Thesis for the Degree of Master of Business Administration

Comparison of Busan Port and Mersin Port According to Information Technology Used:
Implications for Turkish Ports

by
Yavuz Keceli

Department of Management Information Systems
The Graduate School
Pukyong National University

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(항만 정보 시스템에 의해서 부산항과 메르신항의 비교: 터키 항만들을 위한 의미고찰)

Advisor: Hakyun Kim, Ph.D

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Approved by:

Chairman: Prof. Myung [illegible]

Member: Prof. Jae Jung Lee

Member: Prof. Hakyun Kim

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Abstract

In this research, the current situation of Turkish ports in information technology point of view was described, by comparing the results with those of Busan Port. Mersin Port was selected as representative Turkish port. Then, a few implications for the development of information system in Turkish ports were derived.

Due to the nature of the topic, a descriptive method was used. Since it is difficult to get relevant information, several officials in Busan Port and Mersin Port were contacted, and interviewed for required information. Due to space and time limitations, the interviews were carried out on written basis.

According to the content obtained by these interviews, the basic problems of Turkish ports are administrational, rather than technical or economical. This result is derived depending on the fact that previously designed systems couldn't be used properly since they were not in accordance with managerial processes. So, *business process reengineering, a better information planning, employee training* and *privatization* were offered in order to overcome these problems. Busan Port may not be a proper object for benchmarking, unless these precautions are taken.

Keywords: port management information systems, port performance, Busan Port, Mersin Port.

1. INTRODUCTION

It is for sure that ports are one of the most important elements of a country's economy. They are not only the intersection points of different modes of transport, but also focal points of economic activity.

Until the end of the first half of this century, the cost of inland and maritime transport was relatively so high that the cost of port operations could be considered as insignificant. The ports were considered as "instruments of state or colonial powers and port access and egress were regarded as a means to control markets."(World Bank, Port Reform Tool Kit). In such an environment, the competition between ports was not significant and the effort to increase port efficiency was not considered to be important.

By the time passes, efficiency of ports became a major problem and the competition between ports became more severe due to;

- decreasing costs of inland and ocean transport,
- increasing amount of international trade
- increasing capacity of ship vessels.
- change in cargo type (from bulk to container)
- evolution of markets, services, technologies and regulatory forces(Tennet, 2004).

In the era of globalization, ports gained vital importance for the economy of the country. Today, ports should not be considered as the places where ships load and unload cargo. They have a very important position in domestic and international transport and macro logistic system of a country with their hinterlands, provided services and properties like capacity, speed...etc.(Cubukcu, 1998) Being an important link in maritime trade, ports are indicators of economic and political power.(Baskaya, 1999) On the other hand, this link is one of most important and the weakest links in the chain of transport. Since the strength of a chain is specified by the strength of its weakest link, increasing the capacity of the chain of transport is possible –first of all– by increasing the service capacity of the ports. (Ergunes, 1993)

There appears the problem of port efficiency. Because it is natural that a ship is earning money only when transporting cargo at sea, and spending money when waiting in a port.(Yenel, 1998) For example, operating a third – or forth– generation container ship carrying up to 7000 TEU's, costs the shipping companies US$50,000 each day. (Applegate, 2000, p315) That's what forces rival terminal companies not only to develop into the latest loading and unloading technology, but also to renovate their terminal facilities in order to reduce the length of staying time of vessels at their terminals.(Choi, 2003)

The port authority carries on the coordination of various activities; such as basic operations like loading, unloading, storage and tugging, as well as relations with state authority (customs), banks, insurance companies, ship owners, cargo owners, haulers, freight forwarders, agencies, brokers and service providers. Besides these, the port management must deal with the documentation of several commercial (i.e. billing) and legal (i.e. custom declaration) operations.

Such a chain of operative and commercial activities cannot be properly carried out without computerized systems in the world of "information age". The necessary information to manage organizations can be transferred by integrated computerized information systems to the decision maker timely and precisely, and necessary reports can be generated precisely, quickly and with desired accuracy. (Cubukcu, 1998)

In the world of globalization, in contrast to old times, the ports are competing with each other severely. This competition forced the ports to upgrade their infrastructure as well as their management strategies. Among these, the advent of computers and sophisticated information and communication technologies had a deep impact on not only the infrastructure but also the processes. It is obvious that any port that neglects the impact of information technologies is likely to lose competition and become stagnant.

1.1. Purpose of the Paper:

As explained above, efficient operation of ports are very important for a country's economy. They supply foreign currency to the country (Baskaya, 1999) and are "the major economic multiplier for the nation's prosperity" (Alderton, 1999). They are focal points for industrialization and economic activity. Since more than 80% of the international trade of the world is carried out by maritime transport (Baskaya, 1999), it is obvious that efficiency of ports is a vital issue for any country to improve their economic position in the world.

Turkey is no exception. Being surrounded by Black Sea, Aegean Sea and Mediterranean Sea, Turkey has a shoreline 8333 km long. Turkey has a very important geopolitic and geostrategic position because of being in the intersection of three continents, Europe, Asia and Africa.

On the other hand almost every study about Turkish ports claim that Turkish ports suffer from severe efficiency problems. (see Yucel, 1997, Baskaya, 1999, Cubukcu 1998 ...etc)

For the time being, Turkey is holding negotiations with European Union. If the negotiations will be successful, Turkey is expected to be a member of EU within the next decade. Even the probability of this membership is enough to lead foreign investments to Turkey, because of cheap land and manpower, as well as easy access to European countries. It will be reasonable for multi-national enterprises to manufacture their goods in Turkey and export to European or North African countries. Obviously this will increase the load of the ports and cause congestions.

Another issue is the Iraq War. Equipment and material will be sent from various countries for the reconstruction of Iraq, after the war. For the time being, Mersin Port seems to be the most suitable port for the handling of these equipments and material. For this task, Mersin Port is in severe competition with Tartus and Lazkiye Ports of

Syria. (Mersin Chamber of Commerce and Industry webpage http://www.mtso.org.tr/mp/contents.php?id=180)

For these reasons, Turkish ports should undergo a good renewal, i.e. management innovations, solution for infrastructure problems and technological enhancement. Losses due to delays are affecting Turkish economy in a negative way.

The purpose of this research is to depict the present situation of Turkish ports in ICT point of view. Mersin Port was chosen as the representative Turkish port. The results are compared to those of Busan Port and some implications for Mersin Port are derived.

Why Mersin Port?

There are two main reasons to choose Mersin Port as the representative Turkish port.

1) Even though Izmir Port has a greater container throughput, Mersin Port is still considered to be the biggest port in Turkey, according to ship capacity, general cargo capacity, open area, closed area and number of staff. (see Table 1-1)

2) Major ports in Turkey are operated by TCDD (Turkish State Railways). And TCDD is governing these ports similarly, even with fixed fare policy (Yucel, 1997). In her research, Yucel criticizes this policy, such that it handicaps port's local competitiveness (p. 68). Nevertheless, it can be concluded that results derived from Mersin Port can easily be applied to other ports of TCDD, due to this similarity in management.

1.2. Composition of the Paper:

This paper is composed of six chapters. In the first chapter a brief introduction is given and the purpose and the composition of the research is explained, briefly. The second chapter is reserved for theoretical background of the paper. In this chapter, main issues

		Mersin Port	**Izmir Port**
Ship Allowed (ship/year)	**Capacity**	Freight: 4059 Passenger: 623	Freight: 2389 Passenger: 1246
	Realization	3961	2644
Handling (*1000 tons)	**General Cargo Cap.**	2.704.600	1.357.300
	General Cargo Real.	11.260	4.841
	Container Capacity	3.997.700 (372,250 TEU)	5,061,400 (549,000 TEU)
Area (m^2)	**Open Area**	589.230	215.940
	Closed Area	32.649	24,678
Staff	**Officer**	319	205
	Permanent Worker	1017	452
	Temporary Worker	0	106

Table 1-1. Mersin Port vs. Izmir Port (2004 statistics)(source: TCDD 2000-2004 Annual Report)

and basic definitions about ports, port performance, port management information systems are given and the relation between port performance and PMIS is described, on the basis of the results of previous studies.

In the third chapter, the research method of the paper is explained.

The fourth chapter can be considered as the main body of this thesis. It is consist of two parts. In the first part, the general situation of Busan Port and Mersin Port, and the information systems used in these ports are described. In the second part, the two ports are compared on the basis of both performance indicators and the opinions of the managers that are interviewed during data collection process.

The fifth chapter is the discussion part where the results of the research are discussed and some implications for information systems development for Turkish ports are derived.

Finally, in the sixth chapter, a brief summary of the research is given, limitations to the research and recommended future work are explained.

2. THEORETICAL BACKGROUND

2.1. Port Performance:

The word "productivity" is defined as "a ratio to measure how well an organization (or individual, industry, country) converts input resources (labor, materials, machines etc.) into goods and services. This is usually expressed in ratios of inputs to outputs ... It is not on its own a measure of how efficient the conversion process is." (http://www.accel-team.com/productivity/productivity_01_what.html). On the other hand "efficiency" is defined as "the capability of acting or producing effectively with a minimum of waste, expense, or unnecessary effort. The term has widely variant meanings in different disciplines."(http://en.wikipedia.org/wiki/Efficiency).

Since ports are the places where "service" is produced, the productivity or efficiency of ports can be measured by quality, safety and – the most important of all – speed of the service(Yucel, 1997).

In a port, the efficiency and the adequacy of the operations are assessed by the evaluation of the values of several parameters (Yenel, 1998). These parameters are called port performance indicators. The word "performance" is defined in many sites as "a major factor in determining the overall productivity of a system" that "is primarily tied to availability, throughput and response time."(e.g. www.e-formation.co.nz/ glossary.asp)

Properties of these indicators are:

- They indicate how efficiently the sources of the port are used, such that the planners can do their planning when extra sources are needed.
- They indicate how frequently the sources of the port are used, such that the planners can do their planning when extra sources are needed.
- They indicate the quality of the service to the ship owners and ship operators.
- They indicate the quality of the service to the cargo owners.

According to Yenel, port performance indicators are the only source to compare two ports. These indicators can be utilized steadily or for a specific interval in time. Both methods serve for different purposes. The indicators that are utilized steadily are related to the corresponding port, only. If the port performance goes down, the results will turn out to be bad in what manner they are compared to any other port. All standards are the port's own standards and these standards are composed by considering aspects of the port that constitutes the port's characteristics, such as equipment, investment, geography and traffic.

On the other hand, when a decision whether something is going wrong or not, is to be made, indicators that display the performance of the port for definite time interval are needed. When an expert –who has information and expertise about other ports– is called in order to evaluate the port and compare it with other ports, these indicators will be the tools that this expert will use.

For any kind of comparison, standards are needed. However standards don't mean anything when the effects of other factors (most important of them is cargo type) are considered. Since ports are very complex constitutions, they are affected by various factors. They cannot be measured by one or two figures, a set of primary and secondary indicators are needed. Cubukcu and Yucel list these factors as follows:

1.General Factors:

1.Location and size

2.Marketing scale

2.Technical Factors:

1.Technology

2.Quality control

3.Surveying

4.Ergonomics

3.Social Factors:

1.Education

2.Organisation

3.Salary

4.Psychological Factors:

1.Motivation

2.Moral condition

5.Organizational Factors:

1.Free market

2.Financial opportunities

3.Economic policy

As mentioned above, ports are very complex constitutions. Every port and every pier in a port may have different characteristics. That's why these indicators are very diversified. Ports need to choose and put emphasis on related indicators. Namely, major port performance indicators used in previous researches are mentioned below.

Yucel (1997) divides performance indicators into five categories: berth throughput, ship turnaround time, berth occupancy, ship productivity and labor productivity. Berth throughput is related to the amount of cargo handled across a berth, whereas ship turnaround time is the average time elapsed between the ship's time of arrival and time of departure.

Indicators of berth occupancy are used to understand the level of demand for a berth, can be defined as total time of ships at berth divided by total time and number of berths. On the other hand, high values of berth occupancy do not always mean good efficiency, especially when it leads to congestion.

Indicators of ship productivity are basically related to ton per ship working hour, whereas indicators of labor productivity express labor cost per ton of handled cargo.

The study of Yenel (1998) is related to the optimization of these port parameters by simulation technique. The indicators used in her research are; annual port or terminal capacity, queue length (number of ships in queue), total number of ships, arrival rate (average number of ships arriving at the port per unit time), service time, waiting time, ship turnaround time, berth occupancy and dimension of vessels. (Among the parameters used in the simulation, ones related to probability are not considered as indicators)

According to UNCTAD, port performance indicators are divided into two broad categories: macro performance indicators designate the cumulative impact of the port on economic activity, whereas micro performance indicators focus on the operations (i.e. input, output ratios) within the port. Like most of the researches referred here, this thesis focuses on the micro indicators.

The paper published by Bichou and Gray (2004) is related to a logistics and supply chain management approach to port performance measurement, whereas the study of De and Ghosh (2003) is related to the causality between port's performance and traffic. Although the constitutions of these researches are not directly related to our subject, they provide valuable information about port performance indicators.For example, in the former study, port efficiency and productivity is reduced to three broad categories: physical indicators, factor productivity indicators and economic and financial indicators. Among them, physical indicators are the ones which are generally related to "time" and mainly concerned with the ship, such as ship turnaround time, ship waiting time, berth occupancy rate, working time at berth...etc. Factor productivity indicators that supply "some knowledge of the productivity of labor and capital" (Trujillo, Nombela., (unknown) http://www.worldbank.org/html/dec/Publications/Workpapers/wps2000series/wps2181/wps2181.pdf, p48), such as tons per worker-hour or per gang-hour, tons per crane-hour, tons per berthing location or per linear meter and tons per ship-day. Economical and financial indicators are "to reflect port's finances and level of charges to users" to those institutions in charge of port's regulation. These are operating surplus over GRT/NRT or operating surplus over handled ton, total income (expenditure) over GRT/NRT or ton and charge per TEU.

On the other hand, Bichou and Gray state that these indicators are related to the sea access and mostly focus on the maritime side of the port. Other indicators such as landside connections, cargo output (i.e. output per worker, output per wharf etc.), efficiency according to data envelopment analysis (DEA) and performance measurements based on profits are also used as measures of port performance.

In the study of De and Ghosh (2003), the authors try to develop a composite index from several port performance indicators with the help of principal component analysis. This index –called port performance index– comprises the following indicators:

1. Indicators of Operational Performance:
   A. Ship Turnaround Time
   B. Pre-Berthing Waiting Time
   C. Percentage of Idle Time at Berth to Time at Working Berth
2. Indicators of Asset Performance:
   A. Output Per Ship Berth Day
   B. Berth Throughput Rate
   C. Berth Occupancy Rate
3. Financial Performance:
   A. Operating Surplus Per Ton of Handled Cargo
   B. Rate of Return on Turnover

As it is seen above, port performance is expressed in various ways with quite a big number of indicators, and these indicators are not based on any standard. For this reason, some of these indicators (reasonably the ones that are related to port management information systems) are needed to select among those. More information about selected performance indicators is given in Chapter 2.3.

2.2. Port Management Information Systems (PMIS):

Just as is the performance indicators' case, the field of port management information systems is extremely wide and the concept is not based on any standard definition. The main reason of this may be different ports –even different terminals in the same port- may have different information systems (Choi, 2003). For this reason, this paper will try to describe the concept by the help of some previous studies and some well-know applications around the world.

In his study in 1998, Cubukcu emphasized on the necessity of information system in port management and offered a simple PMIS software programmed in MS Access.

Information systems are computer supported automation systems designed for information processing, data processing and decision support systems. (Christopher Martin, Phillip Powell, Information Systems, London: McGraw-Hill, 1991, p9)

Management information systems are defined as computer supported systems that supply instantaneous and strategic information, needed by the managers and in lower levels. (Cubukcu, p44)

Since the ports consist of various activities with different characteristics, a well-designed port management information system should supply information, goals, timing and frequencies to enable decision making for efficient port management.

The structure of port management information systems is explained in Cubukcu's study, as hardware, software, database, rules and procedures, and personnel (p48). The physical appearance of the system depends on functions, organization, procedures, physical area, equipment and the communication methods used in the port (p 59).

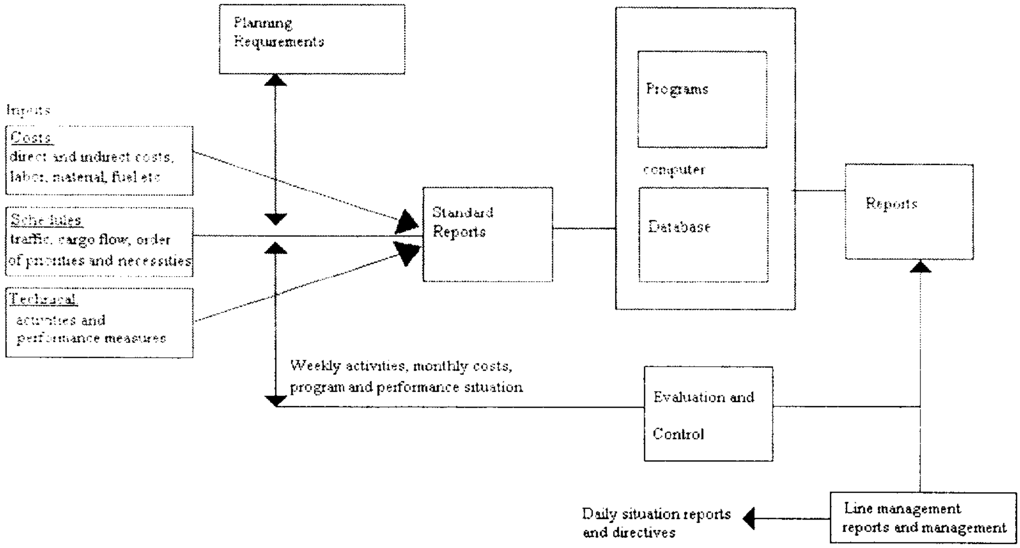

Figure 2-1. Functions and Elements of Port Management Information Systems (Frankel, p581)

A typical PMIS should produce two kinds of reports; master reports and daily reports. Master reports are submitted to the top management and provide the efficiency and the control of the activities. On the other hand, daily reports supply information to support resource usage and administration of other line activities (p60, see Figure 2-1).

The study of Kia, Shayan and Ghotb, called "The Importance of Information Technology in Port Terminal Operations"(2000), proves exactly what is emphasized in this thesis. In this study, the role of information systems for container terminal operations are tried to discover by developing a computer simulation model to compare terminals with electronic devices versus terminals without such devices. Two virtual container terminals with identical properties –but one having electronic devices and the other without such devices– were constructed and simulated by the real data provided from US and Australian ports. Since everything except IT system is identical for two cases, the difference in results solely depends on the impact of IT system. The results shows that electronic devices implemented in the container terminal reduced crane service time, ship time at berth, ship cost at port, straddle service time, service time in human resources and occupancy of the stacking area. The economical effect of electronic devices on Australian ports is estimated to be US$ 180 million.

According to this study, three types data processing is required in port terminals. These are recording container movements, direct access to the computer from the points where container movements take place and possibility of communication of yard operations via computer (p334).

However, the study of Kia, Shayan and Ghotb is basically based on "hardware". On the other hand, the study of Choi et al. (2003) criticizes that "the investment in software systems ...... has been relatively neglected compared with the large investment in the expansion of terminal facilities and infra-structure" (p198). In this research, an ERP system for container terminal operations is offered. The problems of existing terminal operating systems are summarized as problems related to:

1. information connection with outside parties
2. business connection among departments in container terminal
3. integration of system function
4. optimal planning and simulation function
5. management decision support and information service,

and it is stated that an ERP system can solve all these problems due to its information interchange, information sharing and information service characteristics (p200).

The designed system consists of five modules, which are planning, operation, CFS operation, operation support and management modules. Among these, planning module is pointed out as "the core of ERP for container terminal ... such as berth planning and yard planning" (p197).

The PMIS applications used in some major ports around the world can be summarized as follows:

2.2.1. Singapore:

Port of Singapore is a good example for one of the best usage and application of information technology in port terminal operations. Port of Singapore Authority (PSA) runs one of the most technologically advanced ports in the world and information technology is the key to become the most efficient port in the world (Lee-Partridge et al., 2000, p86). Since the country is in severe lack of land, the efficient utilization of existing land is crucial for the Port of Singapore, and this was achieved by the sophisticated technology used in the port. This can be a good example of overcoming external limitations by the proper utilization of information technologies.

In the case study by Nancy Barlett under the supervision of Professor Lynda M. Applegate (Harvard Business School case 802-003), the information system implemented in the Port of Singapore is separated into three levels. In the first level, main operations are streamlined, synchronized and integrated by a program called Computer Integrated Terminal Operating System (CITOS). These main operations include preparations before the arrival of the cargo, loading, unloading, yard operations, storage and flow of trucks through the gates. In the second level, real-time management, coordination and control of the operations are offered by PSA staff. In the third level, another proprietary software, called PORTNET, connects the port with other organizations, including shipping lines, haulers, truckers, customs, marine service providers etc.

Such investments in information system infrastructure returned back to the Port of Singapore as performance increase and high efficiency. For example, the world record in vessel loading and unloading (243 containers in an hour) was broken in April 25, 2000 (Applegate, p328). And in March 2000, the port handled 1.5 million TEUs in a single month, which is still an unreachable record in anywhere else in the world (Lee-Partridge et al., 2000, p86). On the other hand, this success depends on not only the IT system but also modern management strategies of the government and the port authority. In fact, absence of such awareness can be a major obstacle in front of Turkish ports.

Another case study about the rise of Singapore as a global container hub, was carried out by Airriess in 2000, and tries to explain the rise of Singapore as a global port. According to this study, the rapid development of the Port of Singapore is highly dependent on its sophisticated ICT infrastructure and "the developmental state" of Singapore. Effects of lack of such a state in Turkey will be discussed later.

In the study of Lee-Partridge, Teo and Lim (2000), the rapid development of the Port of Singapore was analyzed and four key management success factors were defined. These are (1) having a business-driven IT investment, (2) aligning business and IT plans, (3) maintaining a flexible and extensible IT infrastructure and (4) encouraging IT innovation and creativity.

2.2.2. Hong Kong:

Having the maximum container throughput in the world (16.21 million TEUs in 1999, 20 45 million TEUs in 2003, 21.98 million TEUs in 2004), the Port of Hong Kong is in competition with not only Singapore but also evolving ports in Mainland China, especially with the ones in the southern region.

In order to deal with enormous amount of container, Hong Kong International Terminals (HIT), managed by Hutchison Port Holdings (HPH), invested in "its Productivity Plus Programme (3P). The primary objective of the programme was to increase productivity and overcome throughput constraints before they arise" (http://www.hph.com.hk/ technology/it/3p.htm). Depending on 3P, the terminal management system called PIONEER is being operated in order to support and automate the complete flow of container handling operations by its fully integrated functions (http://www.hph.com.hk/technology/it/pioneer.htm). These functions include vessel, gatehouse and yard operations, operation management, inventory management and billing management.(for more information, see PIONEER Brochure, downloadable at http://www.hph.com.hk/technology/it/pioneer.htm)

Unlike Singapore, most researches concerning the Port of Hong Kong do not focus on the utilized information systems. For instance, the study of Cullinane, Fei and Cullinane (2004), investigates the container terminal development in Mainland China (esp. Shenzhen Port) and its impact on the competitiveness of the port of Hong Kong. According to the results, even Shenzhen Port has potential advantages, such as low labor cost, closeness to manufacturing sites, no border passings etc. Hong Kong is likely to maintain its position as a global hub. It is stated that one of the main reasons of this result is "absence of appropriate logistics infrastructure and software" in Mainland China's ports (p 50-51).

2.2.3. Europe:

In this section, information systems used in some European ports will be summarized.

The Thames Port, in London, started to operate in 1990 and experienced a drastic increase in throughput by the adoption of automation system. Container throughput increased drastically from 9,600 TEU in 1990 to 450,000 TEU in 1997. There are 5 manual high-speed quay cranes and 14 fully automated yard cranes. The containers are transported from quay to yard by remote controlled yard chassis. Although the terminal computer selects the proper handling method by processing the updated information, such as staking at lanes, gantry crane operations, gate operation time, waiting time at the gate...etc, operators continue to communicate with the supervisor for proper control of handling.

In 1997 HHLA granted the right to operate Alternweder Container Terminal, in Hamburg, Germany, in order to develop an automated terminal. The port is equipped with fully automated gantry cranes, remote controlled unmanned container transporters and automated yard cranes. There are electronic sensors that inform the control center about the movement of the unmanned vehicles.

2.3. Relation Between Port Performance and PMIS:

The main purpose of port information systems can be summarized as increasing the port's performance. This can be achieved only with a well-designed system. Else, whole investment in IT infrastructure may sink and turn into a "white elephant" (Tennet, p2).

As explained above, the concept of port performance is very broad. To summarize, a good performance may be defined as handling maximum amount of cargo in minimum time with minimum price. This idea was derived from several researches. Those researches explain how IT systems influenced the selected performance indicators.

On this basis, four performance indicators are selected because it was stated in some previous study that they were influenced by the applications of information systems. These indicators are: (1) berth throughput, (2) ship turnaround time, and (3) berth occupancy rate. Among these, the first one is related to amount, the second and the third are related to time.

2.3.1. Berth Throughput:

Berth throughput is related to the amount of cargo handled across a berth and defined as "total tonnage of cargo handled at berths divided by total number of berths"(Kek Choo Chung, 1993). This is a common method that total tonnage handled by each berth is summed up and divided by the number of berths, to determine the average throughput. It is also measured in terms of tonnage handled per linear meter (or foot) of wharf.

On the other hand, it should be noted that type of the cargo is essential for berth throughput calculations, so the calculations must be carried out separately for each berth groups (Kek ChooChung 1993, Yucel 1997).

The positive relation between berth throughput and port management information systems is clearly stated in many researches. In many cases, berth throughput drastically increases after the utilization of information systems.

Singapore is the best example. Because "Singapore has witnessed the most rapid annual growth in container throughput" (Airriess, 2001) among the busiest ports in the world.

From 1976 to 1997, Port of Singapore steadily increased its rank from 21st to the first (p239). Total container throughput increased from about 1 million TEUs in 1983 to 17.04 million TEUs in 2000 (Applegate, p323). The study of Lee-Partridge et al. addresses the key to this advancement as "having an excellent infrastructure", and information technology is stated to be an important element of this infrastructure (p 87).

Not only the Port of Singapore itself, other ports around the world also underwent such advancement in cargo throughput, after implementing the IT system developed by the PSA. For example, Voltri Container Terminal, in Genoa, Italy, was planned by two PSA consulting subsidiaries in 1991 and in 1998, the PSA 60% of the port. As expected, the port underwent an incredible increase in throughput, from 60,000 TEUs in 1994 to 700,000 TEUs in 1998. (Airries, p250).

It is not surprising that, PIONEER systems utilized by Port of Hong Kong, also had an significant impact on berth throughput. For example, in the Yantian International Container Terminal, People's Republic of China, this system was implemented in 1994 and utilized until 1998, before being upgraded to 3P system (explained above). The total throughput of the terminal increased from 100,000TEUs to 800.000 TEUs (PIONEER Brochure, downloadable at http://www.hph.com.hk/technology/it/pioneer.htm).

2.3.2. Ship Turnaround Time:

According to Kek Choo Chung (1993), ship turn-round time can be defined as "the duration of the vessel's stay in port and is calculated from the time of arrival to the time of departure" and is the primary measures of operational performance. On the other hand, factors like volume of cargo, facilities made available and the composition of the cargo itself. So, it is a common application for ports to break down the basic ship turn around time into various parameters, for example according to service time or waiting time (Yucel, p50, 51), or dividing it by volume of cargo (the tonnage handled per day or hour that the vessel is in port, Kek, p2).

To sum up, ship turnaround time is an indicator for the speed of handling. And there are a lot of studies about the impact of information systems on the speed of handling.

The most remarkable example is the Port of Singapore, because it has the lowest turnaround times, due to its sophisticated information systems. On February 8, 2000, the ship called Ever Growth unloaded 2001 containers in 9 hours 51 minutes, and set the record of maximum number of containers (203) in a single hour. On April 25, 2000, this record was enhanced to 243 containers (Applegate, p328).

The relation between ship turnaround time and information systems is also mentioned in the study of Airries. In this study, it is stated that the ship turnaround time in the Port of Singapore is dramatically reduces by the utilization of CITOS (p243). It is also stated that Port Klang of Malaysia lost the competition with the Port of Singapore due to higher values of ship turnaround time (16-17 hours for Port Klang, whereas 12 hours for Singapore). The main reason of lower ship turnaround time is indicated to be because of lack of appropriate information infrastructure (p246).

The fact that CITOS and other information systems in the Port of Singapore decreased the ship turnaround time, is also implied in the study of Lee-Partridge (p89).

Another research indicating the relation between ship turnaround time and information systems is the study of Kia et al. (2000). In this study, one of the main benefits provided by information systems is stated to be "increased productivity through faster turnaround of containers" (p 333).

2.3.3. Berth Occupancy Rate:

Kek Choo Chung (1993) states that berth utilization rate (the percentage of actual working time at the berth in relation to the time that the berth is occupied) seems more useful than the berth occupancy rate (the time that the berth is occupied relative to the total time that is available). On the other hand, Yucel defines berth ocuupancy in three different ways. (see Table 2-1)

		SHIP	
		Working Hours at Berth (A)	Total Hours at Berth (B)
BERTH	Working Hours (C)	A/C = Working Efficiency	B/C = meaningless
	Total Hours (D)	A/D = Net Rate of Berth Occupancy	B/D = Gross Rate of Berth Occupancy

Table 2-1. Berth Occupancy Rate

High values of berth occupancy may indicate both good and bad situations. If the ships stay in the berth for a long time by paying the price and without causing congestion, this is a good situation, else a bad situation. On the other hand, low values of berth occupancy indicate good situation if the staying time of the ship is lessened by efficient and speedy handling of cargo. Else if the ships prefer to call at other ports due to high prices, low berth occupancy indicate bad situation. (Yucel, p51)

The relation between information systems and berth occupancy is mentioned in the study of Kia et al. (2000). Using a simulation model, it was discovered that ports having information systems have lower occupancy rates that those that don't have corresponding information systems. It is stated that due to this lowering in berth occupancy, more ships could be accommodated at berths, and expansion of ports caused by the unavailability of berths would be prevented (p342-343).

3. RESEARCH METHOD:

In this paper, properties of Busan Port and Mersin Port are to be compared on a descriptive basis, due to certain limitations. These limitations are discussed in Chapter 6.

First of all, the ports are described according to their history, basic characteristics, implementation processes of information systems, capabilities and problems of the existing system. Then, the two ports are compared according to their performance values.

However, as it is mentioned above, ports are so complex constitutions that they cannot be compared according to one or two figures. That is because so many factors –in macro or micro level– influence port's performance values. Even if the performance values of a port are low, it does not necessarily mean that that's because of poor utilization of information technology.

So, the best means to seize the effect of information technology on port's performance was thought to be asking it to the port executives. For this purpose, interviews with some of the officials in both ports were arranged. Due to time and space limitations, the interviews were carried out on a written basis.

Two sets of questions, one containing objective questions, the other containing subjective questions, were composed. In order to avoid confusion, the one containing objective questions is called "investigation content", where as the other one is called "questionnaire" (see Appendix). These question sets were translated into Korean and Turkish before execution.

The "investigation content" consists of two parts. In Part A, basic functions in a port terminal are listed and asked whether they are carried out by computer-based methods or paper-based methods. The research of Choi et al. (2003) was referenced for the functions listed. In Part B, several aspects of PMIS are listed and existence of these aspects is asked. Since the nature of these questions is objective, only one official from each unit were asked to fill in it.

The "questionnaire" also consists of two parts. In the first part, the proportion of effect of information systems on the whole performance of the port is asked. In the second part, the efficiency of each unit composing the information system is asked. Since the characteristics of the ports and properties of their information systems are not standard, an open-ended question is attached to the end of each section, in case some aspects of the port or information system are not included.

Subjective nature of the questions in the "questionnaire" implies that it should be applied to as many people as possible. On the other hand, the content requires some special expertise that executives who are not computer oriented in their tasks failed to fill in it. As a result, number of respondents was too small to carry out statistical analysis.

Another source about Mersin Port data is TCDD Headquarters. According to Freedom of Information Act, unless confidential, any official inquiry of individuals or corporations must be replied. Any information that is not available elsewhere is asked to TCDD officials via e-mail.

It should be noted that any information that is not related to any reference, is obtained from port officials by direct inquiries.

4. COMPARIZON OF THE PORTS:

4.1. Description of the Ports:

4.1.1. Mersin Port:

As stated above, Mersin Port is the biggest port in Turkey. It is located on the south coast and feces the Mediterranean Sea. It is located at 36° 46' 20" north latitude and 34° 39' 00" east longitude. It has an advantageous geographic position and is the import-export gate for Middle Anatolian and GAP (South East Anatolian Project) regions. So Mersin Port is very important for the industrial and agricultural activities in these regions. It possesses a good potential to be transshipment hub and a distribution center for container transport over the Mediterranean Sea (Mersin Chamber of Commerce and Industry, 2003). The port is also a good transshipment hub for Middle Eastern countries. It is the most important port that connects North Cyprus Turkish Republic (not recognized by other countries except Turkey) to the world.

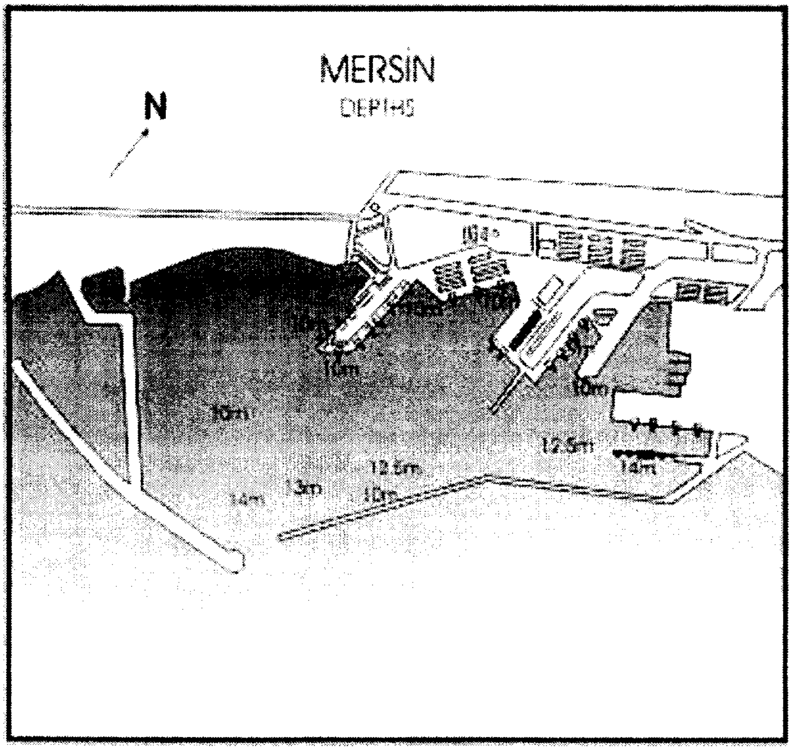

Figure 4-1. Mersin Port (source: http://www.cerrahogullari.com.tr/ports/images/PORT%20OF%20MERSIN.jpg)

4.1.1.1. History:

Mersin, being a small fishing village in 1841, became a subdistrict in 1850 and a district in 1865. Wharf construction became an important issue in the district since 1860, and number of ships calling at the port increased tremendously by the opening of Adana-Mersin Railroad in 1886. These improvements forced Mersin Municipality to build Tas Wharf, and then Gumruk Wharf.

Related to the rapid increase in the maritime trade, need for a serious port management was severe. For this reason Mersin Port Cooperation was established in August 29th, 1927, by the union of Mersin, Tarsus, Seyhan and Ceyhan Municipalities, Seyrisefain Agency, Mersin Chamber of Commerce and Mersin Private Accountancy.

Due to natural disasters, the company experienced tremendous loss and was transferred to the government in 1942. The operation right was given to General Directorate of State Railways and Ports.

The reconstruction of Mersin Port in a modern and protected way, started in May 3rd, 1954. The construction works were carried out by *Holland Royal Port Construction Company*.

The port was opened in 1962 with all facilities reinforced in a modern way.

4.1.1.2. General Features:

Like other major ports in Turkey, Mersin Port is owned by the government and operated by TCDD (Turkish State Railways). Total number of wharfs is 27 which have a total length of 4,108 meters. Some basic characteristics are shown in Table 4-1.

Berths in Mersin Port and their characteristics are listed in Table 4-2.(1998)

	Mersin Port
Total Wharf Length (m)	4,605
Port Area (*1000 m^2)	994
Max. Draught (m)	-14.5
Number of Workers	1,098
Total Ship Receipt (Ship/Year)	4,692
Total Handling Capacity (*1000 Tons/Year)	6,131
Total Wharf Capacity (*1000 Tons/Year)	10,967
Capacity of Container Wharf Equipment (*1000 Tons/Year)	319
General Cargo Storage Capacity (*1000 Tons/Year)	8,500
Container Storage Capacity (*1000 Tons/Year)	371

Table 4-1. Basic Characteristics of Mersin Port (source: http://www.tcdd.gov.tr/liman/kapasite.htm)

Berth	Berth Group	Length (m)	Depth (m)
1	Passenger	150	-10
2.3	General Cargo	275	-10
4	General Cargo	160	-10
5,6	General Cargo	335	-10
7	Dry Bulk	158	-10
9	Container	225	-12
10	Container	175	-10
11	Ro ro	40	-10
12,13	Container	310	-12
14	Dry Bulk	275	-11
15	Container	275	-14.5
16	General Cargo	69	-6
17,18,19	General Cargo	480	-6
20,21	General Cargo	253	-12

Table 4-2. Physical Characteristics of Berths in Mersin Port (source:Yenel, 1998)

The physical equipment in the port are listed Table 4-3.

Type of Facility	Facility	Number
Pilotage	TCDD guide captain	5
	Plot boats	3
	Guide boats	2
Towage	3500HP tugboat	2
	2500HP tugboat	2
Terminal Services	Transteiner (35 tons)	18
	Full container forklift (35 tons)	12
	Empty container forklift (12 tons)	10
	Tractor (50tons)	33
	Trailer (40 tons)	42
Loading/Unloading Equipment	Gantry crane (35-55 tons)	5
	Quay crane (3-35 tons)	17
	Mobile crane (6-70 tons)	15
	Floating crane (60 tons)	1
	Hauler (1.4 tons)	1
	Mini hauler (1.4 tons)	1
Container Filling	Full container forklift (35 tons)	12
	Empty container forklift (12 tons)	12
	Normal forklift (2-5 tons)	43

Table 4-3. Physical Equipments in Mersin Port

4.1.1.3. Information System Development in Turkish Ports:

Since there is no separate information system implementation project for Mersin Port, the attemps to utilize information technology in Turkish ports are considered as a whole.

Ports Branch of TCDD provided ofice automation systems to the headquarter and seven ports (Haydarpasa, Derince, Izmir. Bandirma.Samsun. Iskenderun and Mersin)operated by it, first in 1998. The aim of the project was:

1. to increase the work productivity
2. to enable the measuring of the increased productivity
3. to develop the employees' information and skills to use computer.

For this purpose, 8 office automation systems that include IBM 8088 PS2 server (6 users). Novel 2.0 network, DOS operating system and periferal hardware were supplied. As an example, the network details of Izmir Port is given.

TCDD ports started to build container terminals in 1985 to catch up the rapid changes of container transport in the world. Among these, Mersin, Haydarpasa and Izmir Ports were the ones with busiest container traffic.Increased traffic in these ports caused congession due to Turkish custom regime that is not flexible enough to develop regulations to easy such transport and the lack of sufficent control of the port operations with computerized systems.

In order to supply compter support to container terminals of Mersin, Haydarpasa and Izmir Ports, Ports Branch and Data Procesing Branch of TCDD prepared "TCDD Port Services Telecommunication Project", abbreviated as DELIMTEL. Unfortunately, no data about this project is available via internet.

The analysis tasks were started in August of 1990. The aim of the project was:

1. Analysis of container terminal activities and determination of their needs.
2. Supplying software and hardware to the headquarter as well as the selected pilot port, rapid coding, developing and activation of aplication programs container terminal management activities.
3. Developing interports and within-the-port management information systems. including the headquarter.parallel to the usage of application programs for the managerial activities of the pilot port.

4. Implementation of the computer support to container operations to other ports and supplying required hardware.
5. Constructing the computer infrastructure for other main and periferal functions of the ports that have container terminals.
6. Supplying computer support to the ports that don't have container terminals and supplying required hardware for the construction of inter ports computer network.

The sixth step of the project was estimated to be finished by the second half of 1992.

European Union (EU), carried out a project called MEDITEL, in order to develop a computer application program to ease the services the ports that face Mediterranean Sea and to form an information network that enables information transfer about ship and cargo traffic between these ports. The software package called ESCALE that was developed by Port of Marseille Authority was to be used in this project.

TCDD declared to be involved in this project in 1991. Haydarpasa Port was chosen as the pilot port. According to the agreements, EU would finance the cost for software, and $70,000 of the hardware cost would be compensated by PMA.

The port officials examined both the software and the hardware to be used in the project and it was agreed that Haydarpasa Port is suitable for the project. On the other hand the modifications to be made on ESCALE package in order to fit the differences in management technique and infrastructure couldn't be finished on time by the French officials. Instead, the second ESCALE package was offered because of being better for problem handling. But even the second package couldn't fit the existing system. Negotiations with French officials and EU did not end in any result, and the project was clogged. So, in August of 1995, the technical committee declared to EU officials that developing a new application program for this port would be more suitable.

After four years, TCDD project group added "fare services", which was missing in the original project, to the application program of DELIMTEL and MEDITEL Projects and finished the new program called ""Computerized Tracking of Port Operations Project" in the beginning of 1999. For the time being, this program is in service except for "services offered to the ship" (i.e. pilotage, fuel supply etc) interface.

In 1995, another project was developed by using C programming language under UNIX operating system, in Izmir Port. This program was activated in Izmir Port after testing phase. But because of the problems about real-time operation of this application program with manually offered services, usage of this program was cancelled in 1999.

In order to ensure effective terminal and port management for TCDD ports through the application of "fully automated terminal operations", a technical committee was formed within TCDD and this committee started to compose required technical specifications in the beginning of 2000's. On the other hand, in the beginning of 2005, High Council of Privatization Administration decided that all services except transfer of ownership in all TCDD ports except Haydarpasa Port, would be privatized. This decision resulted in the cancellation of the project.

Meanwhile, server and computer parks provided to Mersin and Izmir Ports in 2004 and the application program developed by Haydarpasa Port's IS staff is still in use as an out-of-project application. (source: directly obtained from TCDD Headquarter, Ankara)

On the other hand, our investigation in Mersin Port revealed that this program is not used by the port staff. Most of the operations are still carried out on paper. See Chapter 4.2.2.1 for these operations.

4.1.1.4. Performance Indicators:

Port traffic:

	1999	**2000**	**2001**	**2002**	**2003**
Loaded goods	6520	6276	6622	5994	5880
Unloaded goods	7509	7104	7007	7769	9597
Total	14029	13380	13629	13763	15477

unit: *1000 tons

Table 4-4. General Cargo Traffic of Mersin Port

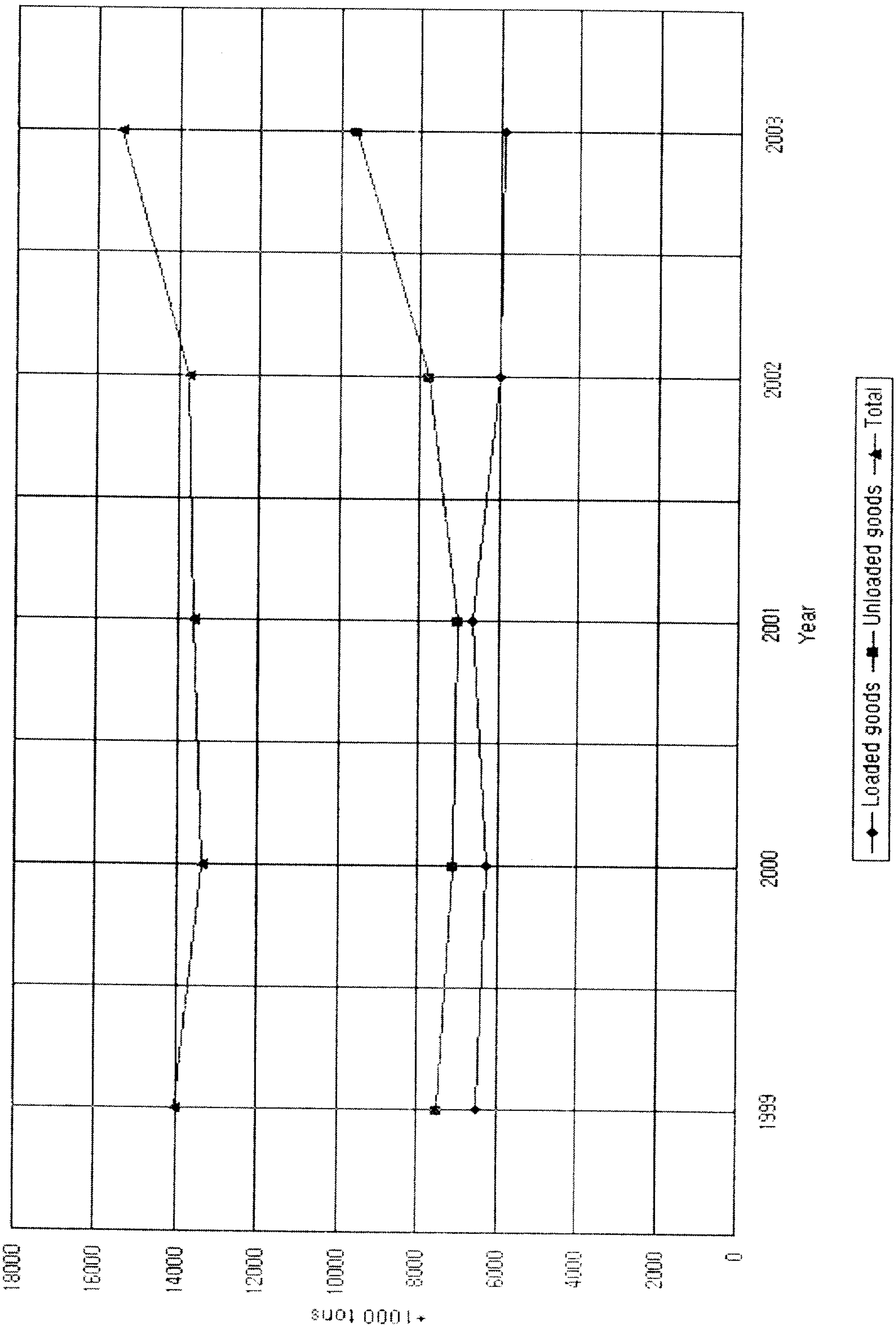

Figure 4-2. General Cargo Traffic of Mersin Port

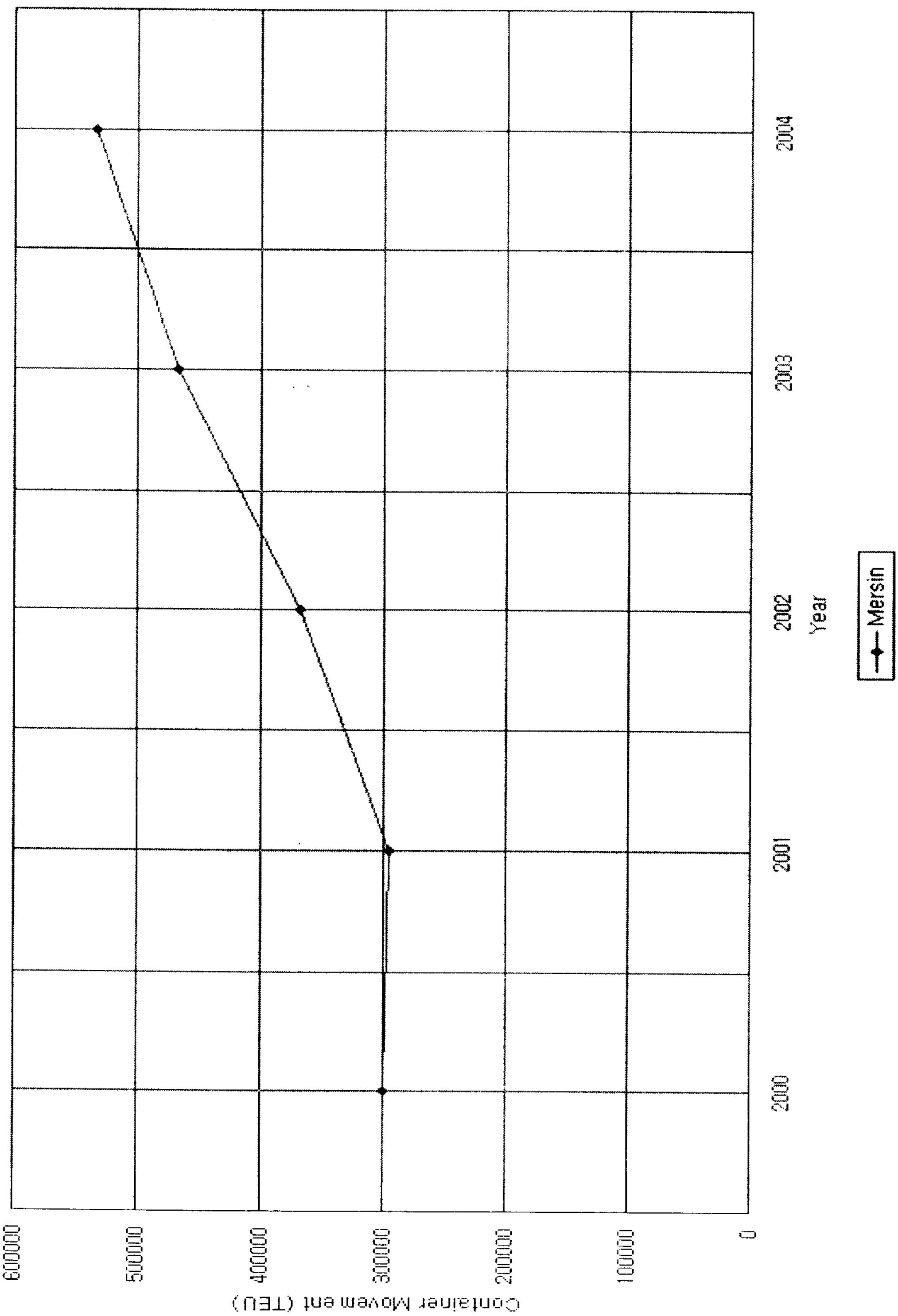

Figure 4-3. Container Traffic of Mersin Port

Container Traffic:

Year	2000	2001	2002	2003	2004
Container	299376	294734	368806	467109	532999

unit: TEU

Table 4-5. Container Traffic of Mersin Port

Ship Turnaround Time:

Since such data is not offered in the annual statistics report of TCDD, these vaules are to be calculated. The following data is obtained from Mersin Chamber of Shipping.

Table 4-6 shows the arrival and the departures times, and the total number of containers containerships that called at Mersin Port, between November the 3rd and 8th, 2005.

Name of the Ship	Arrival Time	Departure Time	Total number of containers
A. Sofia	03.11.05/15.00	05.11.05/03.00	466
Faust	03. 11.05/19.00	04.11.05/14.00	185
Damaskus	03.11.05/21.00	05.11.05/01.00	514
Dongeborg	04.11.05/19.00	05.11.05/13.00	321
Karina	04.11.05/03.00	04.11.05/19.00	240
MSC Perle	04.11.05/05.00	05.11.05/04.00	356
MSC Imma	05.11.05/06.00	06.11.05/01.00	508
MSC Amy	05.11.05/07.00	06.11.05/15.00	517
MSC Tuskany	08.11.05/06.00	09.11.05/06.00	504
Roerborg	08.11.05/08.00	09.11.05/02.00	352

Table 4-6. Ship Arrival and Deparure Times of Mersin Port between November the 3rd and 8th. 2005

According to this data, the average ship turnaround time can be calculated as **21.6 hours**.

Berth Occupancy Rate:

Like ship turnaround time, berth occupancy is also calculated from that date obtained from Mersin Chamber of Shipping.

1) Total length of berths in Mersin Port is 4750 meter.(including TMO, Atas Refinery, POAS and Free Trade Zone).
2) Berths which are numbered as 17, 18 and 19 were not used in 2004 due to deepening and restoration works. Total lenght of these berths is 500 meters.
3) Ro-ro type small ships that operate between Mersin and North Cyprus Turkish Republic, performed a total number of 1005 sailings, in 2004.
4) The total number of ships that called at Mersin port during 2004 is 3968.

According to the data above, berth occupancy rate can be calculated as **93.4%** or **72.3%**. These calculation are carried out, assuming that the lenght of berths that are dedicated to Ro-ro type smal ships is 150 meters at maximum. (source: Mersin Chamber of Shipping)

4.1.1.5. Conclusion:

The most challenging problem about these calculations was obtaining consistent port performance data, since the annual reports of TCDD only expresses the cargo movement and the finacial state.

So, for ship turnaround time and berth occupancy rate values, we had no chance but to rely on the data that was supplied by Mersin Chamber of Shiping.

In order to dedice whether these values represent an "efficient" situation or not, we may compare them with those of Busan Port.

4.1.2 Busan Port:

4.1.2.1. History:

The history of Busan Port dates back to 1876. Those days, Korea was heavily influenced by the Japanese and the control of the port, as well as the main important land sites of Busan, were captured by the Japanese. This situation continued until 1945, when the Japanese left the peninsula. So in the web site of Busan Port, the port is stated to be the place where the invasion started and ended.

Major developments in Busan Port are listed in Table 4-9.

1911 ~ 1944	Construction of the 1st, 2nd, 3rd, 4th, 5th, 6th and 8th quay walls as well as the 1st and 2nd central and the 3rd and 4th wharves together with building of revetment
1959 ~ 1964	Construction of the 7th quay wall
1963 ~ 1967	Construction of South Port quay wall
1974 ~ 1978	Construction of the 7th and 8th granary wharves and international passenger wharf as well as coastal passenger wharf/ Reconstruction of the 1st and 2nd wharves
1974 ~ 1982	Construction of Jaseongdae Container Wharf (the 5th and 6th wharves)
1979 ~ 1982	Reconstruction of the 3rd and 4th central wharves as well as the 5th quay wall
1979 ~	Development of Gamcheon Port
1985 ~ 1991	Construction of Sinseondae Container Wharf
1991 ~ 1997	Construction of Gamman Container Wharf
1992 ~ 1996	Construction of Wuam Container Wharf
1994 ~ 1999	Building of inland container depot (ICD)
1996 ~	Expansion of Gamman Container Wharf
1997 ~	Development of Busan New Port
May 1995	Privatization of Jaseongdae Wharf
Feb. 2002	Opening of New Gamman Port

Table 4-7. Major developments in Busan Port (source: http://www.portbusan.or.kr/english/m1/s2/ss3/ss3.asp)

4.1.2.2. General Features:

General features of the wharfs in Busan Port are summarized in Table 4-10.

	Sinseondae	Gamman	Singamman	Wuam	Jaseongdae	Gamcheon
Opening	Sep. 1978	Apr. 1998	Apr. 2002	Sep. 1996	Sep. 1978	Nov. 1997
Operating Company	Pusan East Container Terminal Co., Ltd.	4 companies : Korea Express Co., Ltd. Hanjin Shipping Co., Ltd., Global Enterprise Co., Ltd., Korea Hutchison Terminal Co., Ltd.	Dongbu Busan Container Terminal Co., Ltd.	Wuam Terminal Co., Ltd.	Korea Hutchinson Terminal Co., Ltd.	Hanjin Shipping Co., Ltd.
Main Facilities	1,447km of quay wall, 13 units of C/C, 31 units of T.C, 25,119m2 of CFS	1,400m of quay wall, 13 units of C/C, 34 units of T.C, 7,400m2 of CFS	826m of quay wall, 7 units of C/C, 15 units of T.C, 5,500m2 of CFS	500m of quay wall, 4 units of C/C, 10 units of T.C	1,447km of quay wall, 13 units of C/C, 31 units of T.C, 25,119m2 of CFS	600m of quay wall, 4 units of C/C, 10 units of T.C
Simultaneous Berth Capacity	50,000 ton level vessels (dwt) X 4/ 10,000 ton level vessels (dwt) X 1	50,000 ton level vessels (dwt) X 4	50,000 ton level vessels (dwt) X 2/ 5,000 ton level vessels (dwt) X 1	20,000 ton level vessels (dwt) X 1/ 5,000 ton level vessels (dwt) X 2	50,000 ton level vessels (dwt) X 4/ 10,000 ton level vessels (dwt) X 1	50,000 ton level vessels (dwt) X 2
Annual Cargo Processing Capacity	1,200,000TEU	1,200,000TEU	650,000TEU	270,000TEU	1,200,000 TEU	340,000TEU
Total Area	647,426m2	750,000m2	308,000m2	184,000 m2	647,426 m2	142,333m2

Table 4-8. General features of Busan Port (source: http://www.portbusan.or.kr)

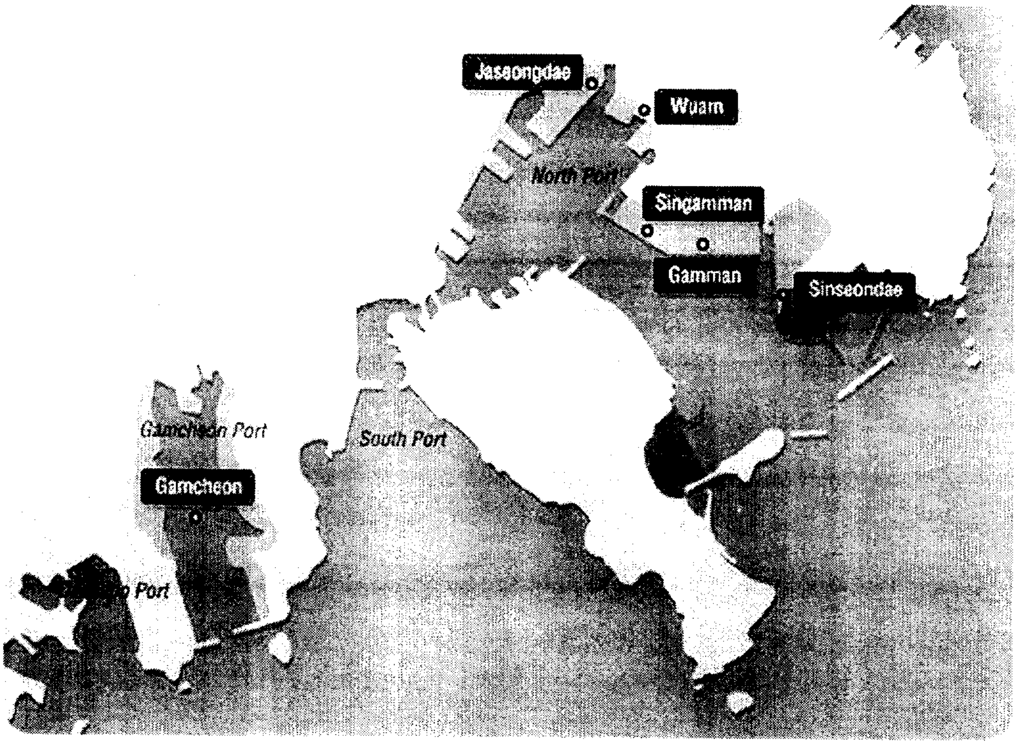

Figure 4-4. General view of Busan Port
(source: http://www.busanport.com/service?id=en_facility_01)

4.1.2.3. Information Systems:

In addition to PORT-MIS, developed by Busan Regional Maritime Affairs and Fisheries Office, everyterminal operating company has its own terminal operating system.

The development of PORT-MIS was initiated in 1987 by The Ministry of Maritime Affairs and Fisheries in order to make port operations more scientitific and advanced. After the first implementation of the system by Busan Regional Maritime Affairs and Fisheries Office, in 1992, the range of the systems was enlarged to Youngnam Region (i.e. Ulsan, Masan and Pohang) in 1994.Required hardware was implemented in Incheon in October 1994, and the system started to operate in Kyung-gi Region (i.e. Incheon and Gunsan) in January, 1995. After the implementation of the hardware in Ho-nam and Young-dong Regions, by the end of 1995, several other projectswere also carried out, such as building an "information net" that connects the ports in five regions of Korea (including the headquarters), or building and e-Logistics net within Busan Municipality.

PORT-MIS has three main functions:

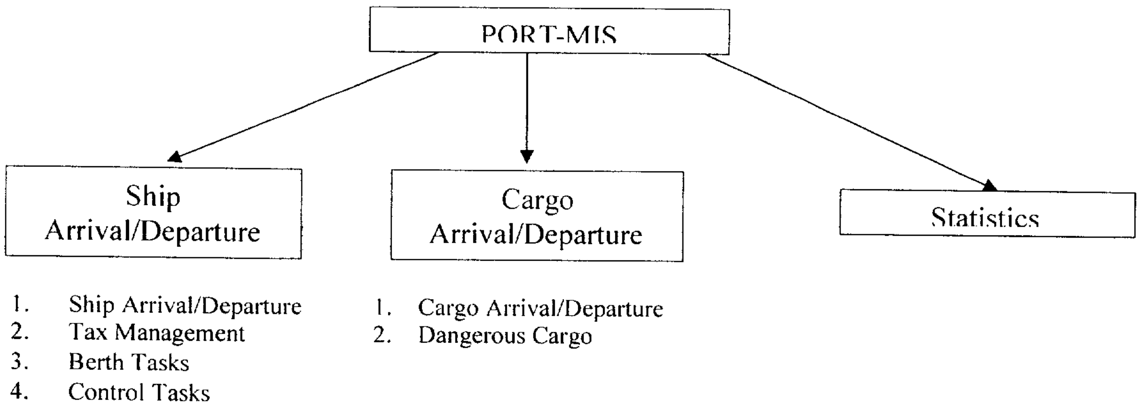

Figure 4-5. Main Funtions of PORT-MIS

On the other hand, terminal operating systems differ slightly since terminals are operated by different corporations. As as example, the system of Korea Hutchinson Terminal Co., Ltd. is summarized in this thesis.

See Figure 4-6 for application overview terminal operating system and Table 4-11 for the list of applications of terminal operating system of Hutchison Korea Terminals.

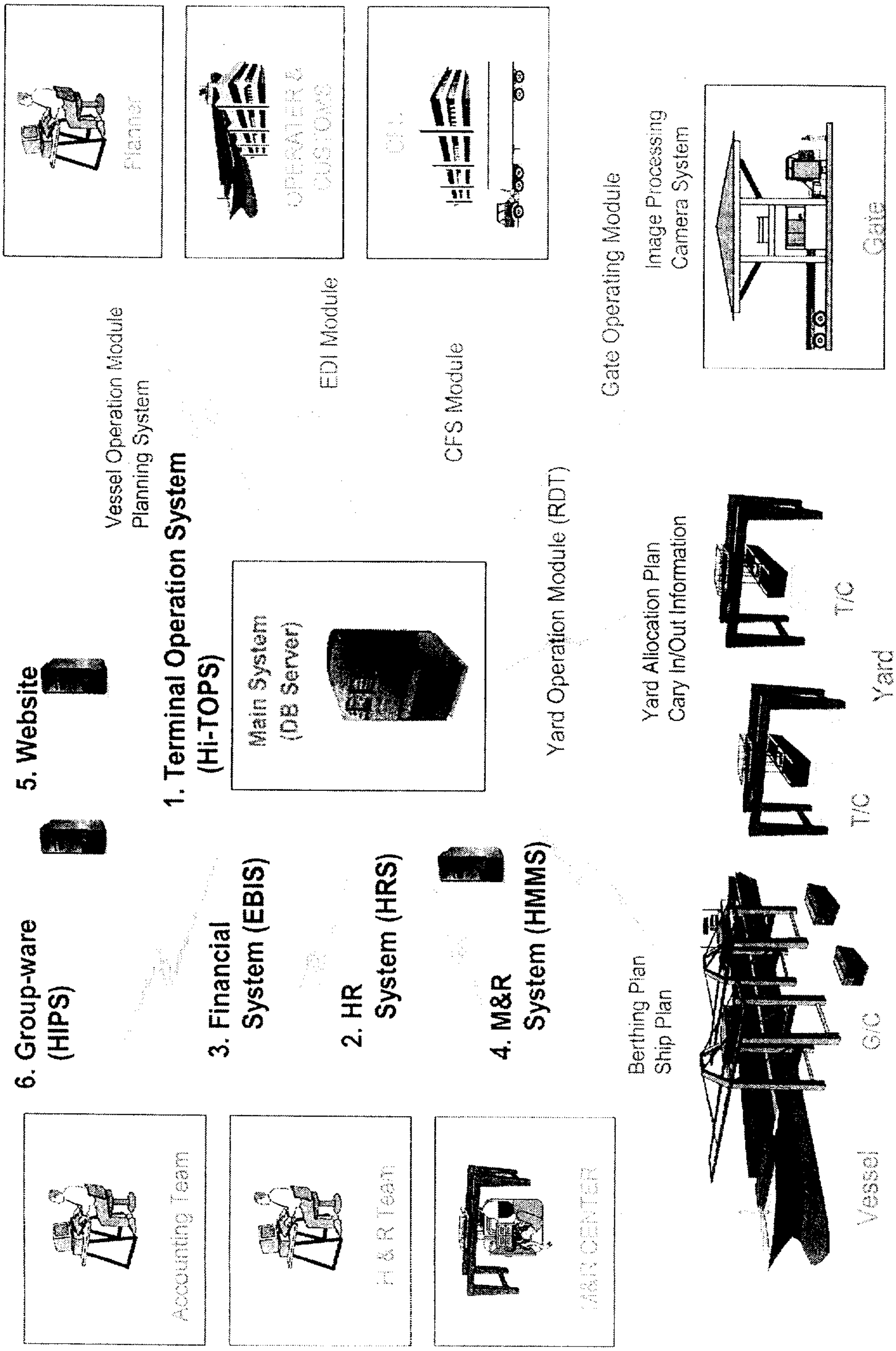

Figure 4-6. Application overview of terminal operating system of HKT.

Class	System	Details
In-House System	1) Terminal Operation (Hi-TOPS) • Gate Operation • Yard Operation • Vessel Operation • Sales Operation • Statistics Operation • CFS, EDI, Customs and so on.	• Gate Operation ■ GATE Authomatic System ■ GATE In/Out Control, Yard Assign Processing, COPINO • Yard and Vessel Operation ■ Ship Planning ■ Vessel Monitoring ■ Yard & Vessel Document Job Manage ■ RDT Control • Adjustment and Billing System • Operation Statistics • Other Systems
	2) HRS- Human Resources System • Human Resource Management • Payroll Management	• HR Employee Basic Item Manage • Payroll and Bonus Process
	3) EBIS- Financial System • Oracle ERP (AP, AR, GL, FA) • FAMS, VATS	• Budget, AR, AP, Slip & Statement (B/S, G/L, P/S) Management • VAT Management • FAMS: Physical Asset Counting Management

	4) HMMS – M&R System • Material Purchase & Stock Management • Equipment Repair Management	• Equipment Spare Part Purchase and Stock Manage • Maintanance and Repair Manage • Outsourcing Construction Manage
	5) Web Service • Homepage Operation • Information Service	• Homapage Maintenance • Web Service Maintenance (Customer Service) • Bulletin Board, Data Room Maintenance
	6) HIPS – Groupware • E-mail and E-approval Function • Team Site Function	• Internal/External E-mail, Approval System • Team Portal Site • Common Information
Purchase System	1) Guiders • Ship Planing System	• Ship Planning System (manuf. by HIT) ■ Loading/Discharge Module • Interface with Hi-TOPS

Table 4-9. Application list of terminal operating system of HKT.

4.1.2.4. Performance Indicators:

For the data below, data other than container terminals are not used.

Berth Troughput:

	2000	2001	2002	2003	2004
Busan (total)	7540387	8072814	9453356	10407809	11491968
Jaseongdae	1433801	1272288	1534586	1584429	1825523
Sinseondae	1282135	1319761	1528285	1786112	1994881
Gamman	1769120	1922540	2261484	2546391	2723733
Singamman			481182	745544	976321
Uam	313299	447693	502450	533285	549827
Gamcheon	386818	432941	505959	512240	548074

unit= *1000 TEU

Table 4-10. Container Traffic of Busan Port

Ship Turnaround Time:

	2000	2001	2002	2003	2004
Busan (average)	17.2	14.6	17.2	16.7	15.9
Jaseongdae	16	14	19	17	16
Sinseondae	21	16	18	19	18
Gamman	17	17	17	19	17
Singamman	15	12	15	15	14
Uam	-	-	14	14	15
Gamcheon	19	20	21	20	19

Unit: hours

Table 4-11. Ship Turnaround Time of Busan Port

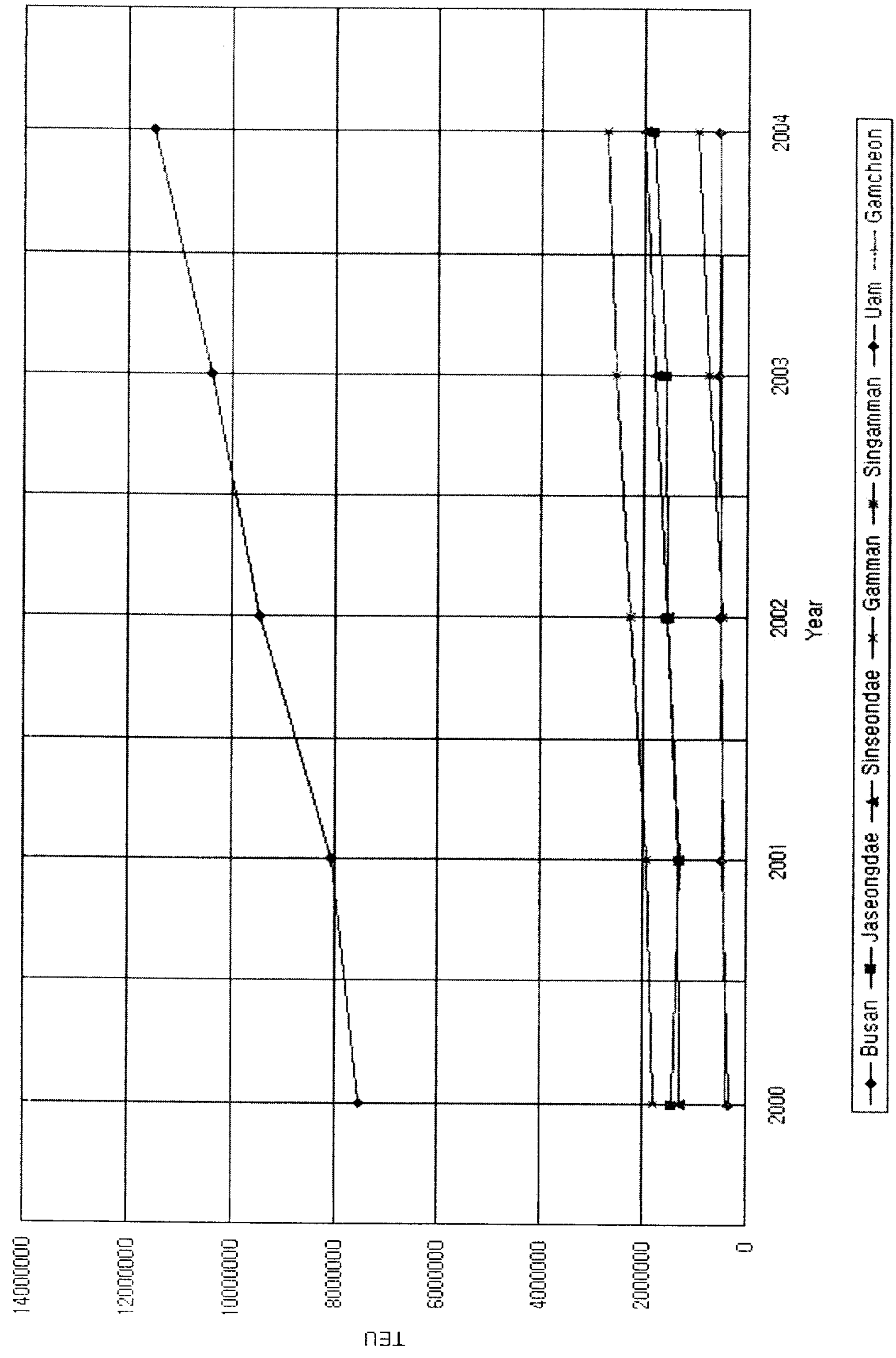

Figure 4-7. Container Traffic of Busan Port

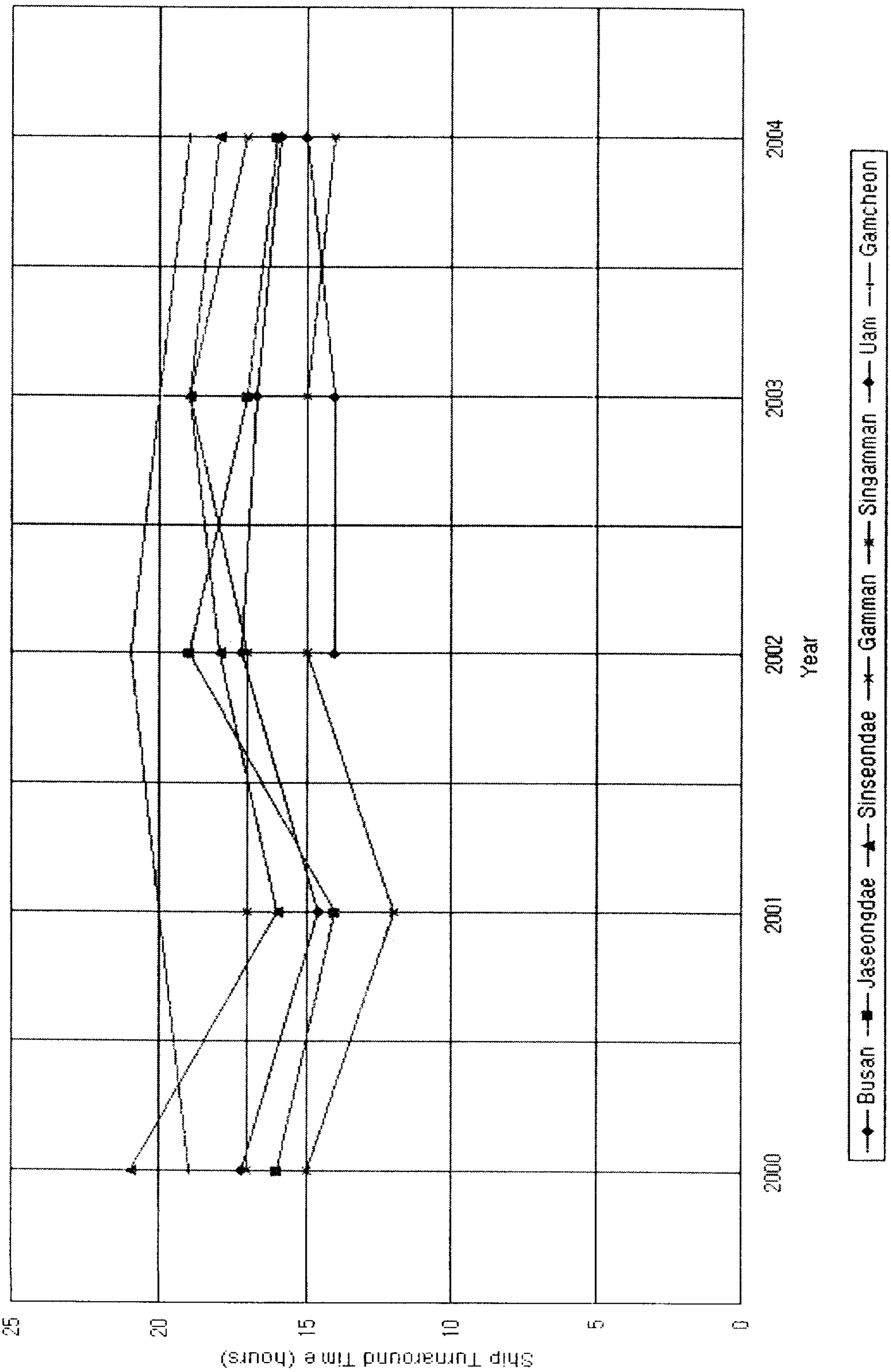

Figure 4-8. Ship Turnaround Time of Busan Port

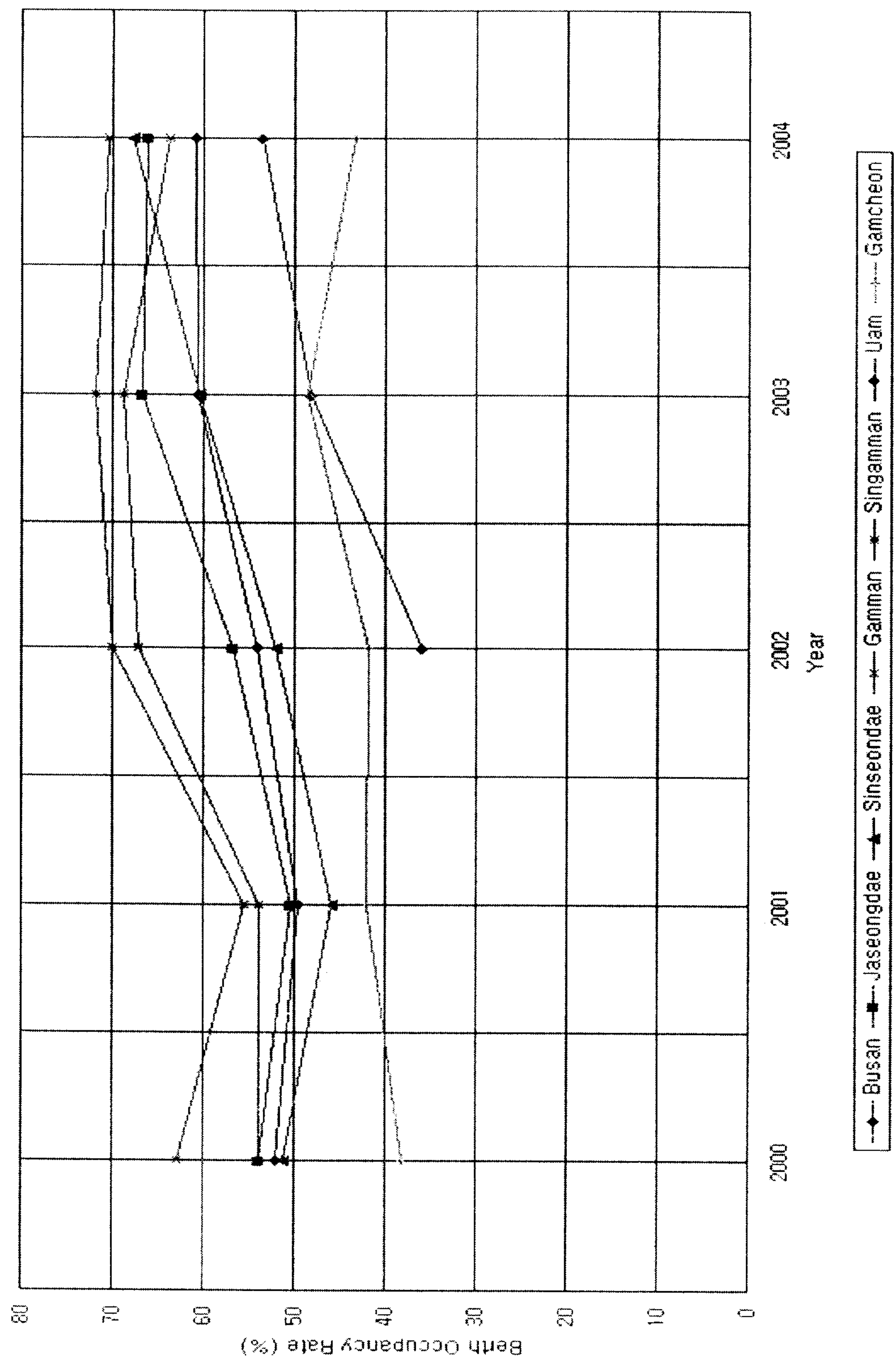

Figure 4-9. Berth Occupancy Rate of Busan Port

Berth Occupancy Rate:

	2000	2001	2002	2003	2004
Busan (average)	52	49.6	54	60.7	60.8
Jaseongdae	53.9	50.5	56.8	66.8	66.1
Sinseondae	51.2	45.9	52.1	60.4	67.8
Gamman	53.8	53.8	67.2	68.7	63.7
Singamman	62.8	55.6	70.1	71.8	70.5
Uam			35.9	48.2	53.5
Gamcheon	38.2	42	41.8	48.5	43.3

Table 4-12. Berth Occupancy Rate of Busan Port

4.1.2.5. Conclusion:

With a container throughput over 11 million TEUs, Busan Port is still keeping its leader position as a global hub. The role of information technology to gain this position is very important.

In the next chapter, the data of two ports will be compared to see if some implications for information system development for Turkish ports can derived by benchmarking the system in Busan Port.

4.2. Comparison of the Port Data:

4.2.1. Based on Performance Indicators

4.2.1.1. Based on Berth Throughput:

Container throughputs of Mersin Port and Busan Port are given in Figure 4-9.

These values may not mean anything if it is considered that Busan Port is by far bigger than Mersin Port. On the other hand, the results do not chance if container throughputs of different terminals are consider separately (see Figure 4.10).

Among the terminals of Busan Port, Gamman Terminal has the highest container throughput values whereas Uam Terminal and Gamcheon Terminal have the lowest. The container throughput of Mersin Port is even lower than that of Uam Terminal and Gamcheon Terminal.

4.2.1.2. Based on Ship Turnaround Time:

The average ship turnaround times for Busan Port and Mersin Port, in 2004, are shown in Figure 4.11.

Even though the average tonnage of ships that call at Busan Port is more than that of ships that call at Mersin Port, the average ship turnaround time is lower. It certainly shows how fast is the service in Busan Port than that in Mersin Port.

4.2.1.3. Based on Berth Occupancy Rate:

The average berth occupancy rates for Busan Port and Mersin Port, in 2004, are shown in Figure 4.12.

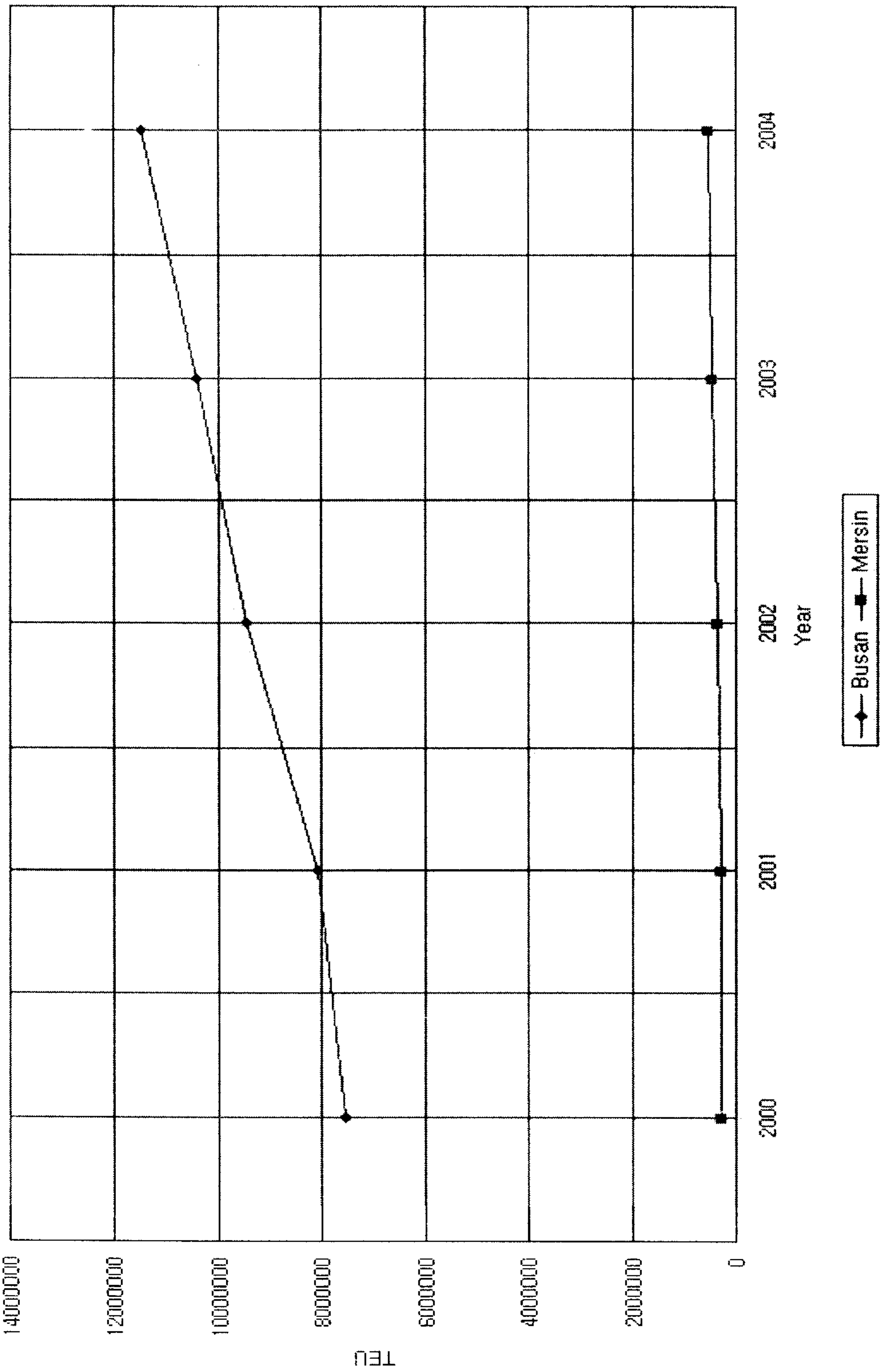

Figure 4-10. Container Throughputs of Merin Port and Busan Port.

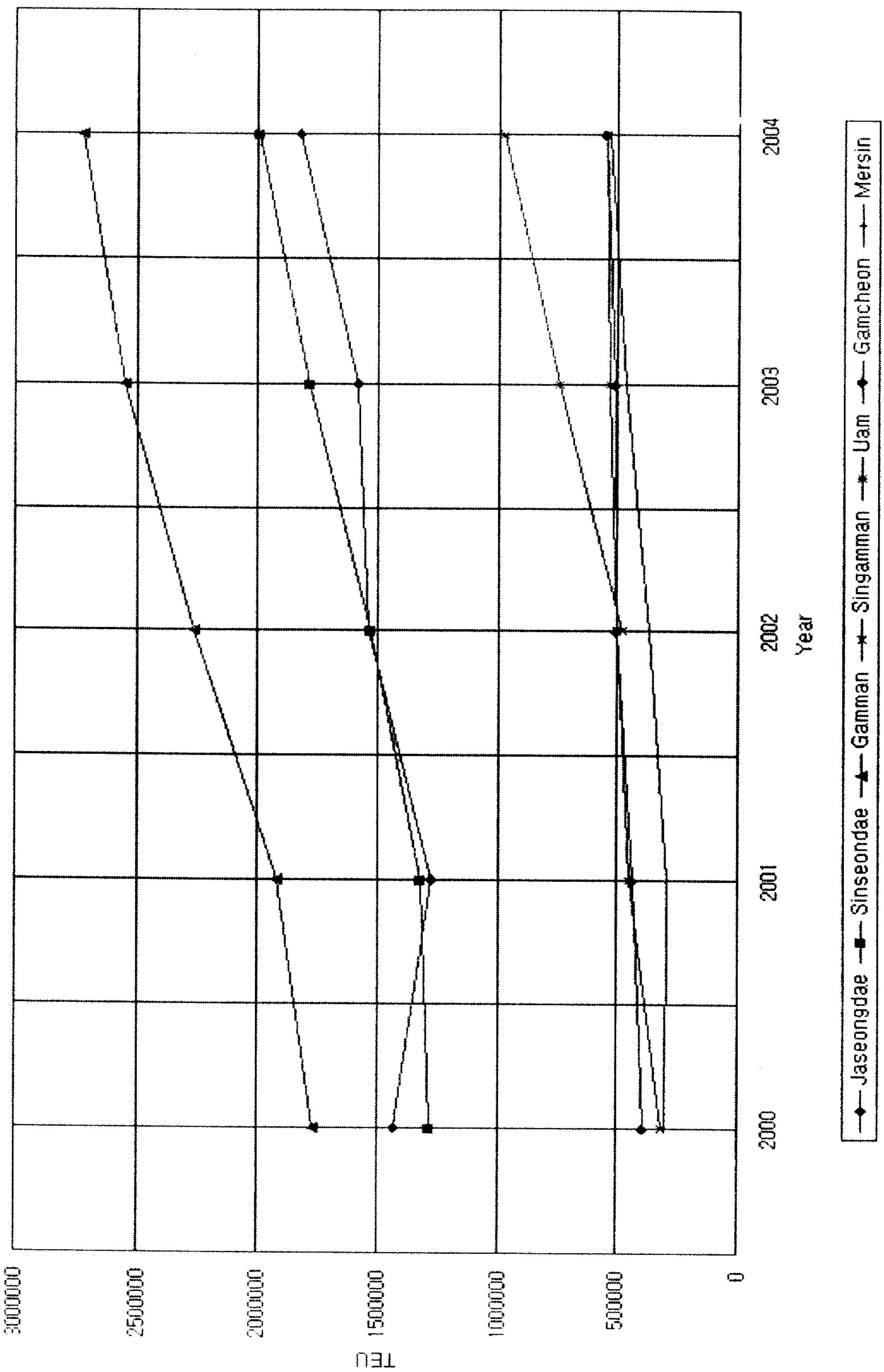

Figure 4-11. Container Throughputs of Mersin Port and the terminals of Busan Port .

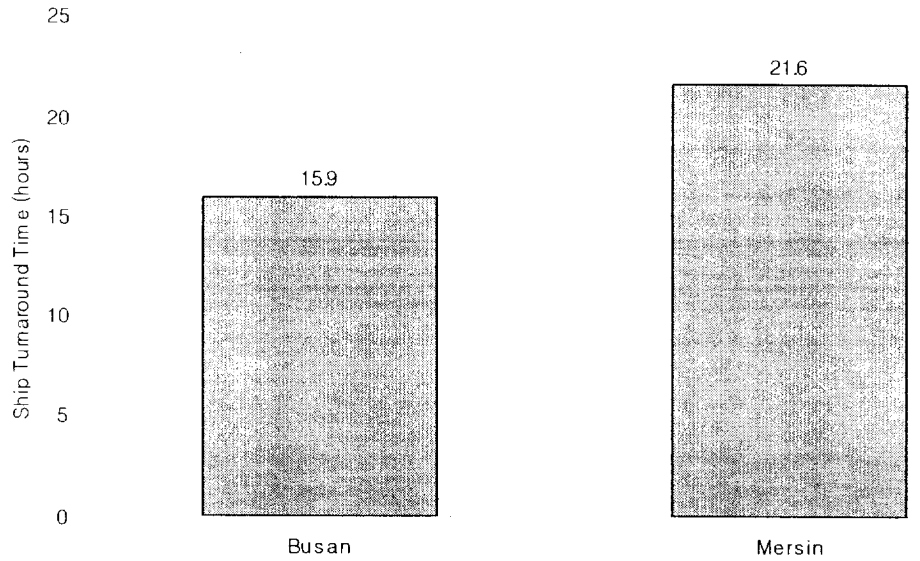

Figure 4-12. Ship Turnaround Times of Busan Port and Mersin Port.

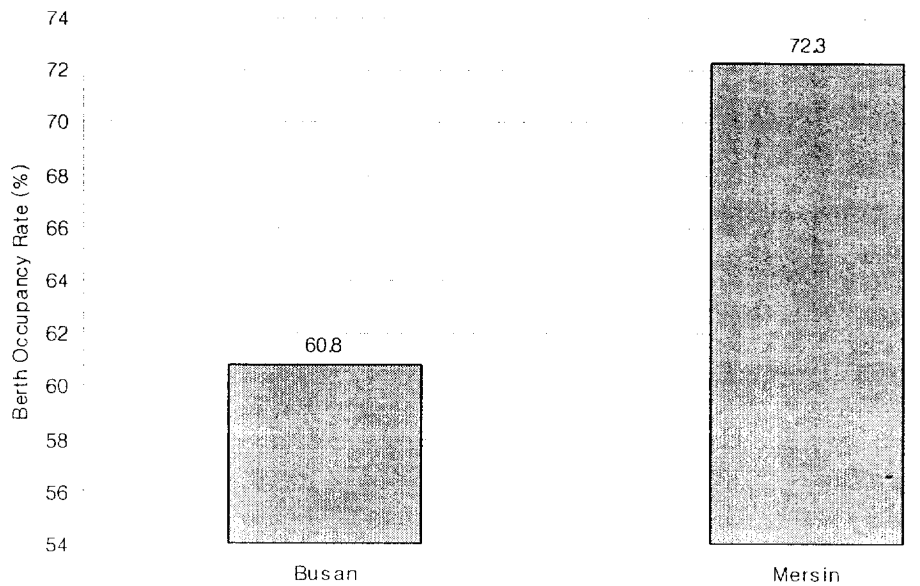

Figure 4-13. Berth Occupancy Rates of Busan Port and Mersin Port.

For a port, having a lower value of berth occupancy rate may imply good or bad situation. If a lower value of berth occupancy rate is due to fast service, it implies a good situation. If it is due to high service prices that cause the ships to call at another port, it implies a bad situation. On the other hand, a higher value of berth occupancy rate implies a good situation if and only if ships stay in the berth by paying the corresponding fees, without causing congestion. (Yucel, 1997, p 51)

According to the port statistics, in 2004, the number of ships that called at Busan Port is 12,683 whereas the number of ships that called at Mersin Port is only 3961.Since the ship turnaround values indicate that the service speed in Busan Port is much higher than that in Mersin Port, a lower value of berth occupancy rate in not unpredictable.

4.2.2. Based on Expert Opinions

As it is explained in Chapter 2.1, there are so many factors affecting the efficiency of a port. Measuring the quantitative effect of information systems is almost impossible, because of the uncontrollable effects of various factors, ranging from the economy of the country to motivation of the workers.

For this reason, the best way to figure out the main reasons underlying the efficiency of the corresponding ports was to ask the opinions of the "experts". These experts are the port officials who are responsible for IT systems in each port. These experts were located by "snowball sampling" and their names are listed in Table 4-13.

Mersin

Mersin Port	Yener Emiroglu, Fahri Fuzul Ozcan
Mersin Chamber of Shiping	Halil Delibas, Mehmet Kollu

Busan:

BPA	Shin Ho Park
BRMAFO	Myung Hun Jung
PECT	Yong Jin Kim
Hutchison	Bong Hwan Choi
Hanjin	Du Ho Park, Ho Young Jeon
Korea Express	Jong Hun Kim
Uam	Tae Kuk Ha
Dongbu	Han Chu
Busan New Port	Ho-In Lee

Table 4-13. Experts who were interviewed during the research

Questions asked to these officials were divided into two groups. The objective questions were named as "Investigation Content" and only one person in each terminal was asked to reply. On the other hand "Questionnaire", which contains subjective questions, was replied by every official working in the IS department of each terminal. (see Appendix for these question sets)

The results are summarized below.

4.2.2.1. Based on "Investigation Content":

The results of the "investigation content" are supposed to shed light on the systems utilized in each port. The results are tabulated in Table 4-14 and Table 4-15.

As it is seen on the Table 4-14, the range of usage of IT systems in Mersin Port is very narrow and almost every task is carried out by paper-based methods. On the other hand, every task in Busan Port –except for facility management– is carried out by IT systems in at least one of the divisions of the port.

The experts in Mersin Port replied almost all of the questions in Part B as "No". Two doubtful replies were shaded as gray and marked with an asterisk in order to indicate that those replies are corrected by the author. The table also shows that neither system enable on-line connection with trade chambers (shaded).

	Mersin	BPA	BRMAFO	PECT	KHT	Uam	Hanjin	K Exp	Dongbu
1) Planning									
a. Berth Planning	PB	IT	NA	IT	IT	IT	IT	IT	IT
b. Yard Planning	PB	IT	NA	IT	IT	IT	IT	IT	IT
c. Loading/Unloading	PB	IT	NA	IT	IT	IT	IT	IT	IT
d. Rail Planning	PB	IT	NA	PB	PB	NA	IT	IT	NA
e. Resource Allocation Planning	PB	IT	NA	PB	IT	PB	IT	IT	IT
2) Operation									
a. Overall Control	PB	IT	IT	IT	IT	IT	IT	IT	IT
b. Yard Operations	PB	IT	NA	IT	IT	IT	IT	IT	IT
c. Loading/Unloading	PB	IT	NA	IT	IT	IT	IT	IT	IT
d. Gate Operations	PB	IT	NA	IT	IT	IT	IT	IT	IT
e. Rail Operations	PB	IT	NA	PB	IT	NA	PB	IT	NA
3) CFS Operations									
a. Export Freight	PB	IT	NA	IT	IT	NA	IT	IT	IT
b. Import Freight	PB	IT	NA	IT	IT	NA	IT	IT	IT
c. Stock on Hand	IT	IT	NA	IT	IT	NA	IT	IT	PB
4) Operation Support									
a. Equipment	PB	IT	NA	IT	IT	IT	IT	IT	IT
b. Business Activities	PB	PB	NA	IT	PB	PB	PB	PB	PB
c. Billing	PB	PB	NA	IT	PP	NA	PB	PB	PB
d. Communication	IT	IT	NA	IT	IT	IT	IT	IT	IT
e. Logistics Information	PB	IT	NA	IT	NA	IT	IT	IT	IT
5) Management									
a. Human Resources	PB	IT	NA	IT	IT	IT	PB	IT	IT
b. Financial Accounting	PB/IT	IT	NA	IT	IT	IT	IT	IT	IT
c. Planning	PB	PB	NA	IT	PB	PB	PB	PB	PB
d. Material/ Purchasing	PB	IT	NA	IT	IT	PB	PB	IT	IT
[redacted]									
f. Environmental Safety	PB	PB	NA	PB	PB	PB	PB	IT	PB

Table 4-14. Results of "Investigation Content", Part A

(PB: Paper-based, IT: Information Technology, NA: Not Applicable)

	Mersin Port	BPA	BRMAFO	PECT	KHT	Uam	Hanjin	K.Exp	Dongbu
1) Is there a local network connecting the activities in Part A?	N	Y	NA	Y	Y	Y	Y	Y	N
2) Is there REAL-TIME information exchange between the departments in the port?	Y*	Y	Y	Y	N	Y	Y	Y	N
3) Is there a local database to which responsible staff from each department can connect?	N	Y	Y	Y	N	Y	Y	Y	N
If the answer is "YES", which ones of the following are connected to this database?									
a Port Authority	N	N	Y	N		Y	N	Y	web
b Loading/Unloading Staff	N	N	N	Y (EDI)		Y	Y	N	web
c Shipping Companies	N	N	N	Y (EDI)		Y	Y	Y	web
d Customs	N	N	N	Y (EDI)		Y	Y	Y	web
e. Storage Yards	N	N	N	Y (EDI)		Y	Y	Y	web
f. Warehouses	N	N	N	Y (EDI)		Y	Y	N	web
g. Berth Operations	N	Y	N	Y (EDI)		Y	Y	Y	web
h. Equipment Operations	N	Y	N	Y (EDI)		Y	Y	Y	web
i. Port Support Companies	N	N	N	Y (EDI)		Y	Y	Y	web
4) Is there an EDI system implemented in the port?	N	Y	Y	Y	Y	Y	Y	Y	Y
5) Is the port related information offered to the customers through the internet?	Y*	Y	Y	Y	Y	Y	Y	Y	Y
6) Is there a "freight tracking" system implemented in the port?	N	N	N	Y	NA	Y	Y	Y	N
7) Before the ship arrives at the port, is the related information about the vessel and the cargo (i.e. ETA) sent to the port on an on-line basis?	N	Y	Y	Y	Y	Y	Y	Y	N

Table 4-15 Results of "Investigation Content", Part B. (Y: Yes. N: No. NA: Not Applicable)

	Mersin Port	BPA	BRMAFO	BRMAFO	PECT	KHT	Uam	Hanjin	K.Exp	Dongbu
8) During loading/unloading operations, is there a system which supplies the related information about the cargo to the crane operator in order to ease the operation of the cranes?	N	Y		NA	Y	Y	Y (only T/C)	Y	Y	Y
9) Is there a system that automatically reports to the port authority about the port operations?	N	Y		NA	N	N	N	N	Y	N
10) Is the information about the stored cargo updated with every cargo movement?	N	N		NA	Y	N	NA	Y	Y	Y
11) Are there automatic cranes in the yard whose operations are remotely automated by computerized systems?	N	N		NA	Y	N	NA	N	N	N
12) Is there a system that automatically reads the information printed on the container (i.e. number or barcode) while the container truck passes through the port gate?	N	Y		NA	Y	Y	Y	Y	Y	Y
13) Is real-time management, coordination and control offered by the port's IS department?	N	Y		NA	NA	Y	Y	Y	Y	Y
14) Is there an on-line information exchange between the port and the following parties?				NA						
a. Customs	N	Y			Y	Y	Y	Y	Y	Y
[redacted]										
c. Service Suppliers	N	N			Y	N	N	Y	Y	N
d. Freight Forwarders	N	Y			Y	Y	Y	Y	Y	Y
e. Truckers and Haulers	N	Y			N	N	N	N	Y	N
f. Shipping Companies	N	Y			Y	Y	Y	Y	Y	Y
g. Shippers	N	Y			Y	N	N	Y	N	N
15) Is there a network that connects the port with the other ports in the country?	N	N		NA	Y	N	NA	N	Y	N
16) Is the port connected to any other e-Logistics systems, outside the port?	N	N		NA	Y	N	NA	Y	Y	N

Table 4-15(continued) Results of "Investigation Content", Part B. (Y: Yes. N: No. NA: Not Applicable)

4.2.2.2. Based on "Questionnaire":

In the "questionnaire" research, we asked several subjective questions to the port officials about the relation between port's efficiency and the effect of IT systems on it.

The port officials asked to evaluate the port's overall efficiency from 1 to 7. The average value for Busan Port was 5.05, which can be classified as "above the average". Port's location got the highest grade (5.8 over 7) among the factors affecting the port's efficiency whereas law and bureaucracy got the lowest grade (4.71 over 7). In fact what we wanted to know the location of the "effect of IT systems" among these factors. For Busan Port, the effect of IT systems appeared to be the second most important factor by getting an average grade of 5.76.

The second question was about what to do to increase the port's efficiency. According to the responses, improving the connection with the hinterland of the port got the highest grade (5.75 over 7) whereas more sophisticated management techniques got the lowest grade (4.95 over 7). Again, more sophisticated IT systems appeared to be the second most important factor with an average grade of 5.70.

The officials in Busan Port evaluated the efficiency of the IT systems utilized in the port as 5.17 over 7. The most efficient part of the IT system appeared to be operation (5.11) whereas the least efficient part appeared to be system automation (3.92). The port officials also stated that the overall efficiency of the port increased approximately 50% after the utilization of the existing system.

There was an open-ended question at the end of the questionnaire, asking the most important obstacle to be solved for the development of IT systems in Busan Port. Most of the respondents replied that the biggest problem of the IT systems in Busan Port is the problems of information exchange between the port-related parties due to lack of an integrated system. Every party has its own information system and there isn't enough connection between them. The officials also complained about insufficient standardization of logistics and port administration, and unsystematic port planning.

On the other hand, the results of Mersin Port seem totally different from those of Busan Port. Ports overall efficiency appeared as 3.34 over 7, which can be classified as "below the average". Among the factors affecting the port's efficiency, port's hinterland got the highest grade (5.5 over 7) whereas marketing of the port and the economy of Turkey got the lowest grade (3.4 over 7). The effect of IT systems appeared to be the seventh most important (i.e. the second least important) factor by getting an average grade of 3.6.

The question about what to do in order to increase the port's efficiency was replied by the officials, and more sophisticated management techniques got the highest grade (6.4) and employee education got the second highest grade (6.2). The factor with the least grade appeared to be the improvement of the connection between the port and its hinterland (4.5). It was not very surprising that more sophisticated IT systems appeared to be the second least important factor with an average grade of 5.0.

The efficiency of the existing IT system appeared to be very low, by getting a grade of 2.8 over 7. And the values of all parts of the IT system appeared to be lower that 4. Also it was not very surprising that the system caused almost no increase in the overall efficiency of the port.

According to the Mersin Port officials, the most important obstacle for IT system development in the port is bureaucracy. Cost-productivity analysis and privatization of the port follows it.

Since these results only exhibit the personal opinions of the officials and experts in the ports, they cannot be used to "prove" what the situation really is. But they had a good contribution for us to derive the implications for Turkish ports in the next chapter.

The results are tabulated in Table 4-16.

QUESTIONAIRE	Mersin Port	BPA	BRMAFO	PECT	KHT	Uam	Hanjin	K.Exp	Dongbu	Busan
1) How efficiently does the ……… Port operate?	3.4	5.5	5	5.33	5	5.5	4.75	4.71	4.6	5.04875
1.1) What are the proportions of the following factors that affect the efficiency of the port?										
The location and the planning of the port	4.6	6.5	6	6	5.19	5.8	6	5.29	6	5.3475
The hinterland of the port	5.5	4.5	6	5	4.64	5.2	5.5	5.43	5.2	5.18375
The IT systems used	3.6	5.5	6	6.33	5.09	6.2	5.75	5.43	5.8	5.7625
Physical equipments (cranes, forklifts…etc)	4.2	4.5	5	5.33	4.45	5.4	5.25	5.29	4.6	4.9775
Human resources	4	5	5	5.67	4.64	5	4.75	5.14	5.6	5.1
Law and bureaucracy (customs declaration…etc)	4.6	5	5	4.67	4.45	4.6	4.75	4.43	4.8	4.7125
Management (authority, regulations, ordinances..etc)	4.6	6	6	4.67	4.64	4.8	4.25	4.29	4	4.83125
The advertising and marketing of the port	3.4	5	6	4.67	5.18	5.2	3.75	5	4.2	4.875
Economy of Turkey/ Korea	3.4	5.5	5	5.67	4.27	5	4.25	5	4.8	4.93625
Other(…………………)	0	0	NA	0	0	0	0	0	0	0
1.2) What is to be done in order to increase the efficiency of the port?										
Privatization	5.2	4.5	3	5.67	4.64	6.2	5.75	5.57	4.6	4.99125
Improve the connection of the port with its hinterland	4.5	6.5	6	5.67	4.64	6	5.25	5.71	6.2	5.74625
Use more sophisticated IT systems	5	6	6	5.67	5.36	5.8	5.5	5.43	5.8	5.695
Use more sophisticated physical equipments (cranes, forklifts…etc)	5.4	5.5	5	6	5	5.4	4.75	5.14	5	5.22375
Employee education	6.2	5.5	5	5.67	4.45	5.6	4	5.29	5.6	5.13875
Ease law and bureaucracy	5.8	6	5	5.67	4.64	6.4	5	5	4.4	5.26375
Use more sophisticated management techniques	6.4	5	5	5.33	4.55	5.4	4.75	5.14	4.4	4.94625
The advertising and marketing of the port	5.8	6	6	6.33	4.91	6.4	4.5	5.86	5.4	5.675
Other(…………………)	0	0	NA	0	0	0	0	0	0	0

Table 4-16. Results of "Questionnaire"

	Mersin Port	BPA	BRMAFO	PECT	KHT	Uam	Hanjin	K.Exp	Dongbu	Busan
2) How efficiently does the port management information system (PMIS) of the ……..Port operate?	2.8	4.5	6	3.5	5.1	6	5	4.71	6.4	5.15125

2.1) Evaluate the following parts of PMIS:

	Mersin Port	BPA	BRMAFO	PECT	KHT	Uam	Hanjin	K.Exp	Dongbu	Busan
Hardware	3.5	4	5	3.67	4.45	5.6	4.75	4.71	5.4	4.6975
Planning	4	5	NA	3.67	4.09	4.8	5	4.14	5	4.528571
Operation (i.e. loading, unloading…etc)	3.75	5	NA	4.67	5	5.8	5.25	4.43	5.6	5.107143
Operation support (i.e. billing, communication, logistic information. …etc)	4	3.5	NA	4	4.45	6	4.75	4.57	4.4	4.524286
Storage (i.e. CFS operations, freight tracking…etc)	4	4	NA	4.33	4.18	4.5	4.75	4.29	4.2	4.321429
Management (i.e. human resources, accounting, purchasing…etc)	3.5	3.5	NA	4.67	4.18	4.8	4.5	4.43	4.8	4.411429
Database (i.e. real-time information flow…etc)	3	4.5	NA	5.33	4.45	6	4.75	4.86	5.2	5.012857
Connection with external bodies (i.e. customs, trade chamber…etc)	3.25	3.5	NA	4.67	4	5	4.25	4.86	3.8	4.297143
Connection with customers (i.e. shippers, cargo owners…etc)	3.5	3.5	NA	4.67	4.64	5.4	4.75	4.57	4.4	4.561429
System automation	3.25	2.5	NA	5	3.91	3.8	4.75	3.86	3.6	3.917143
Other( )	0	0	NA	0	0	0	0	0	0	0
2.2) Did the performance of the port increase after the usage of the existing IT system?	6	75	30	76.7	23.27	83.75	40	26.43	25	50.01714

Table 4-16. (continued) Results of "Questionnaire"

5. DISCUSSION:

In this chapter, some implications for Turkish ports will be derived, on the basis of present conditions, information system development processes and expert opinions.

5.1. Business Process Reengineering:

When the information system development process of Mersin Port is overviewed again, one can realize that the main reason for failure in MEDITEL Project was "the difference in management technique and the infrastructure". In order to match the existing business processes with the functions of the software, the French officials were to modify the software. When it didn't work, they offered the upgrade version of the system, but it didn't work either.

On the other hand the concept of business process reengineering (BPR) implies just the opposite. Hammer (1990) states, "heavy investments in information technology have delivered disappointing results –largely because companies tend to use technology to mechanize old ways of doing business"(p104). In such a case, computers are generally used to speed up the existing processes, but this cannot be sufficient to cover up their fundamental performance deficiencies. Thompson and Cats-Baril (2003) addresses this problem as "before paving the cow path, straighten it; before you automate, improve your business processes"(p354).

The fact that Turkish ports are exposed to severe management problems was already stated in previous studies (see Yucel, 1997, p69). The processes are outdated and the managers are deprived of modern management knowledge. Especially complex bureaucratic processes had to be simplified and task depending on paperwork had to be redesigned such that they would fit the functions of the new information system.

When the information system development process for Turkish ports is inspected, there is no trace about such reengineering work prior to MEDITEL Project. Instead, the software used in this project, called ESCALE, was to be modified. As expected, this "paving the cow path" tasks did not end in a satisfactory result.

In the future, any information system development project for Turkish ports is likely to fail if it will not encounter any improvement for out-of-date business processes.

5.2. A Better Information Planning:

Information planning is very important in IT system development projects. Thompson and Cats-Baril (2003) define the steps of information system development process as follows (p 370):

1. Planning (define goals and objectives)
2. Analysis (define requirements) Generation and evaluation of alternatives
4. Designing the chosen alternative
5. Implementation (convert to the new systems)Operation and maintenance of the system.As the process implies, determining "what is to be done" is always prior

to "how to do it". By doing so, we leave more options open, and that will put us in a better position to generate and evaluate alternative solutions (p376).

Goldsmith (1991) states this fact in his article that we "should always discuss what information will be needed to support the business strategy, never talk about information technology" (p76). He also states that these information strategies cannot be developed independently from the business strategy (p67).

O'Brien (2004) explains the importance of information planning in his book, stating that "a good planning process helps organizations learn about themselves and promotes organizational change and renewal... It results in a strategic plan that outlines a companies business/IT strategies and technology architecture." (p334).

If information system development project for Izmir Port is overviewed again, the project was canceled due to the problems about the real time operation of the application program with manually offered services at the port. This situation is a good example to show how systems fail when they are not properly designed according to the information requirements.

In the future, any information system development project for Turkish ports is likely to fail if the precautions for information planning and business processes are not taken.

5.3. Privatization:

Even if some improvements in business processes of Turkish ports are proposed in this paper, it is not that easy to execute. Because any change in activities must be approved by public officials. In most cases, these officials absolutely have no idea or experience about port operation.

This issue becomes more serious if the fact that Turkish ports are operated by TCDD, which is a public institution also responsible for railroad operations, is considered. For this reason, the management cannot focus on port operation and development, and income of the ports is used to support other operations of TCDD (Yucel, 1997, p70). Both previous studies (i.e. Ergunes, 1993, Yucel, 1997 etc) and expert opinions in our study state that Turkish ports are severely exposed to management problems and complex bureaucracy.

Another problem about information system development process of Turkish ports is that the activities of the technical committee formed by TCDD in 2000, was blocked by the government in 2005, due to the privatization of the services except transfer of ownership in all TCDD ports except Haydarpasa Port. In this case, effort to develop information systems was canceled just for economic reasons. Such a situation emphasizes how important privatization is for information system development.
In his study, Airries (2000) emphasizes the role of the "developmental state" in the success story of Singapore Port. In this study, developmental state is defined as "a government that establishes as its principal of legitimacy its ability to promote and sustain development, understanding by development the combination of steady high rates of economic growth and structural chance in the productive system, both

domestically and in its relationship to the international economy"(p240). Developmental state is related as an "enabling factor" of Singapore's success. The example above shows that Turkish state is far from being such a state.

For these reasons, privatization of Turkish ports is an essential step before development of information systems.

5.4. Employee Education:

During our interviews, it was realized that the application programs designed for DELIMTEL and MEDITEL projects are not used in Mersin Port. The employees continue to do the tasks as they are used to do. Major operations are still carried out by paper-based activities. On the other hand TCDD headquarters claim that the program is still in use.

There appears the question of employee education about the new system. Even a perfect system would not mean anything if it is not properly used by the employees.

On the other hand, employee education is included in many previous researches about information system implementation processes. (For more information; see Ross and Vitale, 2000, p237, Parr and Shanks, 2000, p290...etc)

5.5. Busan Port for Benchmarking:

The results of our investigation indicate that main problem of the information system in Busan Port is the absence of sufficient connection between PORT-MIS and other terminal operating systems. Since Mersin Port consists of only one terminal, this problem is not relevant for Mersin Port. So benchmarking Busan Port would be possible for information system development projects for Turkish ports.

On the other hand, as stated above, the problem of Turkish ports is not only "technical". The main problem is in "processes" that do not go along with functions of the systems.

The system implemented in Busan Port may be technically sufficient to be benchmarked, but if it is not supported by corresponding improvements in business processes and management style, it will not mean anything.

Since the system implementation by using the software of Marseille Port failed due to lack of certain precautions, system implementation by using the software of Busan Port is also has the similar risk. So if Busan Port is selected for benchmarking, more concern should be paid on underlying processes, not the system itself.

6. SUMMARY AND CONCLUSION:

In the modern world of globalization, ports are important links in the chain of transport. Especially by decreasing costs of transport, efficiency of the ports became a more and more important issue. And ports around the world are competing severely in order to increase their throughput and ensure their position in the global arena.

Turkish ports are no exception. But insufficient investments in infrastructure and out-of-date management styles inhibited the improvements of the ports. Although Turkey has a very important and strategic location between Asia, Europe, Middle East and North Africa, it cannot use its resources efficiently to control the cargo transport between these regions.

In this research, the current situation of information systems in Mersin Port, which was selected as a representative Turkish port, was investigated and described. While describing the previous information system development projects, reasons for failure of the projects were derived. Mersin Port's information system and performance indicators were compared with those of Busan Port. While doing these investigations, a lot of experts and port officials were met and interviewed.

The results showed that the main problems of the information systems in Turkish ports depend on managerial faults rather than technical or financial incapability. For example in cases like MEDITEL Project, the system was adopted from Marseille Port and EU economically supported the project. The project failed because the processes in the port were inconsistent with the functions of the software.

After quitting MEDITEL project, TCDD officials tried to develop their own software in Izmir Port. This software started to be utilized after testing phase. But the application of this program was cancelled because of the problems about real-time operation of manually offered services. Failure of a program that was designed specially for that port reminds that there were serious planning problems during the information system development process.

This study aimed to find out whether the information system utilized in Busan Port could be used for future information system development projects for Turkish ports. But the analyses show that benchmarking the information systems in Busan Port will never be sufficient unless management style and underlying business processes are improved.

This study is expected to be the basis of future studies about information system development for Turkish ports.

6.1. Limitations for the Research:

The limitations for this research can be listed as follows:

1. The long distance between the ports, space and time limitations restricted our investigations. For this reason interviews with Busan Port officials were carried out face-to-face, but interviews with Mersin Port officials were carried out on a written-basis.
2. Since the port officials are so busy, they were reluctant to participate in our interviews. On the other hand, carrying out the interviews on a written-basis saved time and increased the participation rate.
3. The questions about information systems were too specific that only related staff could reply. Anyone who is not related to information systems in the port simply refused to participate in the research due to insufficient knowledge about the system. This decreased the possible number of the respondents.
4. Information system in Busan Port is very diverse and every port-related party is concerned about some part of the system. In such a case, it was difficult to identify who is responsible for that part of the system.
5. For the same reason above, it was difficult to obtain expert opinions that are related to overall system in Busan Port.
6. When we carried out the investigation in Mersin Port, the port was about to be privatized. This situation had a negative effect on the officials' morale. They were reluctant to participate in the study and their negative attitude affected the results.

6.2. Recommendations for Future Study:

Recommendations for future study are listed as follows:

1. As stated above, main problems about information systems in Turkish ports are related to out-of-date processes and management problems. In the future, more research about process improvements, information planning and employee education for Turkish ports will be necessary.
2. There are three ports that involved in information system development projects. Among these ports, it is for sure that the application programs developed in these projects are not used efficiently in Mersin Port and Haydarpasa Port. In the future, more information about the present condition of Izmir Port should also be added.
3. After the investigation, Mersin Port was privatized in August the 12th, 2005 and Port of Singapore Authority gained the right of operating Mersin Port for 36 years. In the future, comparison of Mersin Port before and after privatization may yield valuable results.
4. The interviews in this research were limited to IS personnel of each port. But information system may have different aspects for depending on the user. In future studies, the range of interviews may be enhanced in order to include other branches of the port, especially operation personnel.
5. The effect of PMIS on the customers of the port (i.e. shippers, haulers, cargo owners etc) may be a good research topic.
6. On last issue is that, information systems can be extremely specific to the port. Not only each port but also each terminal may have its unique information system depending on its characteristics. In future studies, more specific investigation content should be prepared for each port and each terminal.

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Appendix A: Investigation Content

PART A:

Please specify which ones of the following activities about the …….. Port are carried out by computerized systems and which ones are carried out by paper-based methods.

	computer-based	paper-based
1) Planning:		
a. Berth Planning	❑	❑
b. Yard Planning	❑	❑
c. Loading/Unloading	❑	❑
d. Rail Planning	❑	❑
e. Resource Allocation Planning	❑	❑
2) Operation		
a. Overall Control	❑	❑
b. Yard Operations	❑	❑
c. Loading/Unloading	❑	❑
d. Gate Operations	❑	❑
e. Rail Operations	❑	❑
3) CFS Operations		
a. Export Freight	❑	❑
b. Import Freight	❑	❑
c. Stock on Hand	❑	❑
4) Operation Support		
a. Equipment	❑	❑
b. Business Activities	❑	❑
c. Billing	❑	❑
d. Communication	❑	❑
e. Logistics Information	❑	❑
5) Management		
a. Human Resource	❑	❑
b. Financial Accounting	❑	❑
c. Planning	❑	❑
d. Material/ Purchasing	❑	❑
e. Facilities	❑	❑
f. Environmental Safety	❑	❑

PART B:
Answer the following questions "YES" or "NO"

	YES	NO
1) Is there a local network connecting the activities in Part A?	❑	❑
2) Is there REAL-TIME information exchange between the departments in the port?	❑	❑
3) Is there a local database to which responsible staff from each department can connect?	❑	❑

- If the answer is "YES", which ones of the following are connected to this database?

a. Port Authority ( )
b. Loading/Unloading Staff ( )
c. Shipping Companies ( )
d. Customs ( )
e. Storage Yards ( )
f. Warehouses ( )
g. Berth Operations ( )
h. Equipment Operations ( )
i. Pulling and Tying Staff ( )
j. Port Support Companies ( )

	YES	NO
4) Is there an EDI system implemented in the port?	❑	❑
5) Is the port related information offered to the customers through the internet?	❑	❑
6) Is there a "freight tracking" system implemented in the port?	❑	❑
7) Before the ship arrives at the port, is the related information about the vessel and the cargo (i.e. ETA) sent to the port on an on-line basis?	❑	❑
8) During loading/unloading operations, is there a system which supplies the related information about the cargo to the crane operator in order to ease the operation of the cranes?	❑	❑
9) Is there a system that automatically reports to the port authority about the port operations?	❑	❑
10) Is the information about the stored cargo updated with every cargo movement?	❑	❑

11) Are there automatic cranes in the yard whose operations are remotely automated by computerized systems? ☐ ☐

12) Is there a system that automatically reads the information printed on the container (i.e. number or barcode) while the container truck passes through the port gate? ☐ ☐

13) Is real-time management, coordination and control offered by the port's IS department? ☐ ☐

14) Is there an on-line information exchange between the port and the following parties?

a. Customs ( )
b. Trade Chamber ( )
c. Service Suppliers ( )
d. Freight Forwarders ( )
e. Truckers and Haulers ( )
f. Shipping Companies ( )
g. Shippers ( )

15) Is there a network that connects the port with the other ports in the country? ☐ ☐

16) Is the port connected to any other e-Logistics systems, outside the port? ☐ ☐

17) Please specify if there are others systems are implemented in the port which are not mentioned above:

Appendix B: Questionnaire

1) How efficiently does the …….. Port operate?

very poor			normal			very good
①	②	③	④	⑤	⑥	⑦

1.1) What are the proportions of the following factors that affect the efficiency of the port?

Example:	very unimportant			normal			very important
	①	②	③	④	⑤	⑥	⑦

• The location and the planning of the port	① ② ③ ④ ⑤ ⑥ ⑦
• The hinterland of the port	① ② ③ ④ ⑤ ⑥ ⑦
• The IT systems used	① ② ③ ④ ⑤ ⑥ ⑦
• Physical equipments (cranes, forklifts…etc)	① ② ③ ④ ⑤ ⑥ ⑦
• Human resources	① ② ③ ④ ⑤ ⑥ ⑦
• Law and bureaucracy (customs declaration…etc)	① ② ③ ④ ⑤ ⑥ ⑦
• Management (authority, regulations, ordinances..etc)	① ② ③ ④ ⑤ ⑥ ⑦
• The advertising and marketing of the port	① ② ③ ④ ⑤ ⑥ ⑦
• Economy of Turkey	① ② ③ ④ ⑤ ⑥ ⑦
• Other( )	① ② ③ ④ ⑤ ⑥ ⑦

1.2) What is to be done in order to increase the efficiency of the port?

• Privatization	① ② ③ ④ ⑤ ⑥ ⑦
• Improve the connection of the port with its hinterland	① ② ③ ④ ⑤ ⑥ ⑦
• Use more sophisticated IT systems	① ② ③ ④ ⑤ ⑥ ⑦
• Use more sophisticated physical equipments (cranes, forklifts…etc)	① ② ③ ④ ⑤ ⑥ ⑦
• Employee education	① ② ③ ④ ⑤ ⑥ ⑦
• Ease law and bureaucracy	① ② ③ ④ ⑤ ⑥ ⑦
• Use more sophisticated management techniques	① ② ③ ④ ⑤ ⑥ ⑦
• The advertising and marketing of the port	① ② ③ ④ ⑤ ⑥ ⑦
• Other( )	① ② ③ ④ ⑤ ⑥ ⑦

2) How efficiently does the port management information system (PMIS) of the .... Port operate?

very poor			normal			very good
①	②	③	④	⑤	⑥	⑦

2.1) Evaluate the following parts of PMIS:

Example:							
	very poor			normal			very good
	①	②	③	④	⑤	⑥	⑦

• Hardware	① ② ③ ④ ⑤ ⑥ ⑦
• Planning	① ② ③ ④ ⑤ ⑥ ⑦
• Operation (i.e. loading, unloading...etc)	① ② ③ ④ ⑤ ⑥ ⑦
• Operation support (i.e. billing, communication, logistic information. ...etc)	① ② ③ ④ ⑤ ⑥ ⑦
• Storage (i.e. CFS operations, freight tracking...etc)	① ② ③ ④ ⑤ ⑥ ⑦
• Management (i.e. human resources, accounting, purchasing...etc)	① ② ③ ④ ⑤ ⑥ ⑦
• Database (i.e. real-time information flow...etc)	① ② ③ ④ ⑤ ⑥ ⑦
• Connection with external bodies (i.e. customs, trade chamber...etc)	① ② ③ ④ ⑤ ⑥ ⑦
• Connection with customers (i.e. shippers, cargo owners...etc)	① ② ③ ④ ⑤ ⑥ ⑦
• System automation	① ② ③ ④ ⑤ ⑥ ⑦
• Other( )	① ② ③ ④ ⑤ ⑥ ⑦

2.2) Did the performance of the port increase after the usage of the existing IT system?

❑Yes ❑No

If yes, how much? Approximately ___________%

2.3) What is your opinion about the most important obstacle for improving the IT systems operating in .... Port?

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