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# A model for measuring quality of port services in a container terminal

By

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## Declaration

I certify that all the material in this dissertation that is not my own work has been identified, and that no material is included for which a degree has previously been conferred on me.

The contents of this dissertation reflect my own personal views, and are not necessarily endorsed by the University.

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**In the name of God**

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## Abstract

Title of Dissertation: **A model for measuring quality of port services in a container terminal**

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The dissertation attempts to set up a model in which the quality of port services related to ship and cargo, as well as overall port quality, can be measured.

The quality of the port services is defined then followed by the determination of service characteristics in the concept of port services. These characteristics have caused a number of reactions from port users who have in turn, different expectations over the services with regard to their experiences and uniqueness. A brief look is taken at previous research on determining the criteria used by the port users to select a port over the last three decades. The results indicate an increasing trend in recognizing the factors representing the importance of the port service quality.

By partially adopting the stated preference method and utilizing the quality determinants, a set of quality attributes is determined for individual service related to ship and cargo. Each attribute is then evaluated in respect of its measurability. However, they are grouped into measurable, short answerable and immeasurable attribute categories. Subsequently, appropriate tools are launched to evaluate the first two groups. As a result the model is capable of evaluating measurable and short answerable attributes representing approximately 78 percent of the service quality.

The necessity of recognizing other aspects of port quality rather than purely individual port services has led to looking at a whole port as a service. This embraces other attributes and characteristics, which cannot be determined in the first part. This is called overall port service quality. The introduced model is capable of measuring 88 percent of the port overall quality. Needless to say, the combination of service quality to the ship and cargo and overall port service quality represent the quality of a port.

Additionally, the model is successfully applied to the CMP Container Terminal demonstrating the flexibility and applicability of the model in concrete situation.



**KEYWORDS:** Service quality measurement, port quality, port services quality, overall port quality, port quality criteria, port operational quality.

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| | |
|---|---|
| ILO | International Labor Organization |
| UNCTAD | United Nation Conference on Trade and Development |
| IAPH | International Association of Ports and Harbors |
| DEA | Data Envelopment Analysis |
| SP | Stated Preference |
| ESPO | European Sea Port Organization |
| ISPS | International Ship and Port Facility Security |
| JIT | Just In Time |
| ESC | European Shipper Council |
| CMP | Copenhagen Malmö Port |
| VTS | Vessel Traffic System |
| LOA | Length Overall of the Vessel |
| EDI | Electronic Data Interchange |
| IMO | International Maritime Organization |
| Accep. | Acceptable |
| Exce. | Excellent |

# Chapter 1
# Introduction

## 1. 1. Introduction

In the world where significant changes have taken place due to the globalization of economic activities, the port industry has subsequently become more internationalized. As Frankel says (as cited by Ward, 2003) the globalizations of economy, trade relationships and the information technology revolution have changed many things in the world where major differentiations have happened over the last two decades. This has had a significant impact on entire economic entities in general, and sea transportation industry in particular, since they are important elements in consumer supply chain. In addition, the internationalization of production and consumption, culminating from globalization, has transformed the international work division from production to process based (Ma, 2003, p2). As such, the port industry has been recognized as a significant process of production of goods. Besides, it forms the vital link in the supply chains of the traders (Cullinane, 2002, p803). In these circumstances, an increasingly competitive port market environment has evolved that forces the parties to have more market share or revenue, depending on their objectives, among the competitors. Therefore, the port operators are making all the required efforts to meet customers' needs by upgrading the quality of their services rendered to port users (Ha, 2003, p131), mainly ship and cargo owners.

The impression of being cost effective and more productive by improving port services quality has long been the concern of international bodies, including the

International Association of Ports and harbors (IAPH), the International Labor Organization (ILO), and UNCTAD. (Seno- Ogbinar, 1997, p18).

In the view of ports customers the quality of the port services has become an indispensable element affecting their choice of terminal and port in the competitive atmosphere (Ha, 2003, p131). On the other hand, any decline in the service quality rendered in a port will negatively affect the port's attractiveness to ship and cargo owners (UNCTAD, 1990, p6). Fortunately, in this respect, diverse papers have been written on how to improve the quality of port services but the question of how and with what tools the service quality can be assessed has remained largely unexplored. This might be because service quality is difficult to define and measure (Brown and Swartz, 1989, Carman 1990)[1] and the way of measuring quality of service continues to be a challenging topic (Hensher; Stopher; Bullock, 2003, p499). In addition, an interesting survey outcome achieved by Bolton and Drew on a public telephone, employing a multistage model of customer, indicates that quality assessment, for customers with alternative experience, depends on the perception of current versus preceding service quality (1991, p381). This ascertains that there is different quality measurements derived from customers with various expectations, experience and perception. Besides, in port services it is proved that similar value may be perceived completely different by different port users, depending on their priority requirements, therefore their judgment of service quality may vary greatly (UNCTAD, 1987, p10).

In fact, physical service indicators or quantitative elements are not sufficient to measure the port performance and quality of its services unless it is completed with some service quality indicators (Clarke, 2001, p48). Depending on the methodology employed, they could be measured by determining the difference between what clients ask for and what services are provided (UNCTAD, 1998, p13) or determining some quality indicators, in each service rendered by the port, which can be assessed

[1] Derived from (Cronin and Taylor, 1992, p56)

through a precise determination of the service quality components with their nature of being qualitative or quantitative.

### 1.2. Preceding studies conducted on relevant subjects

Relatively, as already notified, the service quality measurement has not been sufficiently covered by academic research although the achievement of quality in product and service has become a central marketing concern in the past two decades (Frankel, 1993). Nonetheless, a number of fruitful studies in relevant subjects in the maritime and other industry are reviewed hereinafter.

- A study surveyed by **Slack** in 1985 explored the factors shipper employ in port selection process. It focused on the containerized traffic between the North America Mid West and Western Europe to evaluate the factors considered by exporter and freight forwarders in the process. Among the factors such as port security, size of port, inland freight rate, port charge, quality of custom handling, free time, congestion, port equipment, number of sailing, proximity of port and possibility of intermodal links, they were invited to select up to five. The highest mark was given to the number of sailings, freight rate, proximity, congestion and intermodal links. The conclusion of the study suggested that decision makers are affected by the price and service of land and carrier than by perceived differences in the port of entry and exit.

- Another study conducted by **D'Este and Meyrick** in 1992 to identify the decision making process done by shippers in selecting the carrier and port in a ferry trade. They determined eight port decision factors to be ranked by the shippers: proximity, port charges, strike, facilities, tradition, marketing, turnaround time, and rail access. Of them the proximity, turnaround time, strike and facilities were made out as the most important factors for the shippers. The ultimate result was that the shippers are conservative with a strong emphasis on quality of service.

• **Ha** in his first research, on the matter of quality, evaluated the service quality of major container ports in the North East Asia region. He selected nine major container ports in the region and classified the service quality factors into seven key categories. The result revealed that shipping companies' concerns are transport costs and port charges whereas service quality factors scored lower (2001)[2].

• In 2001 **Adler and Berechman** assessed the quality of various airports in the world from the airline point of view; they had previously done an identical study from the passengers' perspective. A questionnaire was dispensed asking for their evaluation of different airport operations; cost and demand attributed e.g. airport turnaround time, local labor cost and potential demand. Based on the consequences of the Data Envelopment Analysis, adopted method, it was inferred that the airlines' assessment differs considerably relative to quality factors and airports. They also suggested that in assessing the overall quality of an airport, airlines clearly distinguish the trade off between the quality attributes of an airport.

• Other research performed by **Lobo and Jain** in 2002 evaluated port users' perspectives of container transshipment service quality in the ports of Singapore, Hong Kong and Tanjung Pelapas. A questionnaire containing 54 attributes of quality service was circulated to the port users. The Principal Component Analysis and Varimax Rotation were used to determine factor groupings for the 54 attributes related to the expectations of port users. Four factors viz., human, financial, and operational and port specific, were chosen among them. After analyzing the result, the port of Singapore was placed on the top chased by Hong Kong and Tanjung Pelpas in service quality.

• Recently, in 2003 an additional paper produced by **Ha**, looked for the difference in service quality factors between Korean container ports and other ports in the globe including New York, Hong Kong, Rotterdam, Hamburg etc. Seven-service quality

[2] Derived from (Ha, 2003)

factors were identified i.e. ready information availability, port location, port turnaround time, facilities available, port management, port cost and customer convenience. By means of interviewing and filling in the questionnaire from shipping operators and logistics manager, their points on the service quality factors were utilized. The outcome of the ranked elements indicated that both port facilities and cost groups were prioritized above the others followed by customer convenience and information. Surprisingly, port turnaround time was located in the lowest position. However, it was realized that there is a considerable concordance between the service quality factors evaluated by respondents.

All in all, the studies were conducted partially to determine the port selection criteria as well as their importance level from the port users viewpoint. Although, in some cases the users have recognized the service quality factors, in general the technical quality including port location, port size etc. was being considered in the process. However, recent studies have shown that quality service importance has persuaded the authors to take the initiative in comparing this issue between ports, but still a way in which the service quality could be clarified in order to at least partially measure the quality of port services are unexplored.

### 1.3. The objectives

In pursuance of the foregoing, this study was undertaken to define, identify and measure the quality of port services provided for cargo and ship owners. Ultimately the measuring of the port quality would not be ambiguous for port users when intending to select a qualified port by having some introduced tools and formulas and means of determining efficiency, productivity and quality of services and facilities provided in the ports.

As already mentioned, it would not be the easiest task to achieve the study objectives. However, some similar studies in other industries by adopting the Data Envelopment Analysis (DEA) have come to valuable conclusions in evaluating the

service quality. To illustrate, the study of Measuring Airport Quality from the Airlines Viewpoint done by Alder and Berechman, deploying the DEA for evaluating and comparing the service quality in a number of European and non European countries, showed that "the airline's evaluations of the airports vary considerably relative to quality factors and airport" (2001, p177). Thus, this variety of quality perceived and judgment has led the author to emphasize and introduce several primarily tools and formulas to be used by the ports users, which intend to evaluate the port service quality before any investment in it. Furthermore, it could be a starting point to understand what a port operator or authority mean, in marketing, when they emphasize their service quality? The last objective could be achieved by providing a guideline to do benchmarking between ports' quality of services.

### 1.4. Methodology

Since the research subject is not well direct sourced material, to achieve the objectives of the study, an attempt has been made to apply the principal of measuring qualitative elements. For instance, partially, the Stated Preference (SP) method, which is now well agreed upon in the transport research community (Hensher and Prioni, 2002, p97), has been adopted. In regard to this approach the port services offered to ships and cargo have been enumerated, defined and attributed in the quantitative and qualitative perspective. The important aspects of each service are determined by splitting up the service into applicable determinants suggested by Parasuraman et al in a conceptual model of service quality in 1985, illustrated in appendix 1. Each determinant is described by a set of quality attributes, which in turn are categorized into three parts; measurable, short answerable and immeasurable attributes. The goal is always to try to decrease the number of immeasurable attributes by converting them to the quantitative elements if possible.

To proceed towards the set objectives the following information is employed:

1. Books, UNCTAD publications, academic journals, magazines, field trip during the course

2. Other academic research outcomes in measuring service quality in other industries
3. Other academic research outcomes of questionnaires prepared to obtain the port users expectations
4. Information through interviewing professionals and experts in the industry
5. Information gathered through the Internet

### 1.5. Limitation of the study

This study was actually undertaken and done under a time limitation. In this circumstance, in addition with the general scope of the study, which is not confined to a specific region, it tries to use the expectation and satisfaction level of port users derived from renowned academic research instead of preparing a questionnaire when needed.

The paper only focuses on the services rendered to ship and cargo in the container terminal; this does not necessarily mean that some quality services cannot be applied in other terminals. Definitely there is room to view this issue in all the services provided in the port and any kind of terminal.

The price of services is not a concern of this study although, under some circumstances, particularly in the competitive environment, it has become a more important factor than the price of service (Francou, 2003, p5).

# Chapter 2
# Ports and Quality

## 2.1. Quality definition and application in port

The word quality means different things to different people, a service or production provider, user of the service or production, individual citizen with dissimilar experience of the quality. Consequently, there are divers definitions of quality in different connections. Nevertheless, there are two major perspectives of the quality, which are more recognized in defining quality. The first is to define quality from the service or production provider's perspective and the second is from the user's perspective. In this respect, Peter Drucker writes that the purpose of a business is to create a customer. This indicates the importance of the customer. In addition to that, ISO 8402 also defines quality as a product or service to satisfy stated as well as implied needs. Therefore, it seems more rational to view quality from the user's perspective rather than from the service provider's. Nevertheless, this viewpoint evaluation should be understood by providers who are willing to improve quality.

As already mentioned in the introduction, the importance of quality in a competitive market environment has led the producer, as well as the service provider companies, to develop, maintain and improve the quality of their service. Having developed quality, based on the customer satisfaction, in order to maintain it, a variety of quality assurance systems have been established making the customer confident that the service provider maintains a system that assures best practice as stated with reference to quality, preventing errors and continuous improvements of its

performance (Horck, 2002, p5). In simpler terms, to make it always fit for the clients' use.

However, there exists an interrelation between how to improve quality and how to evaluate it. Regarding the issue, Gronroos states (1982), when a service provider knows the method in which the service will be evaluated by the users, the provider will be able to propose how to influence this evaluation in a desired direction. This also comes partially under the dominance of new marketing concept to continuously identify, quantify and anticipate the needs and wants of the clients, both presented and potential (Ma, 2003). Therefore, without properly measuring the quality the improvement could not be in line with the customer's wants.

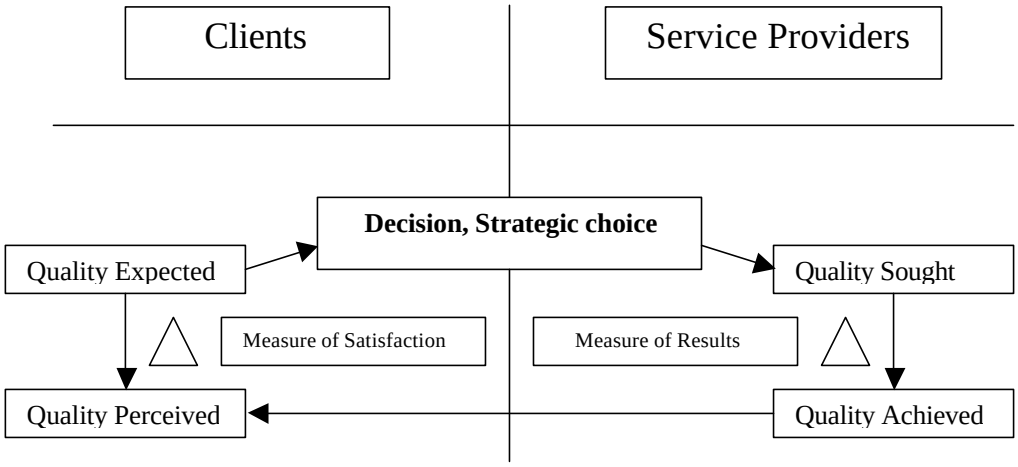


**Figure 1 - The quality loop**

Source: UNCTAD (1998). *Quality management: The port of Nantes/Saint – Nazaire experience.* Geneva: United Nations.

The model in Figure 1 illustrates the concept by emphasizing customer satisfaction. Consequently, the company can be aware of the clients needs to develop and improve the service quality level, which they seek. In line with this thinking, the model contends that customer compares the service they perceived with what they expected, most likely based on their experience, in evaluating service quality. The gap between the two is known as the satisfaction measure that is also quality

definition. The shorter the satisfaction gap, the better the service quality level perceived. In spite of this, the satisfaction measure has to be taken into account when decision maker is processing the strategy in which the level of quality is sought. Again in this loop the achieved quality has to be judged by customer.

Nevertheless, seeing the quality from the service users' point of view would necessitate employing some means or tools in order to properly evaluate the service quality before being involved in the business and using the service. For example, making the establishment or withdrawal of a logistics system decision in a port is most likely a risk without knowing the performances' characteristics and service quality of the port.

### 2.1.1. Port quality

In respect of ports, Lopez and Poole (1998, p83) say "the quality means the provision of services that meets the expectation of clients". When there is a standard the clients of a port wish to receive service according to the standard. In other case, regarding the users' experience the expectation could be different over the service quality. In spite of this, practically, there are four dimensions of the quality of port service that are important for the users such as efficiency, timeliness, security and recently environmental sustainability. These usually respectively refer to: the technical efficiency, punctuality, meant as whether the service is started and finished within a defined or acceptable period and the security condition for ship and cargo passing through a port. (Lopez and Poole, 1998). The last item is emphasizing on the preservation of soil, water and air as what it would have been.

In short, as far as quality in a port is concerned, it is illustrated in the quality performance level of the service rendered to the port's clients as well as quantifiable elements consisting of physical indicators (Francou, 2003, p25). For instance, the duration of "a ship's stay in port" or "turn round time" is vital indicator of the service quality offered to one of the major port users (UNCTAD, 1987, p10). Thus, the

quality of port service including measurable indicators and immeasurable indicators, require respective tools and methods to be evaluated.

### 2.2. Service characteristics and applications in port

A considerable contribution of service in making up the international trade in value, nearly a quarter (Kotler et al, 2001, p533), implies the importance of the service. Thus, this has justified the business and market research community to get involved in spelling out the nature and characteristics of the service in the business areas. Henkoff presents a common definition applicable to all business areas that provide service i.e. "any activity of benefit that one party can offer to another, which is essentially intangible and does not result in the ownership of anything" (1994, pp98-99)[1]. Consequently, based on the definition, service has encompassed a lot of activities. However, depending on the nature of a company's activity, the proportion of service and production, which are produced by them, varies. In some cases the company has focused on the production side and been obliged to provide after sale services but another company's main concern is to render purely service to its customers. The example of the latter can be a port where the only production is the services to its users. Therefore, the activities being carried out in a port fall under the service dominant.

Disregarding the business area that deals with service activities, service has a common nature and characteristics, which makes it more recognizable than others; intangibility, inseparability, variability, perishability and lack of the ownership. These are, in turn, expressing that they cannot be realized before they are bought, they cannot be separated since they are produced and consumed simultaneously, their quality may vary depending on who provides them and when, where and how, they cannot be stored for later sale or use and lastly they cannot be result in the ownership (Kotler et al, 2001, pp535-544). They will be explored in the concept of port service in 2.3.1 below.

[1] Derived from (Kotler et al, 2001, p535)

## 2.3. Port definition and services

There are various definitions each with a different perspective where the port is viewed from different angles e.g. the port generation, port facilities, port size etc. Among them a port definition presented by the European Sea Port Organization (ESPO) seems to be the most appropriate for the use of this study:

> A seaport may be understood to be an area of land and water made up of such improvement works and equipment as to permit, principally, the reception of ship, their loading and unloading, the storage of goods, the receipt and delivery of these goods by inland transport and also include the activities of business linked to seaport. (p8)[2]

Based on this definition and UNCTAD works, generally speaking two major groups of functions are distinguished for a port. The first is the operational and administration functions followed by the second consisting of the internal functions designed to support port operations such as the economic, financial, social, commercial and development functions (UNCTAD, 1992, p17).

As far as the port's services users are concerned the operational and administration functions are designed and performed to respond directly to their requirements. They are corresponding to the various services offered by a port to its external users. They are also called external functions that can be divided into three main groups: port service to ship, sea land interface services and ashore services. Horck has emphasized the latter two as quay operation, teransfer operation, storage operation, receive and delivery operations (2003). UNCTAD has also prepared a complete list of port facilities and services presented in Table 1.

[2] Derived from (Francou, 2002, p8)

**Table 1: List of port facilities and services**

| | |
|---|---|
| Infrastructure: | - Approach channel<br>- Breakwater<br>- Locks<br>- Berths |
| Superstructure: | - Surfacing<br>- Storages (transit sheds, silos, warehouses)<br>- Workshops<br>- Offices |
| Equipment | - Fixed (ship to shore crane, conveyor belt, etc.)<br>- Mobile (straddle carriers, forklifts, tractors, etc.) |
| Service to ships | - Harbor master office (radio, VTS, etc.)<br>- Navigational aids<br>- Pilotage<br>- Towage<br>- Berthing and unberthing<br>- Supplies<br>- Waste reception and disposal<br>- Security |
| Service to cargo | - Handling<br>- Storage<br>- Delivery and reception<br>- Cargo processing<br>- Security |

Source: UNCTAD (1995). Comparative analysis of deregulation, commercialization and privatization of ports. Geneva. United Nations

### 2.3.1. Port service characteristics

Having mentioned the common service characteristics and the port services, they are separately seen hereinafter in the model of port service bringing some special circumstances for both sides i.e. service provider and user.

• The **intangibility** of port services has increased uncertainty when for example a shipper is to buy handling services, which cannot be evaluated before dispatching the purchased goods to the destination port to use the handling service. Although the trend in service providers is to add tangibility cues or quality signals to the service by modernizing the equipment, facilities, employing trained human resource for better communication, emphasizing on reputation (Shapiro, 1983), certification by a third party (Viscusi, 1978) or licensing standards (Leland, 1979), there still exists some

uncertainty level since the appearance cannot sufficiently describe the service itself. For instance establishing new container terminal in a port could not 100 percent assure a qualified handling service with a high efficiency level.

- **Inseparability and perishability** characteristics of port services have created the problem of so-called congestion and the resulting long turnaround time in port. A gantry crane cannot mass-produce its services and stock up to meet the anticipated demand. In addition, the crane with its operator and all the supplementary additions to deliver services are part of service and again inseparable.

- The **variability** of service has given rise to difficulties in controlling the consistency of the services in port. Thus, the port operator cannot assure a hundred percent consistency in delivering its services in any event and all the time. Apart from all the systems, which support the crane operator who is to deliver directly the service, any changes in his or her attitude could change the quality of the handling service. This can be the reason for recently pursuing the establishment of a quality management assurance system in the port industry to assure best practice.

- The **lack of ownership**, which results in having access to services for a limited time. The characteristics along with the variable nature of port services, may constitute the main justification for a big shipping company to adopt the vertical integration strategy by means of coming into a long term contract, concession, lease or other ways of contract, with a port authority. Regardless of their main objectives in taking the operation of a container terminal, Brennan (2002, p39) has summarized them into strategic, economic and operational reasons. The primary driving force is the two latter service characteristics persuading the shipping company to bear the expense of operating a terminal due to their desire to have access and control over the port service and quality whenever and however it is need.

## 2.4. Port users and their expectations

The users of ports can be categorized into direct and indirect, intermediate and final users of ports. For instance, ship owners are direct users, intermediates are forwarding agents and the final users of the port services are a country's producers and consumers. The main objectives of those parties involved in using the service are to transit cargos through a superior service quality at an optimal total cost for them (UNCTAD, 1992, p12). Therefore, because of the overall identical objectives of the port's users, in this study the concern will be the services delivered to ships and cargoes and the parties who are respectively interested in those, namely ship owners and cargo owners, the shipper or forwarding agents. For the sake of simplicity the latter is called cargo owners in this study.

### 2.4.1. Ship Owner

In the past decades, two main breakthroughs in maritime transport known as containerization and specialization have been considered as important driving forces behind the container terminals adopting a compatible system to respond to port users' needs. Nevertheless, other factors and the special characteristics of a container ship operating in a liner shipping system have always been indispensable elements for a port seeking to know the ship owner's expectation of its services being delivered to them. This expectation is either seen in the ship owner's perspective or more effectively in the supply chain concept allowing for a broad view not only of the existing requirements of ship owners but also the expectation of the parties engaged in cargo transportation by sea.

#### 2.4.1.1. Financial characteristics

As Ma states, "shipping is a capital intensive activity" (2002, p67). Explicitly, the shipping cost constitutes ship acquisition, operation and voyage costs. Substantially, a significant part of shipping cost is associated with the acquisition of a ship. Table 2 demonstrates that this particular cost is relatively more intensive in a container ship over the other types of ships mentioned in the Table. Moreover, unlike the tramp

shipping system, a container ship operating in the liner shipping system has to bear all the above-mentioned costs over its tariffs. Therefore, operating a container ship in the liner shipping system primarily necessitates bearing substantial costs before gaining income.

Looking at the situation from a wider viewpoint, it is not the only cost associated with the transportation of containerized cargoes. A container vessel being kept moving not only expends the capital, operation and voyage costs, but also the inventory cost of the cargoes carried on board though it is not borne by the ship owner. Therefore, explicit and implicit costs have to be recognized when a port operator looks at the port services quality and time in port.

**Table 2: New building price of different ship categories in April 2003**

| Ship Type | Ship Size | Acquisition Price US$ |
|---|---|---|
| Bulk Carriers | Panamax | 22,500,000 |
| Oil Tanker | Panamax | 32,000,000 |
| Container Ship | 2750 TEU | 31,000,000 |
| Container Ship | 3500 TEU | 36,000,000 |
| Container ship | 5500 TEU | 60,000,000 |

Source: Compiled from *Containerization International* and *Fearnleys Monthly*

As a result of the above trends to use larger and more specialized vessels in the shipping industry, as well as container ships the required level of attention by port and terminal operators has intensified. Although, on one side, this strategy has led them to achieve the economies of scale and consequently reduce the slot cost of sea transportation, it imposes more notice on what should be paid by a port since the inventory cost of the ship and its cargo increases through employing larger and more specialized vessels.

In brief, in order to recognize the ship owner's expectations of port services the implicit and explicit costs associated with the ship and its cargo, carried on board,

has to be understood. The perfect understanding of the costs will attempt to reduce the time in port by eliminating unproductive time, and streamlining efficiency, which are the primary indications of service quality in port. This implies that the shorter ship turnaround time, the better service realized. To understand their requirements, Francou (2002, p9) has enumerated their expectations as:

- Immediate availability of berth (no waiting time)
- Fast handling operations
- Fast documentation process
- Safety and security
- Reliability of port, no strike or labor disputes
- Good quality of service to ship
- Quality and extent of service to crew members
- Good agency and information network
- A tariff policy compatible with the service quality offered

#### 2.4.1.2. Operational features

The main characteristics of the operation of a liner shipping system can be summarized as a fixed sailing schedule. However, the elements such as fixed ports to be called at, named vessel and fixed price are known as other characteristics of a liner system. In addition, due to the financial features of the liner system, a shipping company has to manage both ship and cargo movements. Under special circumstances, when the shipping company is providing a door-to-door service against receiving a preset tariffs, the company has to manage the logistics system for ships and cargoes (Ma, 2002).

These characteristics of the operation compel the company to deliver their promises given by the sailing schedule. This means the transit time has to be set the way in which the company could manage every process regarding cargo movement from the origin to destination. To do so, the company should know the port services efficiency and quality as an indispensable process through the supply chain of production to

consumption. Furthermore, a port can be reliable and cost effective when its services being offered are productive and highly qualified as stated by UNCTAD (1992, p12) “The port that is expensive for the users is not necessarily the port with the highest tariff, it is rather always the port where the services are poor because of delay, inefficiency and damage”.

In conclusion, since the port and shipping are to some extent coordinating, therefore the operational feature of the liner shipping system, emphasizing service punctuality, has forced ports to be reliable, free of disorder and with a minimum of ad hoc decisions.

### 2.4.2. Cargo owner or shipper

Who is the beneficial owner of the cargo? In this study the cargo owner is defined as a person or entity who purchases the cargo to receive it in the chosen destination by using at least one leg of sea transportation mode and consequently the port. This entity will have the choice of selecting the carrier as well as the port to pass the cargo through. However, it has to be noted that this control can be fragmented depending on the consented Incoterms in the sale contract. Usually, disregarding the agreed terms, a shipper who is the representative of a seller or buyer has the control of transportation. Therefore, in most of the paper the main ports’ clients are called ship owners and shippers (UNCTAD, 92, p28).

The virtual reality is that, as the shipper is also the main client of the carrier thus, it can be said the shipper is the entity creating the demand for the carrier and port. In the liner shipping system, the shipper chooses the carrier as well as the ultimate destination port or place, in a door-to-door service option. In spite of this, a carrier operating in a hub- spoke system, unlike the direct call, has to transship the cargoes from the hub port to the ultimate destination port by feeder shipping.

As described earlier, containerized cargoes are relatively high value cargo therefore their shippers usually use a container carrier not only to benefit from all the advantages of the container, but also to be competitive in the market over decreasing the inventory costs. This will be achieved since the transit time is reduced by the use of container and container ship. Obviously, on time delivery and shortened transit time cannot be realized when there is a sea leg without there being efficient port services. In other words, port activities should be quick, reliable and capable of providing quality service for the ship and cargo (UNCTAD, 1992, p28). However, in reality in order to realize the shipper's expectations, there needs to find the criteria that are used by them when selecting a port.

#### 2.4.2.1. Factors affecting port selection

The selection of port and carrier in the maritime transportation field is a critical decision facing a shipper. For a shipper who is to negotiate a long-term contract with a maritime transportation provider it is a fundamental choice, which cannot be easily changed. However, many shippers have to continuously make decisions in selecting the best port therefore; they must frequently assess the choice of the port and carrier, which is available to them. Furthermore, this depends on various differentiations between the shippers including the cargo value, location, cargo volume etc. making this selection vary too.

Fortunately, a number of valuable studies have been carried out in different regions with the intention of determining the important factors influencing the decision making process of a shipper when selecting a port, carrier, and their relative importance. Some of them are mentioned hereinafter with the intention of determining the changes, which have taken place in the importance of the factors and attitudes of the shipper as the time goes by.

**Slack Study 1985**

Slack undertook a study in 1985 to explore the criteria that shippers employ in the port selection process in the containerized traffic between the North American Mid-West and Western Europe. Ultimately he came to the conclusion that "the decision makers are influenced more by price and service consideration of land and ocean carries than by perceived differences in the port of entry and exit."(Slack, 1985, p293).

In the study a list of general factors was assigned which could be important for a shipper in choosing a port to pass the cargo through. A questionnaire was prepared and the responses were ranked and summarized into five important criteria that shippers in those regions pay more attention to in selecting a port. (See Table 3)

**Table 3: The ranked table of the port selection criteria**

| Priority | Ranked criteria |
|---|---|
| 1 | Number of sailings |
| 2 | Freight rate |
| 3 | Proximity of port |
| 4 | Congestion |
| 5 | Intermodal link |

Source: Slack, B. (1985). Containerization, competition and port selection. *Maritime policy and management*, 12, 293-303

In addition to this questionnaire, the respondents were asked to answer the question of what port services do you consider important? A ranked list of port services criteria in order of importance was prepared based on the responses shown in Table 4 below. However, based on the breakdown of responses in each region, it was judged that although certain discrepancies have been recognized, the level of uniformity among the region in prioritizing the general criteria was considerable. Another important study conclusion was that "For the large companies undertaking regular shipment the question of quality of service is more relevant."(p301)

In this study the number of sailings from and to a port has been recognized as the first criterion from a shippers' viewpoint in selecting a port, which still is a matter of importance for a shipper, particularly for those who have to apply the "just in time"(JIT) policy. This assists them to gain from the decrease in inventory carrying cost.

**Table 4: Port service criteria**

| Priority | Port services | Response% |
|---|---|---|
| 1 | Road and rail services | 81 |
| 2 | Container facilities | 67 |
| 3 | Tracing systems | 53 |
| 4 | Warehousing | 48 |
| 5 | Consolidation services | 47 |
| 6 | Heavy lift services | 43 |
| 7 | Marshalling yard | 30 |
| 8 | Bulk facilities | 13 |
| 9 | Cold storage facilities | 8 |

Source: Slack, B. (1985). Containerization, competition and port selection. *Maritime policy and management*, 12, 293-303

The second criterion has always been a controversial topic when it comes to the comparison between cost and service quality. There is no absolute answer to this question although nowadays the trends are more towards quality (Francou, 2003). For instance, as already noted, it was found by the study that shippers with regular shipments are more interested in service quality than price.

The proximity of a port was considered in third place in selecting a port, but these days this has changed to a matter of time rather than distance. Availability of efficient and modernized land transport between a port and intera and inter hinterland has eliminated the concern about the vicinity of a port.

The fourth and fifth criteria somehow imply the port service quality. They implicitly indicate that shippers want to have seamless and smoothness of movement of their

goods through a port to the ultimate destination. This cannot be achieved in the absence of an efficient and quality port service and a proper hinterland link recognized as a decisive factor in the era of competitive environments.

**APC Survey 1989**

This study was made by the large intermodal, shipping line APC in 1989. The company was willing to observe what the shippers most desire from their transportation service. A quantitative approach was implemented on the data obtained from the questionnaire. The shippers' expectation was then prioritized in descending order as shown in Table 5 below.

Although the study did not specifically deal with the port selection criteria, the port was seen as a vital process in the whole transportation service. For example, on time delivery in the transportation services, consisting of at least a sea leg fraction, cannot be attained without efficient, productive and quality port services. The overall responsiveness, transit time and claim processing are not only relevant and interdependent to the port activities, but also they are the attributes of service quality in all the process of transportation. However, in comparison with the Slack study, the attributes of service quality in the APC shippers' perspective were paid more attention than in the Slack study.

**Table 5: What shippers want most**

| Priority | Items | Priority | Items |
|---|---|---|---|
| 1 | On time delivery | 7 | Billing accuracy |
| 2 | Overall responsiveness | 8 | Correct equipment |
| 3 | Price | 9 | Degree of control |
| 4 | On time pick up | 10 | Claims processing |
| 5 | Transit time | 11 | Tracing capability |
| 6 | Service territory | | |

Source: American Shipper (1990). Buzzword for the 90's. *American Shipper*, March p50.

**D'Este and Meyrick Research 1992**

In 1992,D'Este and Meyrick conducted research to evaluate the shippers' main concerns when deciding on a carrier in the Ro Ro ferry trade across the Bass Strait, between Melbourne on the mainland of Australia and ports on the north coast of Tasmania. They accept as true that the port is an essential and integrated component of the shipping service. Accordingly, the shippers were asked to point out whether the port is a factor affecting their selection and if so to position the weight of a number of port elements when selecting a carrier. They analyzed and ranked port decision factors as demonstrated in Table 6 below.

More than 85% stated that the port was a significant decision factor. The proximity of a port to the production point was prioritized, the most important factor, followed by the strike record and availability of appropriate loading facilities. Moreover, the shippers identified the port marketing, port charge and tradition of shipping through a particular port as relatively unimportant factors. The value of rail access largely depends on the particular shipper.

A very important discrepancy in making this study distinguished is that, before implementing the research the factors influencing the shippers' decision were determined and grouped into qualitative and quantitative elements and the emphasis was on rating the importance of the factors rather than judging the performance.

**Table 6: Port decision factors**

| Rank | Factors | Rank | Factors |
|---|---|---|---|
| 1 | Proximity to production point | 5 | Port marketing |
| 2 | Port turnaround time | 6 | Port charge |
| 3 | Industrial dispute record (strikes) | 7 | Tradition of company trough port |
| 4 | Special loading facility | 8 | Rail access |

Source: D'Este, G.M. and Meyrick, S. (1992). Carrier selection in a Ro Ro ferry trade. *Maritime policy and management*, 19, 115-126

However, based on the abstract of the study, it was discovered that "the shippers were found to be conservative decision makers with a strong emphasis on quality of service" (p115). Moreover, the study highlighted the emphasis, within the price bound for some shippers, on the service quality particularly on speed and reliability. This could be a surprising outcome, which explicitly indicates the importance of service quality in 1992.

**Murphy, Daley and Dalenberg study 1992**

This study was carried out to develop a framework for classifying existing transportation choice research. The paper then presented the results of empirical study involving a single decision (international water port selection) evaluated by multiple participants namely large and smaller shippers, international water carriers, international water ports and international freight forwarders.

Based on the survey a table was prepared illustrating the ranking of port selection factors in the view of different parties as presented in Table 7 below. Although the individual participants had different views over marking the attributes, the average combined responses indicated the importance of claim handling, large size freight, large volume shipment, special handling equipment and shipment information criteria.

The study almost embraces the opinions of all the parties involved in sea transportation. They concluded, "In the era of global economy a port is no longer a merely good handlers, rather ports increasingly are in the goods distribution business. Therefore, many ports need to improve their ability to provide information concerning cross boarder shipment" (Murphy et al, 1992, p252).

Needless to say that the information criterion has nowadays become a decisive element in a port that wants to serve modernized and advanced users with the huge capital engaged.

**Table 7: Within group ranking of port selection factors**

| Attribute | Combined responses | Smaller shipper | Larger shipper | Freight forwarder | Ocean carrier | Water port |
|---|---|---|---|---|---|---|
| Large freight | **8** | 9 | 9 | 6 | 8 | 7 |
| Large shipment | **7** | 8 | 8 | 4 | 7 | 4 |
| Handling charge | **4** | 5 | 4.5 | 8 | 4 | 6 |
| Loss & damage | **2** | 1 | 1.5 | 2 | 2 | 2 |
| Equ. Availability | **1** | 2 | 1.5 | 1 | 1 | 1 |
| Pickup & delivery | **3** | 4 | 3 | 3 | 3 | 3 |
| Shipment info. | **5** | 3 | 4.5 | 7 | 5 | 8 |
| Claims handling | **9** | 6 | 7 | 9 | 9 | 9 |
| Special handling | **6** | 7 | 6 | 5 | 6 | 5.5 |

Source: Murphy, R.P. et al. (1992). Port selection criteria: An application of a transportation research framework. *Logistics and Transportation Review,* 28,237-255

### 2.5. Recent trends of European shippers 2001

The European Shippers Council (ESC) on response to the Directive of the European Parliament in 2001, on the Market Access to Port Services states that:

> Considerable rigidities in the port system and lack of flexibility in responding to customers' needs continue to exist. The growing importance in the reliability and performance of manufacturers' supply chains, and the need to improve efficiency in the supply chain, has created greater demands on the port industry to meet customers services expectations.
>
> Port and service provider play a key role in the operation of intermodal door to door transport chains and their efficient functioning is essential for shippers. Ports are used primarily for the handling, storage and distribution of goods, as part of the logistics chains. The attractiveness of a port to a shipper is judged by

the quality of service provided in port. The ability of ports to attract a wide range of services is of critical importance to European industry.

## 2.6. Conclusion

The special characteristics of port services, accompanied by ship owner and shipper expectations, have compelled ports to provide a set of quality services to meet the users' requirements. They need a smooth and seamless movement of cargo through the ports. In other words, they define the requirements with respect to their ultimate goal that is to make available a seamless, reliable and connective cargo movement through the steps of the customer supply chain.

The importance of a port's role in achieving the objective has persuaded scholars to research and evaluate the different criteria being used by decision makers and users, to select a port in the movement process. However, on the whole, all the criteria can be classified into three groups; port technical quality, port location quality and port operational quality. In the technical quality criteria, the port users seek the quality of infrastructure and superstructure. They are the traditional criteria of a port quality.

The location quality of a port is concerned with its strategic and geographical location. Furthermore, it embraces the means in which a port is linked to its hinterland.

Finally, the general tendency with respect to port selection criteria emphasizes the port quality characteristics, diversification of requirements and evolution towards land transport link with port. Among them the operational quality dealing with the port service quality has become a vital criterion used by the users to select a port. The efficiency, reliability, flexibility, safety, security and other service quality indicators have been recognized as an indispensable element of a qualified port service. Without having the merits of operational quality a port could not be attractive for the users.

However, the evaluation of operational quality criteria is not the easiest task. For instance, the quality of container handling is not always pinpointed by efficiency. There have to be some tools and methods to evaluate all aspects of service quality. The following chapters endeavor to introduce a model in which this important criterion is hopefully evaluated; both in the physical service indicators combined with service quality indicators.

# Chapter 3

# Ship and cargo related quality services measurement

## 3.1. Measurement approach

To approach the objective, which emphasizes the operational quality of services being provided, the services made available to the waterfront and landside will be analyzed separately from the client's perspective. A minimum expectation is arrived at by interviewing some shipmasters, shipping companies and the existing papers and studies relevant to the subject. The author endeavors to apply the Parasuraman's (1985) service quality determinants to each service if applicable. He suggests a set of 10 key determinants, which regardless of the type of service is used basically by clients in evaluating service quality. This will be facilitated by spelling out a service in its different characteristics derived from his innovation to evaluate service quality by using 10 key elements viz. reliability, responsiveness, competence, accessibility, courtesy, security, communication, credibility, understanding and tangibles. This is mentioned in detail in appendix 1. Although, some of them are rarely used in the process, which is replaced by other newly required elements such as safety, the concept is still of much help when looking at a service from different angles.

Furthermore, attributes of a service, again by using the same source as already noted, are identified leading to precisely determining their measurability and immeasurability. They are then categorized into applicable measurement models that are short answer, quantitative formulas for measurable elements that are often performance indicator and efficiency and immeasurable elements that objectively can be evaluated by means of survey.

However, all the processes have been performed for seven major services to ships consisting of the harbor master office service, aids to navigation service, pilotage service, anchorage area facility, towage service, mooring and unmooring service as well as 4 major services to cargo namely quay operation, transfer operation, storage service, receive and delivery operations. They are, in turn demonstrated in appendix 2, Tables 1 to 7 and appendix 3, Tables 1 to 4. In the following sections certain terminology used during the process will be discussed.

### 3.1.1. Service quality determinants

From the foregoing, it has been attempted to apply the determinants as much as possible to each service since the more having applicable determinants, the better the service is described. Considering this, the nature of services is different therefore; the number of applicable service quality determinants varying for each service.

When a service is judged in general, it is more likely described incompletely. For instance, a quay handling service quality often implies efficiency and productivity for people in the industry. As a result, even though they indicate the service quality to some extent, all angles of quality cannot be discovered properly and sufficiently.

However, the set-up service quality determinants generate an opportunity to find out various components of a service that together make up and define the quality of a service. In order to realize the quality completely, it has to be looked at from its different angles and components. The reason behind this is to refine a service through a process, which separates the measurable components of it concealed in its totality.

### 3.1.2. Quality attributes

The quality of a service can be spelt out by assigning its determinants, which are in turn made up of a number of quality attributes. Actually, the process of converting the conceptual model of service quality determinants to the quality attributes is

identical to moving towards applying the appropriate measurement method. In addition, the attributes can properly mean the determinants because they are well known for the industry and some of them are more tangible. In appendices 2 and 3 the quality attributes are presented for each determinant and progressively for every service.

### 3.1.3. Applicable measurement method

In this step, the quality attributes are categorized into three parts i.e. short answer, measurable and immeasurable. Respectively, the short answer attributes are evaluated by making use of yes/no or presence/absence. In order to measure the measurable attributes, simple mathematical calculations are used that are mostly representing the performance indicators or productivity formulas. Lastly immeasurable attributes that should be evaluated by using a ranking system in order to make use of quantitative analysis. This has to be achieved by making a survey to indicate the gap between perceived and expected quality through existing port users. Since, this should be done in the specific and determined port or ports they are therefore not to be evaluated in the study, being only processed to the starting point of the survey.

Progressively, the measurement model of each attribute is separately suggested, leading to evaluate the quality of each service.

## 3.2. Statistical result of aggregate measurement models

To define the quality attributes of the entire ship and cargo related services, nine quality service determinants have been utilized. Among them, reliability, accessibility & flexibility and safety are considered as relevant determinants to all services and facilities, followed by responsiveness, competence, communication, security, credibility and courtesy, which have been used for less than eight services.

In general, the service quality of both sides' services and facilities has been identified by 109 quality attributes that had been previously classified under nine quality service determinants.

**Table 8: Weight comparison between measurable and immeasurable elements**

| Services to ship | Relevant determinants no. | Quality attributes no. | Applied measurement model | | |
|---|---|---|---|---|---|
| | | | Yes/No | Meas. | Imme. |
| Harbormaster | 8 | 16 | 6 | 6 | 4 |
| Aids to navigation | 3 | 6 | 5 | 1 | 0 |
| Pilotage | 7 | 13 | 6 | 2 | 5 |
| Shelter area | 4 | 7 | 6 | 1 | 0 |
| Approach channel | 4 | 12 | 8 | 3 | 1 |
| Towage | 7 | 11 | 4 | 3 | 4 |
| Mooring | 6 | 8 | 3 | 3 | 2 |
| Quay handling | 8 | 10 | 4 | 3 | 3 |
| Transfer | 7 | 9 | 3 | 4 | 2 |
| Storage | 7 | 10 | 5 | 3 | 2 |
| Recieve&delivery | 7 | 7 | 2 | 4 | 1 |
| Total | ------- | 109 | 52 | 33 | 24 |

Source: Compiled by the author

As shown in Table 8, surprisingly, of 109 attributes, 85 could be classified as the qualitative element, which can be measured either by presence, absence or by performance indicators. They are explored in the appendices 2 and 3. In other words, approximately 78 percent of quality of the services and facilities are easily determinable. The minority of attributes, about 23 percent, are known as purely qualitative elements that have to be evaluated objectively in different conditions by means of a survey to get the users' experience of the service.

### 3.3. A model for measuring service quality

Having attained the measurement tools to evaluate the attributes, given in Tables 1 to 7 appendix 2 and Tables 1 to 4 appendix 3, the measurable and short answer elements are assessed and weighed up in a model for each service provided for a ship and its cargo. However, because the immeasurable elements should be appraised individually they are not dealt with profoundly in the model.

In the model, all measurable elements assigned a ranked system consisting of excellent, good, acceptable, poor based on the result calculated by measurement tools. The short answer attributes are ranked by “yes or no”. In order to convert the ranked system to quantitative elements, a key table is used which is staged in the following process in Table 10. The comparison of evaluated result against the perfect quality situation, which is the maximum mark, will be the quality of a service. This is to be performed for the services offered to ship and cargo hereinafter followed by applying the model to the Copenhagen Malmö Port (CMP) as an illustration to clarify the procedure and applicability of the model.

#### 3.3.1. Ship related services

Ship related services consisting of seven major services are discussed and assessed hereinafter based on the results derived from the relevant appendices.

##### 3.3.1.1. Harbor master office

A wide responsibility of harbormaster can be summarized into the safety of ship and port within the port, the sustainability of the environment encompassed by a port and controlling and coordinating the arrival and departure of ships from the ports. (Alderton, 1999). Accordingly, the expectation of the ship owner from the aquatorium system and nautical service is to be served by a well coordinated services combined with safety, reliability and efficiency. Nevertheless, The quality of the harbor master office service has been assessed by sixteen measurement tools. They consist of six short answers, six measurable and four immeasurable elements. The

measurable elements are given marks in Table 9. Other quality attributes in harbor master office service, which should be assessed by "yes or no" are:

1. Presence or absence of a record keeping and feedback system
2. Presence or absence of VTS
3. Are the personnel certified?
4. Are they capable of properly speaking English or a mutually agreed language?
5. Are round the clock services offered?
6. Is the service easily accessible by an existing means of communication?

In addition to the guidelines given in Tables 9 and 10 the equivalent mark for the quality categories is provided as well as the short answer measurement tools.

By doing so, about 75% of the harbor master office service quality could be assessed using the model.

**Table 9: Quality level of measurable tools for harbor master office service**

| Measurement tools to evaluate the measurable attributes | Quality Categories | | | |
|---|---|---|---|---|
| | Exce. | Good | Accep. | Poor |
| Proportion of calculated or expected ship movement time from anchorage to berth against actual time where other services are available | 90-100% | 85- 90 % | 80-85 % | <80 % |
| Cumulated time between request of the harbor master office service and taking necessary measure per ship during the time in port | 1-5 Minutes | 5-10 Minutes | 10-15 Minutes | >15 Minutes |
| Contribution of cumulated waiting time due to disorder in harbor master coordination in average time in port | 0-3 % | 3-6 % | 6-9 % | >9 % |
| Availability level of communication equipment | 98-100% | 96-98% | 94-96% | < 94% |
| Delay in providing timely information by the number of complaints per 100 ships call | 0-2% | 2-4% | 4-6% | >6 % |
| Number of any kind of accident and near accident due to improperly performed harbor master duties per 100 ships call | 0-1% | 1-2% | 2-3% | >3% |

Source: Compiled, inferred and suggested by the author from statistics of various ports

**Table 10: Key table of Points**

| Evaluated as | Marked |
|---|---|
| Excellent | 5 |
| Good | 4 |
| Acceptable | 3 |
| Poor | 2 |
| Yes | 4 |
| No | 2 |

Source: Complied by the author

### 3.3.1.2. Aids to navigation

The objective of the service is to provide suitable groundwork to assist a ship in approaching and leaving the port safely. It has to be in such a way, so that the maximum efficiency in navigation can be achieved. In the model the service consists of five short answers and one measurable quality attribute weighed up in Table11.

**Table 11: Quality level of measurable tools for aids to navigation service**

| Measurement tools to evaluate the measurable attributes | Quality Categories | | | |
|---|---|---|---|---|
| | Exce. | Good | Accep. | Poor |
| Availability level of beacons, buoys, signs and marks[1] | 98-100% | 96-98 % | 94-96 % | < 94 % |

Source: Compiled, inferred and suggested by the author from statistics of various ports

The quality attributes suggested to be assessed by “yes or no” consist of:

1. Presence or absence of any discrepancy between actual and mapped position of navigational aids
2. Is the service offered 24 hours a day?
3. Is there standardized equipment in suitability perspective?
4. Is there standardized equipment in sufficiently perspective?

[1] - The unavailability hours are dedicated to the breakdown hours; hypothetic is that preventive maintenance is done when there is no ship passage.

5. Is there standardized equipment in functioning and painting perspective?

Tables 10 and 11 are utilized to measure 100% quality of navigational aids service since it is only appraised by the measurable and yes or no means.

**3.3.1.3. Pilotage**

The majority of ports in the world require ships over a certain size to employ pilots when entering or leaving a port. The responsibility of the pilot is to give advice to the master of the ship concerning its navigation within the port (Alderton, 1999). However, the general expectation of a ship owner is to have a pilot embarked with minimum delay and get a good advice to safe navigation.

The service, in the model, has made use of six quality attributes to be measured by the short answer, three measurable attributes and five immeasurable attributes. Table 12 illustrates the criteria of marking the quality of measurable elements. In addition to the table, the other quality attributes that have the capability of being evaluated by "yes or no" are:

1. Are the pilots certified under standard requirements?
2. Is the pilot service operating 24 hours per day?
3. Are they flexible to provide an ad hoc service on request?
4. Are the pilots able to speak English?
5. Do they work in a reasonable working pattern?
6. Is there a safety management system on pilotage service?

Responding to these questions, finding the situation of a port in Table 12 and marking them with the aid of Table10 will describe 61% of pilotage service quality.

**Table 12: Quality level of measurable tools for pilotage service**

| Measurement tools to evaluate the measurable attributes | Quality Categories | | | |
|---|---|---|---|---|
| | Exce. | Good | Accep. | Poor |
| Proportion of calculated or expected ship movement time from pilot embarkation point to berth against actual time where other services are available | 90-100% | 85- 90 % | 80-85 % | <80 % |
| Contribution of cumulated waiting time due to pilot embarkation delay to the average time in port | 0-3 % | 3-6 % | 6-9 % | >9 % |

Source: Compiled, inferred and suggested by the author from statistics of various ports

### 3.3.1.4. Anchorage area

This facility is in the port to give a safe and secure shelter for ships waiting to approach the port. In general, a safe and secure shelter is expected by the users. To describe the quality of the facilities, a set of six and one quality attributes are to be evaluated by, in turn, “yes or no” and a measurable tool. The latter is mentioned in Table 13. However, the measurement tool introduced to evaluate the security of the anchorage area varies in different regions of the world. For instance, the Table could not be applied for the Malacca Strait, which has been registered as a risky area of pirate attacks. Therefore, the data in the Table is suggested under prevailing circumstances.

It has been an attempt to assess the quality of the port facilities by using short answers. In this facility they consist of:

1. Does a port have a good shelter in all weather condition?
2. Presence or absence of a muddy bed
3. Is there an organized traffic scheme or Vessel Traffic System (VTS)?
4. Is there any restriction in approaching the area due to the elements?
5. Are there obstacles, including pipelines, cables etc. in the area?
6. Is there a safe distance from any sea going activities?

In the aggregate, 100% quality of the facility can be assessed in the model by responding and calculating the quality attributes.

**Table 13: Quality level of measurable tools for anchorage area facilities**

| Measurement tools to evaluate the measurable attributes | Quality Categories | | | |
|---|---|---|---|---|
| | Exce. | Good | Accep. | Poor |
| Number of pirate assaults or any kind of robbery attacks on ships in the area per 100 ship calls to the area | 0-0.25 % | 0.25-0.75% | 0.75-1.25% | >1.25 % |

Source: Compiled, inferred and suggested by the author from statistics of various ports

### 3.3.1.5. Approach channel

Most ports have to provide a dredged water fairway corresponding to the size of ships expected to be received. Technically, in general terms, a good channel should not have more than one fairway bend and as few curvatures as possible; on average ten total length (LOA). Furthermore, the channel width should not be less than five ships' beams of the largest expected ship to call (Mkango, 1998). Having considered the technical quality, the overall expectation is to maintain its dimension as declared by the port to create safe navigation through out.

However, the facility is assessed by eleven quality attributes split up into eight short answer attributes, three measurable and one immeasurable. Table 14 illustrates the measurable tools. On the other hand, there are a considerable number of attributes that are to be responded to by short answers made up of:

1. Is the port ice-free?
2. Is it operated for 24 hours?
3. Is there any restriction in approaching the channel due to the tide?
4. Is there any restriction in approaching the channel due to the elements?
5. Is there any restriction in approaching the channel due to locks?
6. Is a VTS used for facilitating traffic?
7. Is a port complied with the standards in embedding buoys and beacons?
8. Is the channel under constant surveillance?

Considering that one of the attributes is immeasurable, still about 90 percent of the service quality in the approach channel facility can be achieved by using the model.

**Table 14: Quality level of measurable tools for approach channel facility**

| Measurement tools to evaluate the measurable attributes | Quality Categories | | | |
|---|---|---|---|---|
| | Exce. | Good | Accep. | Poor |
| Proportion of calculated or expected ship movement time in passing through channel to actual time where other services are being well performed | 97-100% | 94- 97 % | 91-94 % | <94 % |
| Actual visibility compared with minimum requirement | > 1 | 0.9- 1 | 0.5-0.8 | < 5 |
| Number of accidents or ship complaints due to discrepancy between channel size declaration and reality per 100 ship passage through the channel | 0-1% | 1-2% | 2-3% | >3 |

Source: Compiled, inferred and suggested by the author from statistics of various ports

### 3.3.1.6. Towage

The expectation of a ship owner over towage services can be mentioned as a safe operation within the port basin. They would like to have a coordinated service through good communication among the shipmaster, pilot and tugs. The ultimate goal is to pass the ship in the basin to berth and vice versa, safely and efficiently. To indicate the towage service quality a set of four short answers, three measurable and four immeasurable quality attributes are employed. By virtue of Table 15, responding to the short answer attributes and making use of Table 10 as a key table, the quality service of towage service can be assessed.

In addition to the table, the short answer quality attributes are:

1. Whether a tug service uses certified crew.
2. Is towage service provided round the clock?
3. Does towage require pre notification?
4. Can they speak English properly?

All the attributes have to be taken into consideration in appraising the service quality. However, approximately, disregarding the immeasurable attributes, 64 percent of service quality can be measured by using the model.

**Table 15: Quality level of measurable tools for towage service**

| Measurement tools to evaluate the measurable attributes | Quality Categories | | | |
|---|---|---|---|---|
| | Exce. | Good | Accep. | Poor |
| Proportion of calculated or expected ship movement time from the starting point of using towage service to the end to the actual time where other services such as pilotage, harbor master and others are being well performed | 90-100% | 85- 90 % | 80-85 % | <80 % |
| Contribution of cumulated waiting time due to towage delay in the average time in port | 0-3 % | 3-6 % | 6-9 % | >9 % |
| Number of any kind of accident or complaint due to unqualified towage service per 100 ships used towage service | 0-1% | 1-2% | 2-3% | >3 |

Source: Compiled, inferred and suggested by the author from statistics of various ports

### 3.3.1.7. Mooring and unmooring

In order to berth and unberth a ship the port has to provide a service known as mooring and unmooring. One or two boatmen with the mooring men assist the ship in getting and releasing the ship's mooring line. In some ports the procedure continues with inspecting the shore's mooring advice and the mooring condition with respect to the tide. This avoids the ship from drifting away from the berth. In spite of this, beside the service itself, it is expected that the terminal advises the Master regarding the mooring line layout and gives other operating advice.

Nevertheless, the service is to be assessed by eight quality attributes consisting of three attributes to be assessed by yes or no, three to be evaluated by measurable tools and two are immeasurable. Table 16 demonstrates the measurement tools and respective quality categories. With respect to the service quality, the short answer attributes comprise of:

1. Whether the service is provided 24 hours per day.
2. Does it require pre notification?

3. Is there an appropriate turning basin?

They should be responded to and marked making use of Table10. Theoretically, 75 percent of the service quality can be determined by the model.

**Table 16: Quality level of measurable tools for mooring and unmooring service**

| Measurement tools to evaluate the measurable attributes | Quality Categories | | | |
|---|---|---|---|---|
| | Exce. | Good | Accep. | Poor |
| Proportion of calculated or expected ship mooring and unmooring time to the actual time where other services such as pilotage, harbor master and others are being well performed | 90-100% | 85- 90 % | 80-85 % | <80 % |
| Contribution of cumulated waiting time due to mooring and unmooring operation delay in the average time in port | 0-2 % | 2-4% | 4-6% | >6% |
| Any accident or near accident due to mooring, unmooring operation as well as berthing time to 100 ships moored and unmoored in port | 0-1% | 1-2% | 2-3% | >3 |

Source: Compiled inferred and suggested by the author from statistics of various ports

With respect to the ship related services quality, they can be evaluated by virtue of the model in calculating the quality of every service individually. Then the overall quality of the services provided for the ship calling at a port will be easily summarized by getting the average from all the achieved service qualities.

### 3.3.2. Cargo related Services

Cargo related services consisting of four major services are discussed and assessed hereinafter based on the result derived from the relevant appendices.

#### 3.3.2.1. Quay container handling operation

The loading, unloading or repositioning of a container aboard ship are the main functions of the quay operation while a ship is being berthed in a port. These

functions, which are often done by gantry or mobile cranes, are dedicated to cargo, though the faster quay operation the lesser turnaround time is obtained for a ship too. However, the safety of operation should be also well observed to generate confidence about using the service. In order to realize the quality of quay container handling, ten quality attributes comprising of four to be evaluated by “yes or no”, three by recommended measurable tools and three immeasurable attributes have been employed. The first two are used to evaluate the quality in the following procedure.

One of the important factors affecting the ship turnaround time and cargo transit time is container-handling speed. In the view of productivity this is called container moves per service time or productive time. This factor is influenced by ship size, ship type and design including fully cellular container ships, semi container ships, hybrids, order or disorder in stowing onboard container or bay plan etc. As a result, the number of container moves per hour will vary in different situations. However, the issue is covered by comparing the expected moves against the actual moves indicating the expectations of different ships and cargo owners.

Besides the measurable attributes and respective quality level determination, mentioned in Table 17, other questions seeking to evaluate quality have to be responded to by “yes or no”. They are:

1. Whether the crane operators are certified.
2. Whether the service is provided 24 hours per day.
3. Whether the parties involved in the service are coordinated with a port network or EDI system.
4. Whether the port complies with the ISPS Code.

Accordingly, summing up the measurable and short answer quality attributes gives the opportunity to realize approximately 70 percent of the quality of quay container handling operations.

**Table 17: Quality level of measurable tools for quay container operations**

| Measurement tools to evaluate the measurable attributes | Quality Categories | | | |
|---|---|---|---|---|
| | Exce. | Good | Accep. | Poor |
| Proportion of recorded container moves to actual moves within one hour of service time or (expected completion time versus actual completion time) | >= 100% | 90-100% | 80-90% | < 80% |
| Contribution of cumulated idle time to the service time | 0-5 % | 5-10% | 10-15% | > 15% |
| Number of any kind of damage to container per 100,000 moves. | 0-0.005 % | 0.005-0.01 % | 0.01-0.015 % | > 0.015 % |

Source: Compiled, inferred and suggested by the author from statistics of various ports

### 3.3.2.2. Transfer operation

This operation maintains the link between quay operations and the container yard. The expectations of parties involved are to provide an efficient service keeping pace with the quay operations. The idea is that the gantry and ship are most expensive therefore they should not wait for transferring equipment. Besides, a safe and secure operation with minimum loss and damage is supposed.

To evaluate the quality of transfer operations in a container terminal a set of six determinants under which nine quality attributes are described is used (See appendix 3, Table 2). Of them, three attributes are to be evaluated by "yes or no", four attributes are measurable by properly suggested tools and two attributes are immeasurable. The measurable attributes are evaluated in Table 18 below.

Furthermore, three quality attributes of transfer operations suggested to be weighed up by "yes or no" answers consist of:

1. Whether the operators of transferring operation are certified according to the port regulations.
2. Whether the service is provided full time per day.

3. Whether the terminal is using a computerized container handling system.

As a result of carrying out the evaluation of measurable and short answer quality attributes, around 78 percent of the quality of transfer operations can be estimated.

**Table 18: Quality level of measurable tools for the transfer operation service**

| Measurement tools to evaluate the measurable attributes | Quality Categories | | | |
|---|---|---|---|---|
| | Exce. | Good | Accep. | Poor |
| Proportion of expected or calculated completion time to actual time | 90-100% | 85- 90 % | 80-85 % | <80 % |
| Contribution of idle time in quay operations emanated from inadequate transferring operation to the service time (Berthing time) | 0-3% | 3-6% | 6-9% | >9% |
| Number of pilferages or other losses per 100,000 containers transferred | 0-0.005 % | 0.005-0.01 % | 0.01-0.015 % | > 0.015 % |
| Number of accidents and containers damaged per 100,000 containers transferred | 0-0.005 % | 0.005-0.01 % | 0.01-0.015 % | > 0.015 % |

Source: Compiled, inferred and suggested by the author from statistics of various ports

### 3.3.2.3. Storage or container yard operation

The storage services offered to indirect routed containers in export and import has these days become significant for port users who are providing door-to-door services by well-established logistics system. The general expectation of service users is therefore to have access to a flexible, reliable and efficient service with a high safety and security level. This would support them to fulfill their objectives of a door-to-door service, which is on time delivery especially in “just in time” policy.

By means of the model, seven quality determinants i.e. reliability, responsiveness, competence, accessibility and flexibility, communication, security and safety have been utilized in order to describe storage service into ten quality attributes. Of them,

five attributes are capable of being evaluated by short answers, three are measurable and two are immeasurable (See Table 3, appendix 3).

The tools and criteria of evaluating the measurable attributes are shown in Table 19. Moreover, the other attributes with the capability of being evaluated by short answers are:

1. Whether a port pre plans the slot location based on a bay plan or shipper container list.
2. Whether a port is capable of tracing and tracking container services.
3. Whether a port has the facility of storing deferent container status e.g. reefer container.
4. Whether a port is offering free storage periods.
5. Whether a port is operating 24 hours per day in storage operation.

In the aggregate, disregarding immeasurable elements, about 80 percent of container yard service quality can be measured where the model is applied.

**Table 19: Quality level of measurable tools for storage services**

| Measurement tools to evaluate the measurable attributes | Quality Categories | | | |
|---|---|---|---|---|
| | Exce. | Good | Accep. | Poor |
| Non coordinated working hours between storage service with quay and gate operations | 0 | 0-1 | 1-2 | >2 |
| Number of pilferages, robberies or other losses to 100,000 containers stored | 0-0.005 % | 0.005-0.01 % | 0.01-0.015 % | > 0.015 % |
| Number of accidents and containers damaged per 100,000 containers stored | 0-0.005 % | 0.005-0.01 % | 0.01-0.015 % | > 0.015 % |

Source: Compiled, inferred and suggested by the author from statistics of various ports

### 3.3.2.4. Receive and delivery

The operations of receive and delivery can either take place on the quayside under the gantry crane or in the grid interchange point in the yard terminal. They are respectively applied for directly routed cargo and indirectly routed cargo. As far as the indirectly routed container is concerned the involvement of the terminal operator in the container yard is more intensive, therefore the title is to focus on the indirectly routed container rather than the other.

However, depending on the equipment system being used in the container yard the locations of receiving and delivering varies. For instance, in making use of the straddle carrier system it takes place at a point called the grid interchange point but in the yard gantry system it is done inside the yard. In general, whatever the system is, the consignee or consignor would like to have easy access and procedure in a secure and safe environment to the services.

In evaluating the service, the model has made use of seven quality determinants consisting of reliability, responsiveness, competence, accessibility, communication, security and safety to spell out the service quality in seven quality attributes. Among them, two attributes should be appraised by “yes or no”, four are to be assessed by measurable tools which are presented in Table 20 below and one is immeasurable that needs to carry out a survey of the existing user’s perception of the service.

In addition to the measurable tools, other attributes, which should be evaluated by “yes or no”, are:

1. Whether the service is provided 24 hours per day.
2. Whether it is assured by an EDI system.

In the aggregate, 86 percent of the service quality can be assessed by using the measurable tools and short answers.

**Table 20: Quality level of measurable tools for receive and delivery services**

| Measurement tools to evaluate the measurable attributes | Quality Categories | | | |
|---|---|---|---|---|
| | Exce. | Good | Accep. | Poor |
| Proportion of actual containers received or delivered to expected containers to be received or delivered in a certain time | 95-100% | 90-95% | 85-90% | < 85% |
| Average waiting time of land transportation mode to access the service where other procedures like customs have been completed | 0-20 Minutes | 20-40 Minutes | 40-60 Minutes | >60 Minutes |
| Number of pilferages, robberies or other losses to 100,000 containers received or delivered | 0-0.005 % | 0.005-0.01 % | 0.01-0.015 % | > 0.015 % |
| Number of accidents and containers damaged per 100,000 containers received or delivered | 0-0.005 % | 0.005-0.01 % | 0.01-0.015 % | > 0.015 % |

Source: Compiled, inferred and suggested by the author from statistics of various ports

### 3.4. Aggregate service quality

Having mentioned the model in which the service quality of each separate service can be measured by the specific set of determined tools. The endeavor is to introduce a combined and curtailed number of formula that can be applied for all the services, regardless of whether being provided for the ship or cargo, instead of separate measurement tools. The reason was realized through applying the model in a practical situation in the Copenhagen-Malmö Port. Since the author was aware that the more summarized, classified and harmonized the model would become the better, faster and more practical it could be examined.

Nevertheless, the combined system is not prescribed for the short answer attributes. They have remained to be considered in the concept of each service. Although there is some overlap in questions between the services, the essence of the services are varied in questioning the presence or absence of the important requirement.

Furthermore, in practice they are easily answerable. All the same, a list of revised questions is included in appendix 6 with the applicable service to the questions that is summarized as much as possible.

Therefore, to reach the intention, firstly the ship and cargo related services were analyzed and combined as illustrated in appendix 6. Secondly, the two parts were also revised and combined. The ultimate measurement tools for measurable attributes consist of:

1. Recorded or expected productivity and consequently completion time to the actual time.
2. Contribution of cumulated idle time in the service time.
3. Waiting time in receiving a service to the duration of the service.
4. Number of complains, accidents, near accidents or any kind of robbery per specific number of ships or containers with respect to the ship or container side services.
5. Non-coordinated hours between consecutive services.

### 3.5. Conclusion

The main result of the chapter analysis shows that by making use of the model, approximately 78 percent of the quality of a port's major services is determined. This is an important statistical result since quality has often been treated as an immeasurable phenomenon. However, although the quality determinants are conceptual elements in which the service quality is evaluated, the model processes the methodology in which they can be converted to the well-known indicators and parameters in the industry.

Nevertheless, in the face of it, the expectation is to recognize the whole port quality by evaluating its main services offered to ship and cargo, but bearing in mind that the entire port quality cannot be encompassed and evaluated by purely considering the major services. For instance, the quality of port environment, supplementary

activities etc. are part of port quality that is not dealt with in the services. Consequently, as a matter of fact, there are other aspects of quality, which are important for the port's users. In respect of this, they are divided into three categories, which are dealt with in the next chapter.

# Chapter 4

# Overall Port Service Quality

## 4.1. Other aspects of port services quality

Hitherto, this paper has been deliberating the quality of the individual operating services rendered by a port to vessels and cargoes. Nevertheless, there are three other aspects of port service quality in the users' perspective, which have impacts on their expectations and consequently evaluation of port services quality. They are classified as: (1) A set of supplementary activities with regard to fulfilling and increasing the customer's requirements and satisfaction e.g. port reception facilities, bunkering etc. (2) The remainder of port operational quality characteristics that cannot be associated with the individual port service. This is therefore recognized as a complete service with its general quality characteristics. (3) Port environmental quality describing the water, soil and air cleanliness condition in a port. These are to be clarified in the following paragraphs.

## 4.2. Supplementary activities of a port

Irrespective of the main services rendered by a port to the users, a port should provide additional services and facilities that directly or indirectly support the main functions of a port. They include cargo consolidation and processing facilities, bunkering, vessel repair facilities, crew facilities, provisioning, reception facilities and so forth. Basically they are for fulfilling the requirements of the ship and the cargo owner.

Similar to every business these provisions and supplementary activities have to be provided in a port adequately, effectively and without causing any delay in providing the service or duration of usage time. Therefore, quality of the supplementary

activities can be evaluated firstly by their presence or absence, and secondly their responsiveness level in being provided on demand. However, since the procedure is similar to other services quality evaluations, this paper's objective is not to discuss the quality evaluation of the supplementary activities.

### 4.3. Port operational quality characteristics

It is believed that this quality consideration has emanated from the port service characteristics implying that the port services are not separable. They are seen as a package indicating that usually the intention of a ship calling at a port is to go through the services from nose to tail. Therefore, apart from the importance of individual service quality, this necessitates the port users to consider not only port services quality individually, but also a whole port as a service.

#### 4.3.1. Measuring overall port service quality

With regard to this view, the port operational quality characteristics are treated as a service, which is called overall port service quality. As such, it is evaluated by going through the quality measurement model from applying the determinants to introducing the measurable tools and the way of measuring other quality attributes as seen in Table 1, appendix 4. Practically, it is more viable for port users to evaluate the port services' quality by considering only the overall service quality. For this reason, it is much sought after to evaluate the quality attributes in a dedicated name of the overall port service quality.

#### 4.3.2. The model

In order to evaluate the overall port service quality, 8 conceptual quality determinants consisting of reliability, responsiveness, competence, accessibility, communication, safety, security and credibility have been employed. According to those determinants the general expectations of the port users have been organized and ordered. Again the same source, including interviewing some ships' master, shipping companies and journals regarding the port users have been exploited.

**Table 21: Quality level of measurable tools for overall port services**

| Measurement tools to evaluate the measurable attributes | Quality Categories | | | |
|---|---|---|---|---|
| | Exce. | Good | Accep. | Poor |
| Proportion of total calculated or predicted time in port spent by 100 ships to actual time under normal circumstances | 90-100% | 85- 90 % | 80-85 % | <80% |
| Total number of casualties, accidents or any kind of losses or damage to containers or ships due to unqualified port services per 100 ship calls | 0-0.5% | 0.5-1% | 1-2% | >2 |
| Number of effective worked days to number of scheduled working days per year | 100% | 98-100% | 95-98% | <95% |
| Contribution of any kind of idle times in delivering port services when ship and cargo are ready to be served to turnaround time | 0-2% | 2-6% | 6-10 | >10 |
| Number of disputes not solved to number of dispute actions | 100% | 95-100% | 90-95% | < 90% |
| Number of disputes solved in 15 days delay to number of dispute actions | 0-2 % | 2-7 % | 7-12 | > 12% |
| Waiting time to service time ratio | 0-3% | 3-5% | 5-10% | >10 |
| Number of non coordinated hours between main port services in 24 hours | 0 | 0-1 | 1-2 | >2 |
| Cumulated number of pilferages, robberies or any other similar cases per 100,000 containers throughput | 0-0.02% | 0.02-0.05% | 0.05-0.08% | > 0.08% |
| Total number of casualties, accidents or any kind of losses or damage to containers or ships per 500 ship calls | 0-1% | 1-3% | 3-5% | >5% |

Source: Compiled, inferred and suggested by the author from statistics of various ports

In respect of the general expectations and quality determinants, 17 quality attributes are classified to convert the conceptual determinants to the technical method, which would be common and understandable in the shipping and port industry. However, five of them are to be evaluated by short answers, 10 are to be assessed by

measurable tools introduced in Table 21 above and 2 are immeasurable attributes requiring a survey of a specific port's users.

The result calculated by making use of the measurement tools in Table 21, indicates the quality categories in which the quality attributes are placed. Each category represents the amount of points that are assigned according to Table 10 in Chapter 3. To complete the model still there are five quality attributes consisting of:

1. Whether a port holds a quality assurance system to make customers confident of providing the service at least with a minimum standard or collective agreement on the required expectations.
2. Whether a port is ice-free.
3. Whether a port's accessibility is affected by a tide.
4. Whether a port provides EDI facilities.
5. Whether a port complies with the international security regulations and particularly with the new code of the International Ship and Port Facility Security (ISPS).

However, according to the tools employed to measure the quality of the service in the measurable and short answer quality attributes, approximately 88 percent of overall service quality can be assessed by making use of the model.

### 4.4. Port environmental quality

As far as the environment in a port is concerned, this is defined as protection, preservation of the existing wildlife as well as taking necessary prevention measures to minimize air, water, soil contaminations caused by port activities. However, the increased awareness of the society with respect to environmental issues has forced the port authorities to be much more concerned about preserving and protecting the port's natural environment. This force is getting intensified since the port users have also to observe the expectation of their customers with regard to environmental issues. For example, the Tetrapak Company, which produces food products, has a motto that says, "The environment is a part of your business so keep and generate

business". They are very obsessed in selecting shipping and ports with the criteria of being environmentally friendly. Accordingly ports have to define their strategy and methodology in which the environment will be protected from pollutant sources in ports including ships, dredged materials, trucks etc.

### 4.4.1. Approach in measuring quality of environment

Actually, the author would like to mention briefly some quality environmental indicators in this study to be explored in more detail in a future study. However, a recent research made by the University of Amsterdam in pursuing the practical use of environmental performance indicators, released a list of performance indicators as well as quality indicators of air, soil and water in European ports. The study was conducted by selecting the environmental aspects on the three level approaches consisting of operational level, management level and condition level as shown in Table 22. Then, according to each level a set of environmental performance indicators was introduced. However, the indicators of the quality were recognized in the condition level. The list of environment quality indicators derived from the study is mentioned in appendix 5.

These indicators simply imply and determine the existing condition and the level of environmental sensitivity of the port authority including air, soil and water in the port area. The indicators' results should be compared with the existing standard and regulation in which the allowed contamination level has been defined. For instance, according to the IMO regulations, the maximum authorized level of SO2 generated by ship emission is 4.5 percent. Nevertheless, there needs much more to be done in respect of environment quality in the preservation as well as improvement of port environmental quality.

## 4.5. Copenhagen Malmö Port (CMP) Container Terminal illustration

Hereinafter the model is to be applied to the terminal in both parts to determine port service quality and overall port quality.

**Table 22: Selected environmental aspects on the three level approaches**

| Operational level | Management level | Condition level |
|---|---|---|
| Dredging | Reporting | Air pollution |
| Dredging disposal | Certification | Water pollution |
| Dust | Compliance with regulation | Soil pollution |
| Noise | Information exchange | |
| Waste | Complains | |
| Risk | Training | |
| Hazardous cargo | | |
| Water contamination | | |

Source: ECOPORTS (2003). *Environmental Performance Indicators In European Ports*. Amsterdam: Author.

### 4.5.1. General information

In order to practically examine the model, a decision was made to exemplify the quality of services offered by the Container Terminal in Copenhagen. This was achieved through the kind cooperation of the corporation particularly the General Manager Mr. Hansen. However, the terminal is operated by the Copenhagen Malmö Port Corporation, who succeeded to exploit the two ports after merging. The terminal in Copenhagen was designed to handle 120,000 boxes with 4 berth points. Notwithstanding this, the terminal throughput reached 75,000 units resulting from 570 ships calling at the terminal in 2002. The terminal also holds a direct straddle carrier system with 4 container cranes, 9 straddle carriers and 3 container trucks. With respect to both ship and cargo related services, they are separately considered in the terminal in the following sections.

#### 4.5.1.1. Ship related services information

The harbormaster functions are still conducted by the state in the Copenhagen port. Therefore, the harbormaster services are provided for every ship calling at the ports and quays within the harbor. The employees working in the office are shipmaster or

chief mate. There is sufficient and proper telecommunication and surveillance equipment to control the harbor and ships. The only problem, which sometimes imposes delays in ship movements, is a narrow entrance of the harbor since two ships cannot pass the entrance simultaneously.

Pilotage services also belong to the state that is provided to the ship on request. Thus, in order to avoid delays in embarking a pilot on time this has to be pre arranged. This can lead to some waiting time where a pilot is needed ad hoc. Nevertheless, according to the state regulations a captain, who has the experience of calling at the port more than five times, is exempt from the obligation of taking on board a pilot.

With regard to the towage services it has to be noted that in the prevailing circumstance when the wind speed is not exceeding 20 meters per second, a ship calling at the port does not require a towage service. However, if exceeded, the service would be provided by a private towage company located in the Malmö port. This implies that since the voyage time from Malmö to Copenhagen is about 1.5 hours, the towage services will not be flexible and require prior arrangement if a ship would like to have access to the service without delay.

As far as the weather condition in the port is concerned there is the possibility of encountering fog and snow in the September, October, December and February. In this circumstance a ship calling or leaving the terminal should slow down its speed, which creates some delays in the turnaround time of ships in the port. However, there seem to be no more points to be mentioned for other ship related services.

#### 4.5.1.2. Cargo related services information

The main cargo related services are provided by CMP Corporation. The services consisting of quay, transfer, storage, receive and delivery operations are rendered 24 hours, 7 days a week except the last that is provided from 0600 to 1800. However, it

is worthwhile mentioning some performance and productivity indicators in the CMP Container Terminal in Copenhagen in 2002 shown as in Table 23.

**Table 23: Handling productivity in CMP Container Terminal**

| | |
|---|---|
| Number of ships calling at the terminal | 570 |
| Average service time | 6 hours |
| Unloading productivity | 32 unit/hour |
| Loading productivity | 28 units/hour |
| Working days | 364 |
| Throughput | 75,000 Box |
| Ship accidents | 1 |
| Containers damaged | 3 |

Source: The CMP statistics 2002

There is no idle time recorded in the statistics. The main reason could be that idle time in cargo handling operations is attributed to three sources; (1) ship related problems, (2) Cargo related problems e.g. unavailability of container for export, (3) breakdown of the equipment, which has not affected the operations since there is sufficient reserved equipment. Therefore, the delay is due to service user problems. For delivery and receive operations the company promises not to cause delays exceeding 15 minutes. In 2002 they succeeded in delivering their promise.

### 4.5.2. Applying the model of services quality to the CMP Container Terminal

The data was specified to the model through a statistical approach. Nonetheless, interviewing the port operational manager provided much help in applying the data to the model. In addition, a small questionnaire was prepared containing the list of measurement tools as shown in Table 24. The questionnaire was circulated to the main container terminal users. Progressively the table was completed by having the port data and users' evaluations.

As indicated in the table, the first column represents the measurement tools to evaluate measurable and short answerable attributes. The first 5 tools are used to evaluate measurable attributes and the remainder is used to evaluate short-answerable attributes. The second column consists of the service titles rendered to ship and cargo, and are marked by comparing the result derived from the tools in the first column with the quality categories mentioned in chapter 3. As such, the given mark represents excellent, good, acceptable and poor categories for measurable attributes and "yes or no" for short answer attributes respectively.

### 4.5.3. Applying the model of overall port services quality to the CMP Container Terminal

From the foregoing, through the exemplification of the model in the CMP Container Terminal the author was persuaded to consider the whole terminal as a service to its users. Subsequently, a set of measurable tools was utilized to evaluate measurable and short answer attributes, as indicated in Table 25. As a result of applying the terminal data and users' evaluations, collected through the questionnaire responses, in the measurement tools, the quality category of each attribute was determined. Those categories consisting of excellent, good, acceptable and poor for measurable attributes and "yes or no" for short answer attributes represent the certain point value mentioned in chapter 3, Table 10.

### 4.5.4. The main services quality and overall port service quality in the terminal

Since the model is limited in evaluating the whole service quality due to the pure immeasurability of some attributes, the services quality mentioned in the table are compared with the maximum service quality that can be measured by the model. However, the comparison between the maximum achievable marks with the actual marks achieved by the terminal indicates the quality of services and overall port quality as shown in Tables 24 and 25 respectively. This is presented in the last row of those tables.

**Table 24: Illustration for applying the model in measuring the main services quality of the CMP Container Terminal in Copenhagen (Statistics data of year 2002)**

| **Measurement tools to evaluate measurable and short answerable attributes** | **Quality marking scheme with respect of measurable and short answerable tools results** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Services rendered to the ship and cargo** | **Harbormaster office** | **Aids to navigation**[1] | **Pilotage service** | **Anchorage area**[2] | **Approach channel** | **Towage service** | **Mooring unmooring** | **Quay handling** | **Transfer operation** | **Yard operation** | **Receive & delivery** |
| Recorded or expected productivity and consequently completion time to actual time | 5 | ----- | 5 | ----- | 5 | 4 | 5 | 4 | 5 | 5 | 5 |
| Contribution of cumulated idle time in the service time | 5 | ----- | 5 | ----- | ----- | 5 | 5 | 4 | 5 | 5 | 5 |
| Waiting time in receiving a service to the duration of the service | 5 | ----- | 5 | ----- | ----- | 4 | 5 | 5 | 5 | 5 | 5 |
| Number of complaints, accidents, near accidents or any kind of robbery per specific number of ships or containers with respect to the ship or container related services[3] | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 4 | 4 | 4 | 5 |

[1] Some of the measurement tools are not used for the facility.
[2] Some of the measurement tools are not used for the facility.
[3] The number has taken from the respective tables in chapter 3.

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Non-coordinated hours between consecutive services | 5 | ----- | 5 | ----- | ----- | 5 | 5 | 5 | 5 | 2 | 2 |
| **Short answer measurement tools** | **Marking scheme for short answer** | | | | | | | | | | |
| Presence or absence of a record keeping and feedback system | 4 | ----- | ----- | ----- | ----- | ----- | ----- | ----- | ----- | ----- | ----- |
| Presence or absence of VTS | 4 | ----- | ----- | 4 | 4 | ----- | ----- | ----- | ----- | ----- | ----- |
| Are the personnel certified? | 4 | ----- | 4 | ----- | ----- | 4 | ----- | 4 | 4 | ----- | ----- |
| Are they capable of speaking English or a mutually agreed language? | 4 | ----- | 4 | ----- | ----- | 4 | ----- | ----- | ----- | ----- | ----- |
| Are round the clock services offered? | 4 | 4 | 4 | ----- | 4 | 4 | 4 | 4 | 4 | 4 | 2 |
| Is the service easily accessible by existing means of communication? | 4 | ----- | ----- | ----- | ----- | ----- | ----- | ----- | ----- | ----- | ----- |
| Presence or absence of any discrepancy between actual and mapped position of navigational aids | ----- | 4 | ----- | ----- | ----- | ----- | ----- | ----- | ----- | ----- | ----- |
| Is there standardized equipment in suitability perspective? | ----- | 4 | ----- | ----- | ----- | ----- | ----- | ----- | ----- | ----- | ----- |
| Is there standardized equipment in sufficiently perspective? | ----- | 4 | ----- | ----- | ----- | ----- | ----- | ----- | ----- | ----- | ----- |
| Is there standardized equipment in functioning and painting perspective? | ----- | 4 | ----- | ----- | ----- | ----- | ----- | ----- | ----- | ----- | ----- |
| Are they flexible to provide an ad hoc service on request? | ----- | ----- | 4 | ----- | ----- | 2 | 4 | ----- | ----- | ----- | ----- |
| Do they work in a reasonable working pattern? | ----- | ----- | 4 | ----- | ----- | ----- | ----- | ----- | ----- | ----- | ----- |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Is there a safety management system on pilotage service? | ----- | ----- | 4 | ----- | ----- | ----- | ----- | ----- | ----- | ----- | ----- |
| Does the port have a good shelter in all weather condition? | ----- | ----- | ---- | 4 | ----- | ----- | ----- | ----- | ----- | ----- | ----- |
| Presence or absence of a muddy bed | ----- | ----- | ----- | 4 | ----- | ----- | ----- | ----- | ----- | ----- | ----- |
| Is there any restriction in approaching the area due to the elements? | ----- | ----- | ----- | 4 | ----- | ----- | ----- | ----- | ----- | ----- | ----- |
| Are there obstacles, including pipelines, wires in the area? | ----- | ----- | ----- | 4 | ----- | ----- | ----- | ----- | ----- | ----- | ----- |
| Is there a safe distance from any sea going activities? | ----- | ----- | ----- | 4 | ----- | ----- | ----- | ----- | ----- | ----- | ----- |
| Is the port ice-free? | ----- | ----- | ----- | ----- | 4 | ----- | ----- | ----- | ----- | ----- | ----- |
| Is there any restriction in approaching the channel due to the tide? | ----- | ----- | ----- | ----- | 4 | ----- | ----- | ----- | ----- | ----- | ----- |
| Is there any restriction in approaching the channel due to the elements? | ----- | ----- | ----- | ----- | 4 | ----- | ----- | ----- | ----- | ----- | ----- |
| Is there any restriction in approaching the channel due to locks? | ----- | ----- | ----- | ----- | 4 | ----- | ----- | ----- | ----- | ----- | ----- |
| Is a port complied with the standards in embedding buoys and beacons? | ----- | ----- | ----- | ----- | 4 | ----- | ----- | ----- | ----- | ----- | ----- |
| Is the channel under constant surveillance? | ----- | ----- | ----- | ----- | 4 | ----- | ----- | ----- | ----- | ----- | ----- |
| Is there an appropriate turning circle in basin? | ----- | ----- | ----- | ----- | ----- | ----- | 4 | ----- | ----- | ----- | ----- |
| Whether the parties involved in the service are coordinated with port network or EDI. | ----- | ----- | ----- | ----- | ----- | ----- | ----- | ----- | ----- | ----- | 4 |
| Whether the port is complied with ISPS code | ----- | ----- | ----- | ----- | ----- | ----- | ----- | ----- | ----- | ----- | ---- |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Whether the terminal is using a computerized container handling system | ----- | ----- | ----- | ----- | ----- | ----- | ----- | ----- | 4 | ----- | ----- |
| Whether the port pre plans the slot location based on bay plan or shipper container list | ----- | ----- | ----- | ----- | ----- | ----- | ----- | ----- | ----- | 4 | ----- |
| Whether the port is capable of tracing and tracking container | ----- | ----- | ----- | ----- | ----- | ----- | ----- | ----- | ----- | 4 | ----- |
| Whether the port has facility of storing deferent container status e.g. reefer container | ----- | ----- | ----- | ----- | ----- | ----- | ----- | ----- | ----- | 4 | ----- |
| Whether the port offers free storage periods | ----- | ----- | ----- | ----- | ----- | ----- | ----- | ----- | ----- | 4 | ----- |
| **Total Marks achieved by the terminal** | **49** | **25** | **49** | **29** | **34** | **37** | **37** | **30** | **36** | **41** | **28** |
| **Maximum mark achievable** | **49** | **25** | **49** | **29** | **34** | **41** | **37** | **33** | **37** | **45** | **33** |
| **Maximum service quality can be measured by the model** | **75%** | **100 %** | **61%** | **100 %** | **90%** | **64%** | **75%** | **70%** | **78%** | **80%** | **86%** |
| **Service quality achieved by the terminal out of maximum which can be measured by the model** | **75%** | **100 %** | **61%** | **100 %** | **90%** | **58%** | **75%** | **64%** | **76%** | **73%** | **73%** |

Table guide: Excellent (5), good (4), Acceptable (3), Poor (2), Yes (4), No (2), Not applicable (-----). Reference to Table 10 Chapter 3

Source: Compiled by the author

**Table 25: Illustration for applying the model in measuring the overall port services quality of the CMP Container Terminal in Copenhagen (data of 2002)**

| **Measurement tools to evaluate measurable and short answerable attributes** | Quality Categories | | | |
|---|---|---|---|---|
| | Exce. | Good | Accep. | Poor |
| Proportion of total calculated or predicted time in port spent by 100 ships to actual time under normal circumstances | 90-100%<br>**5** | 85- 90 % | 80-85 % | <80 % |
| Total number of casualties, accidents or any kind of losses or damage to containers or ships due to unqualified port services per 100 ship calls | 0-0.5%<br>**5** | 0.5-1% | 1-2% | >2 |
| Number of effective worked days to number of scheduled working days per year | 100%<br>**5** | 98-100% | 95-98% | <95 % |
| Contribution of any kind of idle times in delivering port services when ship and cargo are ready to be served to turnaround time | 0-2%<br>**5** | 2-6% | 6-10 | >10 |
| Number of solved disputes to number of dispute actions | 100% | 95-100%<br>**4** | 90-95% | < 95% |
| Number of disputes solved in 15 days delay to number of dispute actions | 0-2 %<br>**5** | 2-7 % | 7-12 | > 12% |
| Waiting time to service time ratio | 0-3%<br>**5** | 3-5% | 5-10% | >10 |
| Number of non coordinated hours between main port services in 24 hours | 0 | 0-1 | 1-2 | >2<br>**2** |
| Cumulated number of pilferages, robberies or any other similar cases per 100,000 containers throughput | 0-0.02<br>**5** | 0.02-0.05 | 0.05-0.08 | > 0.08 |
| Total number of casualties, accidents or any kind of losses or damage to containers or ships per 500 ship calls | 0-1%<br>**5** | 1-3% | 3-5% | >5% |

| Short answer measurement tools | Yes | No |
|---|---|---|
| Whether a port holds a quality assurance system to make customers confident of providing the service at least with a minimum standard or collective agreement on the required expectation. | ----- | **2** |
| Whether a port is ice-free | **4** | ----- |
| Whether port accessibility is not affected by tide | **4** | ----- |
| Whether a port provides EDI facilities | **4** | ----- |
| Whether a port complies with international security regulation particularly with the new code of the International Ship and Port Facility Security (ISPS)[4] Code | **4** | ----- |
| **Total Marks achieved by the terminal** | **64** | |
| **Maximum mark achievable** | **70** | |
| **Maximum service quality can be measured by the model** | **88%** | |
| **Service quality achieved by the terminal out of maximum which can be measured by the model** | **80%** | |

Table guide: Excellent (5), good (4), Acceptable (3), Poor (2), Yes (4), No (2), Not applicable (----). Reference to Table 10 Chapter 3
Source: Compiled by the author

### 4.6. Conclusion

This paper emphasizes that the quality of a hypothetical port cannot be denoted by merely considering the quality of the services rendered to ship and cargo. This has to be jointly evaluated with other features of port quality. The features are at this point grouped into overall port services quality, quality of supplementary activities and quality of a port's environment. The latter two are dealt with in other studies.

[4] They are planning to comply with ISPS requirements coincide with its entry into forces.

According to this viewpoint, a model is presented by which the overall quality of a port's services is measured as capable of 88 percent. The 12 percent remainder represents purely immeasurable attributes. In other words, this is the model limitation of being able to measure the entire quality of overall port service.

For the purpose of practically testing the model, as illustrated in chapters 3 and 4, for measuring the quality of the individual services and overall port service quality, in a concrete situation the CMP Container Terminal has been selected. One of the significant findings is the capability of the model to be implemented in practice. The time needed to fulfill the requirements of the model is not considerable due to the way of utilizing the measurement tools, which are readily accessible and familiar to the people working in the industry.

The end result of exemplification is the comparison between maximum quality, which can be measured by the model with the quality achieved by a container terminal through the process. The gap indicates how far port quality is from the ideal situation.

# Chapter 5

# Conclusion

## 5.1. Conclusion

The globalization of economy, trade relationships, information technology and other major and minor breakthroughs in the shipping world have had a significant impact on the port industry. Ports are no longer holding and controlling their hinterland and captive traffic since they are exposed to a competitive environment. In these circumstances, the quality of ports has an indispensable effect on the users' selection of a port. Thus, there is a need for tools and methodology in order to enable the port users and even port operators to evaluate and measure a port's quality.

The measuring of port quality has become important thanks to the increasing tendency of the port users in recognizing more and more the quality criteria in port selection procedures. However, in the present study this importance is deliberated and discussed, leading to detailed measurement in respect of port operational quality criteria. Notwithstanding this, other criteria grouped under technical and location quality are worthwhile evaluating in future studies.

The study's objectives are attained by establishing the model capable of measuring the quality of the major port services rendered to a ship and its cargo. To obtain this, the model has made use of eight different quality determinants consisting of 85 quantifiable attributes. In the aggregate, 78 percent of the quality of major port services is measured by the model. The remainder are composed of pure immeasurable attributes, which should be evaluated objectively in a specific case by surveying the users' satisfaction levels.

Considering the port service characteristics, which cause some deficiency in the process of determining the port quality by purely evaluating the major services, this study has additionally evaluated the overall port quality. Therefore, a set of six quality determinants, composed of 15 quantifiable attributes, is deployed. Again, due to the existence of two immeasurable attributes, the model is capable of measuring 88 percent of the port overall quality.

The main achievement of this study is the introduction of a model in which the port services quality, as well as the overall port quality, are measured in a containerized port or terminal. This is practically exemplified through the application of the model to the CMP Container Terminal.

In concluding, it is believed that this study has developed a methodology permitting almost exhaustive analysis in connection to the quality of services in a containerized port. Moreover, it allows the combining of detailed analysis in order to determine an overall appraisal of port quality. Furthermore, the models are realistic and practically applicable since, as already noted, they have been applied to the CMP Container Terminal, and can be also used for assessing the quality of different terminals and ports by modifying or amending some of the attributes in line with the characteristics of a prospective port.

Further, it should be mentioned that the flexibility of the model permits the addition or subtraction of different items and quality attributes in different situations. Additionally, the priority of the quality attributes, as well as quality categories of the models, can be changed according to the prioritization table of a prospective port where the model is to be examined. For instance, the ranges in which the quality categories including excellent, good, acceptable and poor are situated are changeable. Besides, in some ports exposed to a risk of terrorism attack or pollutant substances, the necessary attributes can be added and weighted differently based on the priorities. Lastly, multi criteria analysis is suggested where different priorities exist.

## 5.2. Discussion and future study

Since the focus of this dissertation is on a containerized port, it has therefore explored the data regarding a hypothetical container port and terminal. However, there is room for further research to be carried out for different port categories and subsequently, for different shipper and ship-owner categories or supply chain providers. Moreover, the ongoing issues regarding security measures and port environment sensitivity could be paid more attention in different regions through for the research.

In addition, as a matter of fact, the greater the number of quantifiable attributes achieved, the clearer the quality measurement of a port becomes. Therefore, from the foregoing, the endeavours were forwarded, throughout this study, to curtail the number of immeasurable attributes in the process of indicating the quality determinants by the quality attributes. Furthermore, due to the limited time constraints efforts were also employed to find out the applicable attributes, which are recognizable for the people in the industry. Notwithstanding this, a considerable amount of port overall and service quality, respectively 88 and 78 percent, are determined by the model. However, it could be an interesting, productive and great challenge to discover and define more and more quantifiable attributes and thus increase the reliability of the measurements even further.

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# Appendix 1

**Determinants of Service Quality**

**Reliability** involves consistency of performance and dependability. It means the firm performs the service right the first time. It also means that the form honors its promises. Especially, it involves: Accuracy in billing, keeping records correctly and performing the service at the designated time.

**Responsiveness** concerns the willingness and readiness of employees to provide service. It involves timeliness of service. Mailing a transaction slip immediately, calling the customer back quickly and giving prompt service.

**Competence** means the possession of the required skills and knowledge to perform the service. It involves: knowledge and skill of the personnel, research capability of the organization.

**Access** involves approachability and ease of contact. It means the service is easily accessible; waiting time to receive service is not extensive, convenient hours of operation, convenient location of service facility.

**Courtesy** involves politeness, respect, consideration and friendliness of contact personnel. It includes: consideration for customer's property, clean and neat appearance of contact personnel.

**Communication** means keeping customers informed in a language they can understand and listening to them. It may mean that the company has to adjust its language for different customers increasing the level of sophistication with a well-educated customer and speaking simply and plainly with one voice.

**Credibility** involves trustworthiness, believability, and honesty. It involves having the customer's best interest at heart. Contributing to credibility are: company name, company reputation, personnel characteristics etc.

**Security** is the freedom from danger, risk or doubt. It involves: physical safety, financial security and confidentiality.

**Understanding / Knowing** the customer involves making the effort to understand the customer needs.

**Tangibles** include the physical evidence of the service: physical facilities, appearance of the personnel, tools or equipment used to provide service etc.

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A Conceptual Model of Service Quality introduced by Parasuraman, Zeithaml and Berry (1985).

## Appendix 2

# Quality Analysis of Ship Related Services

### 1. Harbour Master Office Service

**Table 1**

| Applicable quality Service determinants | Quality attributes | Applicable measurement method | | | Measurement tools to evaluate the attributes |
|---|---|---|---|---|---|
| | | Yes/No | Measurable | Immeasurable | Efficiency, grade point, intuitive measurement |
| **1. Reliability** | Performing the required service from the arrival notice to the end of departure | | | | Proportion of calculated or expected ship movement time from anchorage to berth against actual time where other services are available |
| **2. Responsiveness** | Record keeping & feedback system | | | | Present or absent |
| | Readiness to prompt response to ship needs | | | | Cumulated time between request of harbour master office service and taking the necessary measures per ship during the time in port |
| | VTS | | | | Present or absent |
| **3. Competence** | Competent and certified personal | | | | Are they certified under the standard requirements? |
| | Knowledge and skill capability to offer advice and suggestions | | | | Objectively can be measured by means of survey in the users' satisfaction and experience |
| | Capability of speaking English or mutually agreed language | | | | Are they able to communicate in English or an agreed language? this can also be ranked between Excellent to Poor |
| **4.Accessibility& Flexibility** | Round the clock service offering capability | | | | Do they operate 24 hours per day? |
| | Service availability without waiting time | | | | Contribution of cumulated waiting time due to disorders in harbor master coordination in the average time in port |
| | Easily accessible by existing means of communication | | | | By VHF, telephone or other means of communication |
| **5. Courtesy** | Being polite and friendly in communicating | | | | Objectively can be measured by means of surveying the users' satisfaction and experience |
| **6. Communication** | Communication equipment perforemance | | | | Availability level of communication equipment |
| | Giving timely information | | | | Delay in providing timely information by the number of complaints per 100 ship calls |
| | Clear and understandable message | | | | Objectively can be measured by means of surveying the users' satisfaction and experience |
| **7. Credibility** | Harbor master office reputation | | | | Objectively can be measured by means of surveying the users' satisfaction and experience |
| **8. Safety** | Performing the duties with minimum mistake | | | | Number of any kind of accidents and near accidents due to improperly performed harbor master duties per 100 ship calls |

## 2. Aids to Navigation Service

**Table 2**

| Applicable quality Service determinants | Quality attributes | Applicable measurement method | | | Measurement tools to evaluate the attributes |
|---|---|---|---|---|---|
| | | Yes/No | Measurable | Immeasurable | Efficiency, grade point, intuitive measurement |
| **1. Reliability** | Functioning consistently and consistency | | | | Availability level |
| | Being thoroughly positioned | | | | Discrepancy between actual and mapped position |
| **2. Accessibility& Flexibility** | 24 hours per day offered | | | | Are they operating 24 hours per day? |
| **3. Safety** | Suitable equipment for transferring varying messages | | | | Comparing with the standards |
| | Sufficient equipment being used | | | | Comparing with the standards |
| | Standard functioning and painting | | | | Comparing with the standards |

## 3. Pilotage Service

**Table 3**

| Applicable quality Service determinants | Quality attributes | Applicable measurement method | | | Measurement tools to evaluate the attributes |
|---|---|---|---|---|---|
| | | Yes/No | Measurable | Immeasurable | Efficiency, grade point, intuitive measurement |
| **1. Reliability** | Consistency of pilotage service | | | | Proportion of calculated or expected ship movement within 30 minutes of confirmed arrival/departure where other services such as towage, harbor master are performed appropriately |
| **2. Responsiveness** | Capability of providing prompt service with minimum waiting time | | | | Contribution of cumulated waiting time due to pilot embarkation delays to the average time in port |
| **3. Competence** | Competent and certified pilots | | | | Are they certified under the standard requirements? |
| | Full knowledge of regional navigation characteristics | | | | Objectively can be measured by means of surveying the users' satisfaction and experience |
| | Efficiency in tug utilization | | | | Objectively can be measured by means of survey in the users' satisfaction and experience |
| **4. Accessibility & Flexibility** | Capability of providing round the clock services | | | | Are they operating 24 hours per day? |
| | No need to pre arrange pilotage | | | | Are they flexible to provide an ad hoc service on request? |
| **5. Courtesy** | Clean and neat appearance of pilot | | | | Objectively can be measured by means of surveying the users' satisfaction and experience |
| | Polite and friendly in communicating | | | | Objectively can be measured by means of surveying the users' satisfaction and experience |
| **6. Communication** | Providing relevant and accurate information | | | | Objectively can be measured by means of surveying the users' satisfaction and experience |
| | Capability of communicating in English | | | | Are they able to speak English? |
| **7. Safety** | Pilots reasonable working pattern | | | | Yes or no |
| | Adopted safety management system in pilotage | | | | Yes or no |

## 4. Shelter Water / Anchorage Area Facility

**Table 4**

| Applicable quality Service determinants | Quality attributes | Applicable measurement method | | | Measurement tools to evaluate the attributes |
|---|---|---|---|---|---|
| | | Yes/No | Measurable | Immeasurable | Efficiency, grade point, intuitive measurement |
| **1. Reliability** | Capability of giving shelter in any weather condition | | | | It can be also ranked from excellent to poor |
| | Good holding ground capability (muddy bed) | | | | It can be also ranked from excellent to poor |
| | Controlled under well organized traffic scheme VTS | | | | Yes or no |
| **2. Accessibility** | Restriction in approaching the area due to the elements | | | | Yes or no |
| **3. Safety** | Obstacle such as pipelines, cables etc. | | | | Yes or no |
| | Safe distance from any seagoing activitiy including fairway, oil exploration | | | | Yes or no |
| **4. Security** | Surveyed by control tower, Radar or patrol boat | | | | Number of pirate assaults or any kind of attackss to ships in the area per 100 ship calls |

## 5. Approach Channel Facility

**Table 5**

| Applicable quality Service determinants | Quality attributes | Applicable measurement method | | | Measurement tools to evaluate the attributes |
|---|---|---|---|---|---|
| | | Yes/No | Measurable | Immeasurable | Efficiency, grade point, intuitive measurement |
| **1. Reliability** | Well designed and maintained | | | | Proportion of calculated or expected ship movement time in passing through channel to actual time where other services are being well performed |
| **2. Accessibility** | Ice free all season | | | | Yes or no |
| | 24-hour operation | | | | Yes or no |
| | No restriction in approaching the channel due to tide | | | | Yes or no |
| | Restriction in approaching the channel due to lock | | | | Yes or no |
| | No restriction in approaching the channel due to the elements | | | | Yes or no |
| **3. Safety** | Well designed against waves and currents | | | | By survey in the designer opinion. The response can be graded between excellent to poor |
| | High visibility in all seasons | | | | Actual visibility compared to minimum requirement |
| | Well organized traffic scheme | | | | Using VTS or not |
| | Channel well buoyed and marked | | | | Is that complying with standard? |
| | Maintained channel depth, width, length as declared | | | | Number of accidents or ship complaints due to discrepancy between channel size declaration and reality per 100 ships passing through the channel |
| **4. Security** | Surveyed by control tower, radar or patrol boat | | | | Is there less than 24 hours surveillance? |

## 6. Towage Service

**Table 6**

| Applicable quality Service determinants | Quality attributes | Applicable measurement method | | | Measurement tools to evaluate the attributes |
|---|---|---|---|---|---|
| | | Yes/No | Measurable | Immeasurable | Efficiency, grade point, intuitive measurement |
| **1. Reliability** | Consistency in towage service | | | | Proportion of calculated or expected ship movement time from the starting point of using towage service to the end to the actual time where the other services such as pilotage, harbormaster are being well performed. |
| **2. Responsiveness** | Minimum waiting time in providing service | | | | Contribution of cumulated waiting time due to towage delay to the average time in port |
| **3. Competence** | Competent tug crews | | | | Are they certified in compliance with the standard? |
| | Skills and experience in operation | | | | Objectively can be measured by means of survey in the users' satisfaction and experience |
| **4. Accessibility & Flexibility** | Round the clock accessibility to service | | | | Is the service being provided 24 hours per day? |
| | No needless to pre arrange tugs service | | | | Do they need to pre arrange? |
| **5. Communication** | Effective communication flow between tugs, pilot, ship | | | | Objectively can be measured by means of surveying the users' satisfaction and experience |
| | English or a mutually agreed language is being used | | | | Yes or no |
| **6. Credibility( if it is provided by private company)** | Company name | | | | Objectively can be measured by means of surveying the users' satisfaction and experience |
| | Company reputation | | | | Objectively can be measured by means of surveying the users' satisfaction and experience |
| **7. Safety** | Safe operation | | | | Number of any kind of accidents or complaints due to unqualified towage service per 100 ships using towage service |

## 7. Mooring and Unmooring Service

**Table 7**

| Applicable quality Service determinants | Quality attributes | Applicable measurement method | | | Measurement tools to evaluate the attributes |
|---|---|---|---|---|---|
| | | Yes/No | Measurable | Immeasurable | Efficiency, grade point, intuitive measurement |
| **1. Reliability** | Consistency in the service | | | | Proportion of calculated or expected ship mooring or unmooring time to the actual time where other services such as pilotage, harbor master are being well performed |
| **2. Responsiveness** | Minimum waiting time to get service | | | | Contribution of cumulated waiting time due to mooring and unmooring operation delay in the average time in port |
| **3. Competence** | Trained and experienced mooring men and boatmen | | | | Objectively can be measured by means of surveying the users' satisfaction and experience |
| **4. Accessibility** | Round the clock accessibility to service | | | | Is the service being provided 24 hours per day? |
| | No needless to pre arrange | | | | Do they need to pre arrangement? |
| **5. Communication** | Proper coordination and interaction between ship, shore, mooring men and boat | | | | Objectively can be measured by means of surveying the users' satisfaction and experience |
| **6. Safety** | Performing a developed procedure and guideline in safe mooring and unmooring as well as berthing time | | | | Any accidents or near accidents due to mooring, unmooring as well as berthing time to 100 ships moored and unmoored in a port |
| | Appropriate turning circle in basin corresponding to vessel length | | | | Present or absent |

## Appendix 3

## Quality Analysis of Cargo Related Services

### 1. Handling or quay operation service

**Table 1**

| Applicable quality Service determinants | Quality attributes | Applicable measurement method | | | Measurement tools to evaluate the attributes |
|---|---|---|---|---|---|
| | | Yes/No | Measurable | Immeasurable | Efficiency, grade point, intuitive measurement |
| **1. Reliability** | Ship output in service time | | | | Proportion of recorded container move to actual move in one hour of service time or expected completion time versus actual completion time |
| **2. Responsiveness** | Minimum idle time during service time | | | | Contribution of cumulated idle time to the service time |
| **3. Competence** | Certified crane operator | | | | Are they certified according to the port regulations? |
| | Experienced operator and gang team | | | | Objectively can be measured by means of surveying the users' satisfaction and experience |
| **4. Accessibility** | Round the clock service offered | | | | Yes or no |
| **5. Communication** | Coordination between ship and shore | | | | Objectively can be measured by means of surveying the users' satisfaction and experience |
| | Port network, EDI | | | | Existence or extinction |
| **6. Credibility** | Steavdoring company reputation and name | | | | Objectively can be measured by means of survey in the users' satisfaction and experience |
| **7. Security** | Compliance with ISPS code | | | | Yes or no |
| **8. Safety** | Safe container handling with minimum risk of damage | | | | Average number of any kind of damages to container emanated from unqualified container loading and unloading to 100,000 moves |

## 2. Transfer operation service

**Table 2**

| Applicable quality Service determinants | Quality attributes | Applicable measurement method | | | Measurement tools to evaluate the attributes |
|---|---|---|---|---|---|
| | | Yes/No | Measurable | Immeasurable | Efficiency, grade point, intuitive measurement |
| **1. Reliability** | Consistency in providing service | | | | Proportion of clculated or expected work completion time to actual time |
| **2. Responsiveness** | Keeping pace with quay operation | | | | Contribution of idle time in quay operation emanated from inadequate transfer operation to the service time (Berthing time) |
| **3. Competence** | Certified transferring equipment operators | | | | Are they certified according to the port regulations? |
| | Experienced operators and gang team | | | | Objectively can be measured by means of surveying the users' satisfaction and experience |
| **4. Accessibility** | Round the clock service offered | | | | Yes or no |
| **5. Communication** | Coordination between crane, transfer equipment, storage area | | | | Objectively can be measured by means of surveying the users' satisfaction and experience |
| | Computerized container handling system in port | | | | Present or absent |
| **6. Security** | Vigilant security measures | | | | Number of pilferages, robberies or other losses per 100,000 containers transferred |
| **7. Safety** | Well marked, signed and lightened driving ways | | | | Number of accidents and containers damaged per 100,000 transfered containers |

### 3. Storage service

**Table 3**

| Applicable quality Service determinants | Quality attributes | Applicable measurement method | | | Measurement tools to evaluate the attributes |
|---|---|---|---|---|---|
| | | Yes/No | Measurable | Immeasurable | Efficiency, grade point, intuitive measurement |
| **1. Reliability** | Consistency in providing service | | | | Non-coordinated working hours between storage service with quay and gate operations |
| | Pre planning the slot location in yard based on bay plan<br><br>for import container or shipper list for export container | | | | Presence or absence of pre planning system |
| **2. Responsiveness** | Tracing and tracking capability | | | | Present or absent |
| | Proper facilities to store different container status | | | | Present or absent |
| **3. Competence** | Experienced and knowledgeable storage personnel | | | | Objectively can be measured by means of surveying the users' satisfaction and experience |
| **4. Accessibility & flexibility** | Free storage period | | | | Yes or no, could be also ranked from excellent for high grace period and poor for very low or no grace period |
| | Round the clock service offered | | | | Yes or no |
| **5. Communication** | Coordination between crane, transfer equipment, storage area and cargo owner | | | | Objectively can be measured by means of surveying the users' satisfaction and experience |
| **6. Security** | Vigilant security measures | | | | Number of pilferages, robberies or other losses per 100,000 containers stored |
| **7. Safety** | Safe container handling with minimum risk of accident | | | | Number of accidents and containers damaged per 100,000 stored containers |

## 4. Receive / delivery services

**Table 4**

| Applicable quality Service determinants | Quality attributes | Applicable measurement method | | | Measurement tools to evaluate the attributes |
|---|---|---|---|---|---|
| | | Yes/No | Measurable | Immeasurable | Efficiency, grade point, intuitive measurement |
| **1. Reliability** | Consistency in providing service | | | | Proportion of cargoes due to be received or delivered to actual received or delivered |
| **2. Responsiveness** | Prompt response to shipper requirements | | | | Average waiting time of land transport to access to the service container where other procedures such as customs have been completed |
| **3. Competence** | Storage personnel skillfull and knowledgable | | | | Objectively can be measured by means of surveying the users' satisfaction and experience |
| **4. Accessibility & flexibility** | 24 hour service | | | | Yes or no |
| **5. Communication** | EDI system | | | | Present or absent |
| **6. Security** | Vigilant security measures | | | | Number of pilferages, robberies or other losses per 100,000 containers received or delivered |
| **7. Safety** | Safe container handling with minimum accident risk | | | | Number of accidents and containers damaged per 100,000 containers received or delivered |

## Appendix 4

## Quality analysis of overall port services

**Table 1**

| Applicable quality service determinants | Quality attributes | Applicable measurement method | | | Measurement tools to evaluate the attributes |
|---|---|---|---|---|---|
| | | Yes/No | Measurable | Immeasurable | Efficiency, grade point, intuitive measurement |
| **1. Reliability** | Consistency in providing services | | | | Proportion of total actual time in port spent by 100 ships to the calculated or predicted time in port under normal circumstances |
| | Accuracy of operations | | | | Total number of casualties, accidents, losses or damage to cargo or ship due to unqualified port services per 100 ship calls |
| | Assuring the best practices confidently | | | | Is the port holding any quality assurance system? |
| | Political stability | | | | Number of effective worked days to number of scheduled working days per year |
| **2. Responsiveness** | Availability of prompt service | | | | Contribution of any kind of idle times in delivering port services when the ship and cargo are ready to be served respectively to time in port and cargo transit time |
| | Efficiency in handling dispute | | | | Number of solved litigations to number of litigation actions |
| | Dispute settled quickly | | | | Number of litigations solved with 15 days delay to number of litigation actions |
| **3. Competence** | Port managing and marketing skills and knowledge | | | | Objectively can be measured by means of surveying the users' satisfaction and experience |
| **4. Accessibility & flexibility** | Waiting time for ship | | | | Waiting time to service time ratio |
| | Round the clock service | | | | Number of non coordinated hours in 24 hours |
| | Ice free port | | | | Yes or no |
| | Tidal or non tidal port | | | | Yes or no |
| **5. Communication** | Is there EDI facility? | | | | Yes or no |
| **6. Security** | Secure port | | | | Cumulated number of pilferages, robberies, or any other identical cases to total BL or manifest |
| | ISPS code | | | | Is a port copmlying with ISPS requirements? |
| **7. Safety** | Safe operation in port | | | | Total number of casualties, accidents, losses or damage to cargo or ship due to unqualified port services per 100 ship calls |
| **6. Credibility** | Steva§doring company reputation and name | | | | Objectively can be measured by means of surveying the users' satisfaction and experience |

## Appendix 5

**Environmental Performance Indicators On The Condition Level:**

**Issue: Air Quality**

**Indicators:**

Evaluation and/or measurement of pollution from land traffic.

Compliance with EU and /or national legislation on air quality

Frequency of monitoring of hazardous gases in the port area

Evaluation and/or measurement of pollution from ships

Evaluation and/or measurement of pollution from activities under the responsibility of the port authority

Number of research programs, measures and solution to reduce air pollution in the port area

Frequency of monitoring of greenhouse gases in the port area

**Issue: Soil Quality**

**Indicators:**

Frequency of monitoring soil quality based on EU or/and national legislation

The cost related to treatment of contaminated soil

Availability of contaminated soil map

**Issue: Water Quality**

**Indicators:**

Frequency of collection of waste from the water surface of the port

Frequency of evaluating the quality of fishes and/or shelves species and/or algae's in port area

Frequency of monitoring of groundwater quality

Frequency of monitoring the concentration harmful pollutants in port seawater

Number of fines for non-compliance with regulations

# Appendix 6

**Measurement and short answer tools for measuring quality attributes**

**1. Combined list of measurement tools for ship side services**

1. Expected or recorded productivity of the operating service in completing the assigned job to the actual productivity.
2. Waiting time in receiving service to the service time. (Service time here means the duration of the service from the beginning to the end)
3. Cumulated idle time during service time to the service time. (Service time here means the duration of the service from the beginning to the end)
4. Availability level of the main equipment being used in providing service.
5. Number of complains per specific number of customers e.g. 50 ships called at port.
6. Number of accidents or near accidents per specific number of customers e.g. 50 ships called at port.

**2. Combined list of measurement tools for cargo side services**

1. Expected or recorded productivity of handling operation in quay, transfer, storage, receive and delivery operation against actual productivity in completing the assigned job.
2. Contribution of cumulated idle time in the service time.
3. Number of pilferages or losses per specific number of containers e.g. 100,000 TEUs.
4. Number of accidents and containers damages per specific number of containers e.g. 100,000 TEUs.
5. Non-coordinated hours between four main services such as quay, transfer, storage, receive and delivery operations.

# Appendix 6

**3. Combination of 1 and 2**

1. Recorded or expected productivity and consequently completion time to the actual time.
2. Contribution of cumulated idle time in the service time.
3. Waiting time in receiving a service to the duration of the service.
4. Number of complains, accidents, near accidents or any kind of robbery per specific number of ships or containers with respect to the ship or container side services.
5. Non-coordinated hours between consecutive services.

**4. Combined list of short answer attributes for ship and cargo side services and their application**

1. Presence or absence of a record keeping and feedback system. (*Applicable in harbour master service)*
2. Presence or absence of VTS. (*Applicable in Harbor master service, anchorage area and approach channel facilities)*
3. Are the personnel certified? *(Applicable in harbormaster, pilotage and towage services)*
4. Are they capable of properly speaking English or a mutually agreed language? *(Applicable in harbormaster, pilotage and towage services)*
5. Are a round the clock services offered? *(Applicable in harbor master, aids to navigation, pilotage, approach channel, towage, mooring and unmooring services and facilities)*
6. Is the service easily accessible by an existing means of communication? *(Applicable in harbor master service)*
7. Presence or absence of any discrepancy between actual and mapped position of navigational aids. *(Applicable in aids to navigation service)*

8. Is there standardized equipment in suitability perspective? *(Applicable in aids to navigation service)*
9. Is there standardized equipment in sufficiently perspective? *(Applicable in aids to navigation service)*
10. Is there standardized equipment in functioning and painting perspective? *(Applicable in aids to navigation service)*
11. Are they flexible to provide an ad hoc service on request? *(Applicable in pilotage, towage, mooring and unmooring services)*
12. Do they work in a reasonable working pattern? *(Applicable in pilotage services)*
13. Is there a safety management system on pilotage service? *(Applicable in pilotage service)*
14. Does a port have a good shelter in all weather condition? *(Applicable in anchorage area facility)*
15. Presence or absence of a muddy bed. *(Applicable in anchorage area facility)*
16. Is there any restriction in approaching the area due to the elements? *(Applicable in anchorage area facility)*
17. Are there obstacles, including pipelines, cables in the area? *(Applicable in anchorage area facility)*
18. Is there a safe distance from any sea going activities? *(Applicable in anchorage area facility)*
19. Is the port ice-free? *(Applicable in approach channel facility)*
20. Is there any restriction in approaching the channel due to the tide? *(Applicable in approach channel facility)*
21. Is there any restriction in approaching the channel due to the elements? *(Applicable in approach channel facility)*
22. Is there any restriction in approaching the channel due to locks? *(Applicable in approach channel facility)*
23. Is a port complying with the standards in embedding buoys and beacons? *(Applicable in approach channel facility)*

*24.* Is the channel under constant surveillance? *(Applicable in approach channel facility)*

25. Is there an appropriate turning circle in the basin? *(Applicable in mooring and unmooring service)*
26. Whether the parties involved in the service are coordinated with port network or EDI.
27. Whether the port complies with the ISPS Code.
28. Whether the terminal is using a computerized container handling system
29. Whether a port pre plans the slot location based on a bay plan or shipper container list
30. Whether a port is capable of tracing and tracking container services.
31. Whether a port has the facility of storing deferent container status e.g. reefer container.

*32.* Whether a port is offering free storage periods.