENT 4310 T	93.3	10.02.13H15	13.02.2018 16H05	-
07	C	ONAT	H.H LINER	SOLARI SHIP	PANAMA	ALGER	49 CONTENEURS	91	-	14.02.2018 21H30	15.02.2018
12	D	LJUTA	GEMA	ST.TRYPHON CORPORETION	ST.VINCENT	FRANCE	BLE TENDRE 30251 T	176.8	03.02.2018 08H00	06.02.2018 11H35	15.02.2018
13	D	SCARLET ROBIN	GEMA	SCARLET ETERNITY	PANAMA	SINGAPOUR	COKE 54900 T	229	08.02.2018 07H00	08.02.2018 08H30	16.02.2018
14	S/C	POAVOSA ACE	MEDSEA	POAVOSA NAVIGATION 01	PANAMA	DUNKERQUE	BALLAST	169.9	10.10.2015 22H00	07.11.2015 07H35	-
16 BIS	S/C	AKUA DEM 2	ANNABIS	AKUA DEM 2	TURQUIE	TURQUIE	CHALUTIER	49	-	12.06.2009 22H45	-
16 BIS	S/C	SERTER AHMET 1	ANNABIS	ZAFER BIROL	TURQUIE	TURQUIE	CHALUTIER	30	-	30.06.2009 14H50	-
16 BIS	S/C	ABDI BABA 3	ANNABIS	EROL BULBUL	TURQUIE	TURQUIE	CHALUTIER	30	-	30.06.2009 14H45	-
17	C	KOOMBANA BAY	SEACOM	NTT LEASING	HONG KONG	GIBRALTAR	PHOSPHATES 24150 T	167	10.02.2018 14H25	14.02.2018 08H30	19.02.2018
22	D	VEGA MERCURY	MSC	VEGA CARINA SHIP	LIBERIA	ESPAGNE	150 CONTENEURS 3419 T	148	-	14.02.2018 07H20	17.02.2018

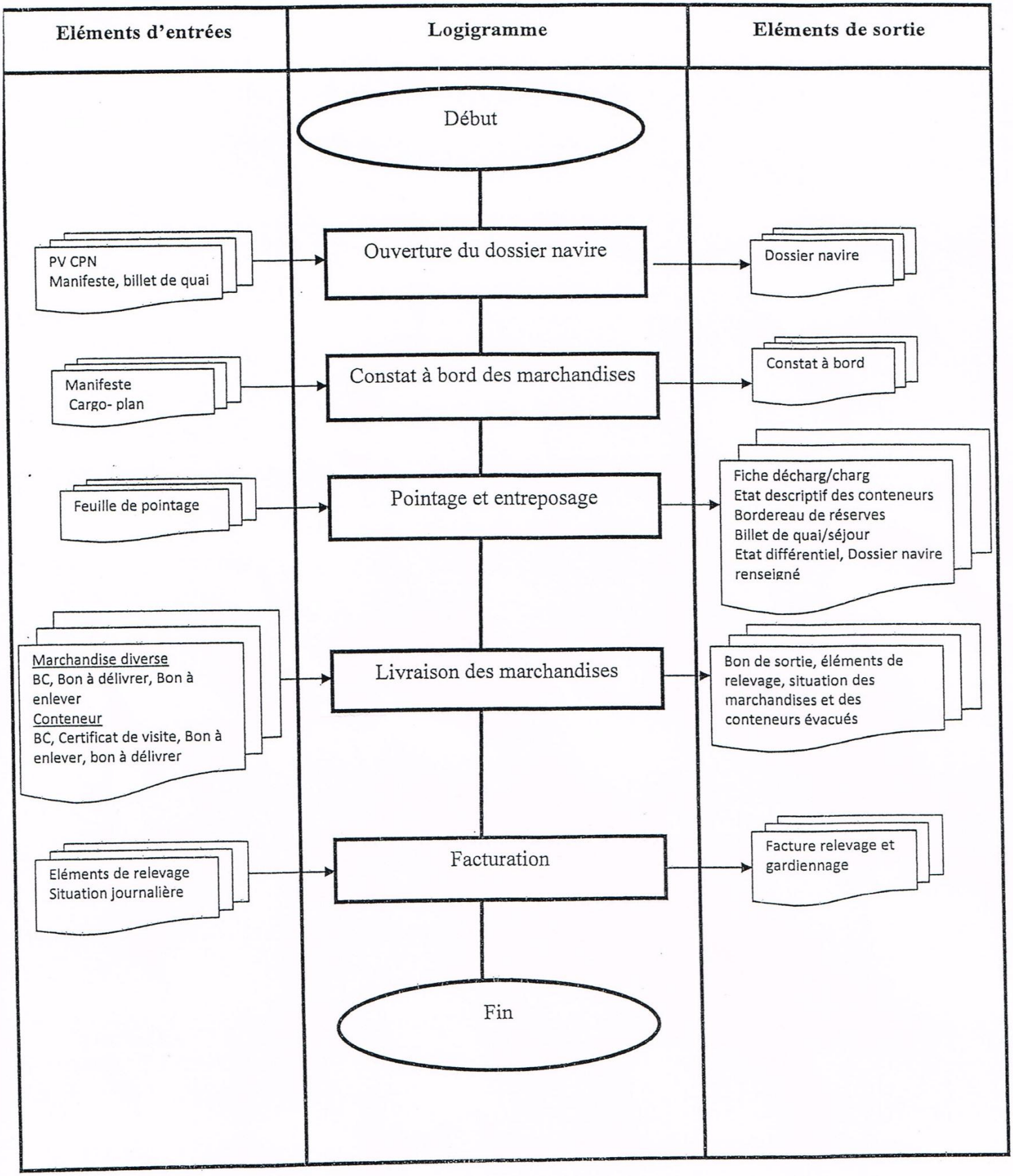
Appendix 04: Handling process in the port of Annaba

Port de ANNABA	FICHE PROCESSUS MANUTENTIONNER	Référence:PS-MAT-07-05-15 Date :Septembre 2015 Page : 2/3



Appendix 05: Stevedoring process in the port of Annaba

	Système de Management Q.E	Code : ERI 01/08- a
	FICHE PROCESSUS Assurer l'acconage	Date d'édition: SEPTEMBRE 2017
		Page : 3 sur 5



Appendix 06: Monthly activity report

RAPPORT D'ACTIVITE MENSUEL

FO-AAC-33-01-02-2018

DATE : ...03.../02/2018

DIRECTION DE MANUTENTION ET ACCONAGE

TERMINAL A CONTENEURS

MOIS DE FEVRIER 2018

ORD	NAVIRES	COMPAGNIE	DATE ARR	EMBARQ VIDE				EMBARQ PLEIN			
				20'	Poids	40'	Poids	20'	Poids	40'	Poids
1	EEMSDIJK	CMA CGM	16/01/2018	35	77 000	26	114 400				
2	VEGA HERCULE	CMA CGM	03/01/2018	72	158 400	200	880 000				
3	HANSA CLOPPENBURG	CMA CGM	13/01/2018	140	308 000	331	1 456 400			8	102 860
4	FAS DAMMAM	CMA CGM	17/01/2018	30	66 000	318	1 399 200				
5	CORONA J	CMA CGM	28/01/2018	20	44 000	28	123 200				
6	JAGUAR	CMA CGM	24/01/2018	73	160 600	252	1 108 800				
sous total				370	814 000	1 155	5 082 000	0	0	8	102 860
7	KANTATA	MSC	04/01/2018	82	180 400	137	602 800	2	2 700		
8	BENEDIKT RAMBOW	MSC	16/01/2018	60	132 000	244	1 073 600				
9	MSC ESHA	MSC	23/01/2018	53	116 600	194	853 600				
sous total				195	429 000	575	2 530 000	2	2 700	0	0
10	ANTWERP	MAERSK	31/12/2017	55	121 000	106	466 400	5	120 840		
11	KANTATA	ANNABIS	04/01/2018	1	2 200		0				
12	CANKA	H-H LINER	13/01/2018	2	4 400	61	268 400				
13	AURETTE	ARKAS	16/01/2018	8	17 600	35	154 000				
14	ANTWERP	MAERSK	17/01/2018	83	182 600	24	105 600	10	249 020		
15	PURKI	CONT SHIPS	20/01/2018	9	19 800	9	39 600				
16	MAX SUN	CONT SHIPS	13/01/2018	3	6 600	118	519 200				
17	KAPTAN AYTAL	ARKAS	20/01/2018	1	2 200	37	162 800				
18	YAKOOT	GSA	23/01/2018	16	35 200	56	246 400				
19	YAKOOT	ANISFER	23/01/2018	15	33 000	4	17 600				
20	BERTA	CONT SHIPS	27/01/2018	15	33 000	69	303 600			1	16 900
sous total				208	457 600	519	2 283 600	15	249 020	1	16 900
TOTAL				773	1 700 600	2 249	9 895 600	17	251 720	9	119 760

FAIT LE : 05/02/2018

LE CHARGE DE SUIVI/TC

KAIDI M^ed ZINE EDDINE

Appendix 07: Time sheet

مـــؤســـســـة مـيـنـــــاء عـنـــابـــة
ENTREPRISE PORTUAIRE D'ANNABA
S.P.A. AU CAPITAL DE 3.000.000.000 DA

Port de ANNABA

FRANCE Intertek

TIME - SHEET (Conteneurs)	REFERENCE : FO-MAT-07-041-01-18
	Date : 01-02-2018
	Page : 1/1

NAVIRE/ANTWERP. — N° ESCALE : 000041/2018
ARRIVE LE /31/01/2018 — Date Début O/C : 31/01/2018
CONSIGNATAIRE : /-MAERSK — Type Navire : P/C.
POSTE : 07 — Mode/Conditionnement : Conteneurs
CLIENT : MAERSK — Nature Marchandise : Conteneurs

DATE	QT	OPERATION	1er Shift	2éme Shift	3éme Shift	4éme Shift
Travaux Effectués						
31/01/2018	1	Equipe Bord/Terre (3Shf)		13h00-19h10	19h30-01h40	
01/02/2018	1	Equipe Bord/Terre	07h00-13h10			
01/02/2018	2	Equipe Bord/Terre (3Shf)		13h00-19h10	19h30-01h40	
Grue Portuaire						
31/01/2018	1	Grue 64 T		13h00-19h10	19h30-01h40	
01/02/2018	1	Grue 64 T	07h00-13h10	13h00-19h10	19h30-01h40	
01/02/2018	1	Grue 45 T		13h00-19h10	19h30-01h40	
Chariot 35 T						
31/01/2018	1	Chariot 35 T		13h00-19h10	19h30-01h40	
01/02/2018	1	Chariot 35 T	07h00-13h10			
01/02/2018	2	Chariot 35 T		13h00-19h10	19h30-01h40	
DP Pour Ouv-Fer Conts						
01/02/2018	2	DP Pour Ouv-Fer Conts	07h00-13h10			
01/02/2018	4	DP Pour Ouv-Fer Conts		13h00-19h10	19h30-01h40	
Utilisation Grue 64 T Ouv/Fer de Cale						
31/01/2018	1	Utilisation Grue 64T Ouv/Fer de Cale		00h30		
01/02/2018	1	Utilisation Grue 64T Ouv/Fer de Cale	00h30	00h30		
Perte de Temps						
31/01/2018	1	Attente unlashing T.C		01h00		
Pointeurs Employés : 09 dont 03 N.						
Fin D'opération						
01/02/2018	1	Fin d'opération				

Le Second Capitaine :

مديرية الشحن والتفريغ
رئيس مصلحة شحن وتفريغ البضائع
Chef Service Manutention

Chef Département Manutention

OPERATIONS ANNABA
MAERSK
Centre Des Affaires Al Djaouhara
9, Rue ALN 4ème Etage
Bureau N°10
Annaba
MAERSK ALGERIE SPA

H.M

Appendix 08: Bill

ROUTE SERVICES PORTUAIRES «SERPORT» SPA
NTREPRISE PORTUAIRE D'ANNABA
irection de la Manutention et Acconage

وزارة الأشغال العمومية والنقل
مجمع الخدمات المينائية
المؤسسة المينائية لعنابة
مديرية الشحن و التفريغ

FACTURE

N° 2/ 188/18

DATE D'EMISSION 12/02/18

DOIT : MAERSK ALGERIE SPA
SIS 47 LOT PETITE PROVENCE YHD
TEL:
FAX:
R.C: M.F: Art.Imp:

CODE CLIENT 411163

OBJET : OPERATION MANUTENTION :

March, 187 CONTS PLEINS
Navire :ANTWERP
Tonnage: 0
Dat opt le: 31/01/18

Debarquement de marchandises

S. G.	C. C.	DATE OPER.	NATURE DES PRESTATIONS	N B R	QUANTITE	UNITE	P . U . (D.A.)	MONTANT (D.A.)
			CONTENEURS					
			CONT PLEINS 45' MB/MG		20	UN	4000.00	280000.00
			CONT PLEINS 20' MB/MG		10	UN	9000.00	90000.00
			CONT PLEINS 20' MB/MG		6	UN	8000.00	108000.00
			CONT PLEINS 40' MB/MG		32	UN	26000.00	832000.00
			CONT PLEINS 40' MB/MG		59	UN	13000.00	767000.00
			Total CONTENEURS :					2077000.00

ARRETEE LA PRESENTE FACTURE A LA SOMME DE :

DEUX MILLION QUATRE CENT SOIXANTE ET ONZE MILLE SIX CENT TRENTE DINARS

TOTAL :	2077000.00
T.V.A. (19%) :	394630.00
TOTAL A PAYER :	2471630.00

مديرية الشحن والتفريغ
رئيس دائرة الفوترة بالنسيابة

NTF:000323036357324
Spa au capital de 3.000.000.000 DA
Tél : 038.86.31.31/43 Fax : 038.86.54.15
Email : epan@annaba-port.com
Web : http // www.annaba-port.com

Adresse : Môle Cigogne, Quai Nord BP : 1232 Annaba - Algérie
R.C. N° : 0363573 B/03 N° NIS : 000323036357324 N°: Article : 23013746062
R.I.B. N° 00 400 201 401 701 160 119 CPA ANNABA

Spa au capital de 3.000.000.000DA

ISO-9001 CERTIFICATION Intertek

Appendix 09: Gross Tonnage handled in 2017

ENTREPRISE PORTUAIRE DE ANNABA

Direction de Manutention et Acconage
Département Acconage
Service Analyses et Statistiques

Etat Général du Tonnage Traité Année 2017

Mois	Conteneurs	P/Métallurgiques	M/Construction	M.O.T.S	P/Agricoles	D/Alimentaires	Minerai-Déchets	P/Chimiques
Janvier	64580	66282	4246	1278	612	0	0	0
Février	81578	37105	70368	1036	27150	0	0	0
Mars	114749	23926	4250	2758	4276	0	0	0
Trimestre1	**260907**	**127313**	**78864**	**5072**	**32038**	**0**	**0**	**0**
Avril	100180	28175	44250	1138	0	0	0	0
Mai	120663	48108	39250	2128	22790	0	0	0
Juin	104274	29113	8499	1852	12681	20000	0	0
Trimestre2	**325117**	**105396**	**91999**	**5118**	**35471**	**20000**	**0**	**0**
Juillet	105216	33707	78158	1244	0	0	0	0
Août	97021	26173	4250	1378	0	0	0	0
Septembre	83658	72071	8500	1887	0	25000	0	0
Trimestre3	**285895**	**131951**	**90908**	**4509**	**0**	**25000**	**0**	**0**
Octobre	142817	78236	8500	1043	0	0	0	0
Novembre	73973	100513	0	1046	29539	0	0	722
Décembre	71139	46851	4250	1712	0	25000	0	0
Trimestre4	**287929**	**225600**	**12750**	**3801**	**29539**	**25000**	**0**	**722**
Total	**1159848,00**	**590260,00**	**274521,00**	**18500,00**	**97048,00**	**70000,00**	**0,00**	**722,00**

Total Tonnage Traités est de : 2210899,00

Appendix 10: Number of containers handled in 2017

TTC

ENTREPRISE PORTUAIRE DE ANNABA

Direction de Manutention et Acconage
Département Acconage
Service Analyses et Statistiques

Etat Général des Conteneurs Traités Année 2017

Mois	M/V	P/C	Tonnage	Import			EVP	Export Vides			EVP	Export Pleins			EVP
				20'	40'	45'		20'	40'	45'		20'	40'	45'	
Janvier	32	17	136 998	956	2035	376	**5778**	713	1598	229	**4367**	345	8	0	**361**
Février	37	24	217237	1163	2424	636	**7283**	1133	3155	557	**8557**	3	4	10	**31**
Mars	36	25	149959	1180	2504	451	**7090**	1377	2709	744	**8283**	6	19	0	**44**
Trimestre1	105	66	504194	3299	6963	1463	**20151**	3223	7462	1530	**21207**	354	31	10	**436**
Avril	35	25	173743	1187	2233	417	**6487**	747	1907	600	**5761**	21	15	0	**51**
Mai	44	29	232939	1061	2625	677	**7665**	1002	2446	453	**6800**	436	7	0	**450**
Juin	34	22	176419	812	2804	453	**7326**	1004	2828	397	**7454**	7	20	0	**47**
Trimestre2	113	76	583101	3060	7662	1547	**21478**	2753	7181	1450	**20015**	464	42	0	**548**
Juillet	42	24	218325	1027	2986	202	**7403**	835	2047	615	**6159**	15	11	0	**37**
Août	38	27	128822	997	2625	156	**6559**	1065	3447	279	**8517**	22	35	0	**92**
Septembre	42	26	191116	853	2632	186	**6489**	1025	2563	221	**6593**	15	36	0	**87**
Trimestre3	122	77	538263	2877	8243	544	**20451**	2925	8057	1115	**21269**	52	82	0	**216**
Octobre	44	28	230596	949	2642	276	**6785**	660	2613	277	**6440**	19	12	0	**43**
Novembre	48	27	205793	880	2319	220	**5958**	1011	1751	340	**5193**	11	12	0	**35**
Décembre	44	26	148952	820	2216	228	**5708**	866	2608	298	**6678**	13	23	0	**59**
Trimestre4	136	81	585341	2649	7177	724	**18451**	2537	6972	915	**18311**	43	47	0	**137**

Total				**11 885**	**30045**	**4278**	**80531**	**11438**	**29672**	**5010**	**80802**	**913**	**202**	**10**	**1337**
Total Général	**476**	**300**	**2210899**	**93 453**											
Total EVP				**162670**											

Service Suivi Activité
Samir ZEHANI
Emis: jeudi 22 février 2018

Appendix 10: Turnover revenue of 2017

ENTREPRISE PORTUAIRE DE ANNABA

ETAT DU CHIFFRE D'AFFAIRE EXERCICE 2017

designation	Dom	TC	Manut	Cap	TOTAL
Canalis. Souter. Aérienr	4 500,00				4 500,00
Redev. Parc à Conteneur		85 503 626,73			85 503 626,73
Fourniture Energie			17 017 622,13		17 017 622,13
Badges	426 809,00				426 809,00
TAXE DE NETTOYEMENT			1 284 900,00		1 284 900,00
Pont Bascule	42 915 888,04				42 915 888,04
Silos	92 499 317,28				92 499 317,28
Pilotage				160 249 642,06	160 249 642,06
Lamanage				103 544 211,70	103 544 211,70
Défenses D'Accostage				35 425 282,43	35 425 282,43
Fourniture D'Eau au Navi				52 429,83	52 429,83
Remorquage				458 136 162,40	458 136 162,40
F. S. D. Algérie				17 412 284,71	17 412 284,71
Débarquements			1 358 216 617,00		1 358 216 617,00
Embarquements			39 353 300,00		39 353 300,00
Extra Frais Navire			64 223 610,05		64 223 610,05
MOYEN DE LEVAGE			130 720 840,00		130 720 840,00
FOUR ENRG ELECTRIQ			1 062 600,00		1 062 600,00
Relevage T. à Conteneurs		845 110 245,70			845 110 245,70
Bachage (FSD Baches)			6 800,00		6 800,00
Gardiennage			44 222 380,00		44 222 380,00
HEURES SUPPLEMENTAIRES			830 060,00		830 060,00
Tracteurs			4 785 360,00		4 785 360,00
Gardiennage T. C		114 114 070,00			114 114 070,00
ENTRETIEN INFRASTRU	5 013 317,00				5 013 317,00
Produits des activités a	104 362 489,25				104 362 489,25
Redev. Port Dts de Qua	66 129 290,66				66 129 290,66
Taxe de Peage	8 478 817,11				8 478 817,11
TAXE	1 159 759,70				1 159 759,70
Taxe de transit TP	20 069 473,36				20 069 473,36
TAX.TRANS.HANG	89 995,96				89 995,96
Location HVTP	66 670 420,89				66 670 420,89
Taxe de depot TP	11 704 714,67				11 704 714,67
Taxe de depot Hang	1 226 870,90				1 226 870,90
TOTAUX	**420 751 663,82**	**1 044 727 942,43**	**1 661 724 089,18**	**774 820 013,13**	**3 902 023 708,56**
	10,78%	26,77%	42,59%	19,86%	100%

01 FEV 2018

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