Level of information systems in Turkish public ports and direction of improvement

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Abstract: In the recent decades, the competition between seaports has become severe due to several factors, such as globalisation, increasing amount of international trade, advent of ultra-large container vessels, technical developments in cargo handling and changing demands of the customers. International transport environment has changed into a ‘hub-and-spoke’ system, in which cargo is shipped to a major hub port by ultra-large container vessels and trans-shipped to smaller ports by feeder ships. For this reason, ports around the world have invested heavily in their infrastructure and operating systems. On the other hand, it is a fact that Turkish ports fell behind in this competition and operational inefficiencies are affecting Turkish economy severely. Therefore, the aim of this paper is to enlighten the improvement direction of information systems for Turkish major public ports, which are currently operated by Turkish State Railways (TCDD). For this purpose, the past and present condition of information systems were seized and compared to that of world’s advanced ports. Then the characteristics of information systems that can solve the current problems were outlined. According to the results, the problems of information systems in Turkish ports are mainly based on administrative incapability, rather than technical or economical.

Keywords: information systems; ports; TCDD ports; Turkey.


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1 Introduction

Recent developments in Information Technology (IT) have deeply affected almost every field of industry. Ports are no exception. 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. The reason for emphasis on information systems for ports is diverse. First of all, since ports are places where various tasks must be carried out in harmony with various bodies, utilisation of IT is inevitable to coordinate and harmonise these activities, ranging from basic tasks like cargo handling to auxiliary tasks like communication between port-related bodies (Cubukcu, 1998). Moreover, due to various factors, such as increasing amount of international trade, increasing capacity of vessels, decreasing cost of inland transport, introduction of new technology to ports and containerisation, the competition between ports has become severe and efficiency issues has become a major point of concern in the last few decades (Talley, 2000; Choi et al., 2006). These factors forced the ports to invest heavily on their infrastructure and operating systems in order to increase their operational efficiency.

On the other hand, for the case of Turkish ports, utilisation of IT has been delayed for such a long time that inefficiency is severely affecting Turkish economy (Mersin Chamber of Commerce and Industry, 2003; Yeni and Tuna, 2003; Yurt, Yumurtaci and Yercan, 2006). Due to undeveloped transport infrastructure, international cargo routes between Europe and Asia is being shifted beyond the borders of Turkey (The Undersecretariat of the Prime Ministry for Foreign Trade, 2001). On the other hand, Turkey is holding negotiations with European Union, and – if the negotiations are successful – is expected to be a member of it within the next decade. This will certainly cause an increase in the amount of imports and exports cargo due to expected foreign investment drawn to the country, because of low land and labour costs compared to European countries. Moreover, the strategic value of Turkish ports, especially Mersin Port, will increase due to reconstruction of Iraq after the war and the port is competing with Tartus and Lazkiye ports of Syria (Mersin Chamber of Commerce and Industry, 2003). Therefore, low efficiency of Turkish ports will be a bottleneck for such improvements.

In this research, first of all, the current sophisticated port information systems utilised in the world’s major ports are overviewed. Then the past projects to develop port information systems for Turkish ports are summarised and the present situation and problems of Turkish ports are described. Finally, based on the past experiences, applications in the world’s advanced ports and the implications suggested by previous studies, some basic characteristics of the information system that should be implemented to solve these problems are suggested.
2 Literature survey

2.1 Port information systems

Utilisation of advanced technology is common in almost every application of a port. The term ‘port information system’ is used for every kind of IT – hardware or software – that is used in port operations. Since the ports consist of various activities with different characteristics, a well-designed Port Management Information System (PMIS) should supply information, goals, timing and frequencies to enable decision-making for efficient port management. Such a system can be extremely diversified according to the functions of the system and the tasks that are carried out within the port.

According to Bagchi and Paik (2001) intelligent use of IT is a critical area for port planners to improve port operations since construction of new terminals would require a long period of time and a huge amount of investment. On the basis of the results of Busan Port case, they conclude that information velocity improves material velocity in the supply chain.

The study of Kia, Shayan and Ghotb (2000) emphasises the importance of IT for port terminal operations. The paper compares two container terminals, one with electronic devices, such as microwave technology, Radio Frequency (RF) tagging and voice recognition, and one without such devices by developing a computer simulation model using the data of two container terminals in the USA and Australia. The results indicate that presence of such electronic devices has significant effect on container terminal operations and could provide approximately US$180 million savings per year in major Australian ports.

Information systems can be divided into three broad categories. Among those categories, Terminal Operating Systems (TOS) are “computer systems available for organising the container terminal itself” (Jeffrey, 1999, p.39). The study of Choi et al. (2003) suggests an Enterprise Resource Planning (ERP) system for solving the problems of existing TOS. In this research, the functions of TOS are described as

- managing the flow of containers through the terminal by relocating the containers in the right places in the most efficient manner
- planning loading/unloading schedule and yard transfer operation by receiving information from shipping companies, describing position of containers on vessel coming into the port and which ones need to be taken off at the terminal
- processing the containers transported into the terminal by rail or road, receiving notification from shipping companies and trucking companies about them
- notifying shipping companies and trucking companies about the locations of containers.

On the other hand, port authorities may need systems to monitor and control the overall port activities and to accept official requests for vessel arrivals or using port facilities, called PMISs. In the study of Park et al. (2005), which compares such information systems according to port’s organisation type in order to suggest development strategies to PORT-MIS of Busan Port Authority (BPA), these systems are also referred as port administration support systems. Such systems can be distinct in the ports that do not operate its own terminals (such as PORT-MIS of BPA) or such functions can
be embedded in an integrated system (such as PORTNET of Port of Singapore Authority (PSA)).

Moreover, Port Community Systems (PCS) are “computer networks which link up the port with all the companies that use it, including haulers, rail companies, shipping lines, feeder ports, shippers and customs officers” (Forward, 2003, p.14). According to Rodon and Ramis-Pujol (2006) it is “an electronic platform that connects the multiple systems operated by a variety of organisations that make up a seaport community”, thus it is a heterogeneous system connecting multiple types of technologies, processes, people and standards since pre-existing systems of the community members will influence the paths of the PCS implementation. The study of Rodon, Ramis-Pujol and Christiaanse (2007) examines PCS in Business to Business (B2B) context and emphasises the importance of standardisation between the stakeholders of the port community.

Although the configuration of the information system can differ depending on the port, an ideal port information system encloses all these functions under the umbrella of a totally integrated system.

In the following sections, IT utilised in some leading ports of the world will be reviewed in order to seize the scope of information systems utilised in those ports.

2.1.1 Port of Singapore

Port of Singapore is a good example for one of the best usage and application of IT in port terminal operations. PSA runs one of the most technologically advanced ports in the world, and IT is the key to become the most efficient port in the world (Lee-Partridge, Teo and Lim, 2000). Since the country is in severe lack of land, the efficient utilisation 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 physical limitations by the proper utilisation of information technologies.

The information system in the Port of Singapore is divided into three levels (Applegate, Dustin and McFarlan, 2003). In the first level, main operations are streamlined, synchronised and integrated by a programme called Computer Integrated Terminal Operating System (CITOS). 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 organisations, including shipping lines, haulers, truckers, customs, marine service providers, etc.

CITOS is defined as ‘a comprehensive ERP system specialising in real-time command and control of information and resources for container terminals’ (http://www.portnet.com/03products/citos.htm). It supports all planning requirements, including berth allocation, yard planning, ship planning, rail planning and resource allocation. It keeps track of all activities related to terminal operations and movements in the yard, regulates gate operations, and enables real-time terminal operation through connections with control centres. It also contains modules for equipment maintenance, performance reporting, invoicing and container number recognition. On the other hand, operation of break-bulk terminals is carried out by another system, called Computer Integrated Conventional Operations System.

PSA offers integrated services to shipping lines, haulers, freight forwarders, shippers and local government agencies operating in Singapore, through Portnet, via internet environment. The system enables online ordering of services, such as berth application,
stevedoring services, yard crane booking, ordering pilot, tug or water boat. Document submission, like Electronic Bay Plan, vessel itinerary or required information for pre-gate activities can be fulfilled through Portnet. The system also allows the customers to track and trace the location and the status of their cargo and orders. Legal or regulatory documentation, like Electronic Delivery Order (EDO), container store and release order, hauler’s job lists and subcontract functions, and government permits applications seamlessly flow through the system. It offers an easy-access data repository to share critical coordination data, such as detailed schedules, ship planning data, reefer containers temperature and dangerous goods containers condition. The system also offers financial functions, such as online charges and billing. Online connection with customs services is supplied through Tradenet (http://www.portnet.com/03products/portnet.htm).

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 25th, 2000 (Applegate, Dustin and McFarlan, 2003). And in March 2000, the port handled 1.5 million Twenty-feet Equivalent Units (TEUs) in a single month, which is still an unreachable record in anywhere else in the world (Lee-Partridge, Teo and Lim, 2000). 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.

2.1.2 Port of Hamburg

Port of Hamburg is one of the most modern ports in Europe. Its highly automated terminals, such as Container Terminal Altenwerder operates 24 hours a day, almost totally automated. The terminal has 14 semi-automated container cranes to load the containers onto ‘driverless’ container carriers, called Automated Guided Vehicles (AGV). On the yard, two automated gantry cranes operate in each block by one passing over the other to ensure high handling rates and avoid time losses due to system failure (Engelhardt, 2006).

The system is coordinated by software called Container Terminal Information System (CTIS). The system enables real-time data overviews, supports Electronic Data Interchange (EDI). If the container data, e.g. from customers and agents, is pre-advised, it will reduce the manual input to a minimum. It also offers windows-based graphic user interface to provide the user with a real-world environment, helping manage the container yard, equipment and resources more efficiently. An overview on the CTIS modules is as follows (http://www.hamburgportconsulting.de/s2_engl.html):

- gate and truck monitoring
- vessel call and berth planning
- yard planning
- ship stowage planning
- Container Freight Station (CFS)/container packing station
- customs access
- EDI
report generator
• connectable devices/systems
• radio data terminals
• internet
• invoicing/tariffing.

On the other hand, Hamburg’s data communications system (Dakosy) networks port operations and logistics companies within the port. It was established in 1982 and was selected as the world’s top transport related EDI system by International Federation of Port Cargo Distributors.

Dakosy provides a data interchange interface that enables information flow among the companies along the whole transport chain. It offers customised software packages for specific segments in the transport chain that not only complement the existing software, but also provide new solutions, such as monitoring dangerous goods or steering railway traffic.

The container information system, called COAST (Container Authorisation System) offers online information about status, location and condition of container. It transfers general communication requirements from phone or fax to user friendly internet (Forward, 2003).

2.1.3 Busan port

Busan port is the biggest port in Korea, which is located at the south-eastern end of the Korean Peninsular and serving as the gateway connecting the Pacific Ocean and the continent of Asia. Although the port facilities are managed by BPA, container terminals are operated by different companies. BPA utilises PORT-MIS, which is originally developed by Busan Regional Maritime Affairs and Fisheries Office, to manage and control port activities, whereas every terminal operating company has its own TOS. The functions of PORT-MIS are shown in Figure 1.

Figure 1  Main functions of PORT-MIS

Source:  http://www.klnet.co.kr/
On the other hand, TOS differ slightly since terminals are operated by different corporations. As an example, the in-house system of Korea Hutchinson Terminal Co., Ltd covers all terminal operations including gate, yard, vessel, sales and related statistics operations. It supports connections with CFS, EDI and customs. It also has modules for human resource management, financial system, equipment maintenance and repair, web page service and electronic mailing for team members. The system is also interfaced with a purchased ship planning system.

The communications and EDI is provided by a private network company called KL-Net. KL-Net offers various B2G solutions through which companies can make online applications and service requests, such as booking for port facilities, customs clearance, immigration application for ship crew, railroad transport, request for inspection (fishery products, dangerous goods, etc) and a financial module that enables online payment for taxes and port services. KL-Net’s Port Logistics' Integrated System for Maritime Business connects carriers, haulers, terminal operators, checking companies and forwarders to support collaborative business. The system covers generation of precise logistics information, automated handling of compared data, maximisation of information pooling, access to ‘job-site’ information, standardisation of requests and orders to minimise information duplication. The system runs on internet-based client/server system. KL-Net also provides various B2B solutions to support shippers, transporters, terminal operators, such as e-port logistics services and electronic tax invoicing (http://www.klnet.co.kr/).

2.1.4 Port of Hong Kong

TOS utilised in Hong Kong International Terminals (HIT), uses BETA TUXEDO middleware that ties the elements of the system. HITs award winning terminal management system, the so-called Plus Productivity Programme (3P), is a fully-integrated solution to handle HIT’s business requirements and enhance and support yard operations. It includes capital, civil works and a large amount of process reengineering, in order to achieve improved stacking capacity, improved handling capacity and improved yard operations (3P Brochure, http://www.hit.com.hk/facilities/3p.pdf).

All necessary information is transferred to the terminal for pre-planning process that ship and yard planning systems decide the method of deploying containers. For the yard operations, all necessary information about container movements and inventory control is exchanged between the system and the terminal mounted in the crane cabinet via radio frequency or fibre-optic network. After loading onto the truck, the crane operator sends a message to the system that regulates the entrance and the exit of the truck through the driver’s identification card. Every component of the system works fully integrated to share information (Forward, 2003).

Based on 3P, the system called PIONEER allows terminal operators to automate their operations and achieve higher levels of efficiency and customer satisfaction (PIONEER Brochure, http://www.hph.com.hk/downloads/pdf/Pioneer.pdf). PIONEER System offers IT solutions not only for terminal operations, but also depot management, freight management and barge management. The functions of the terminal operation system includes vessel operations (container registrations, bay-plan and confirmations, vessel planning), gate operations, yard operations (yard crane and movement monitoring, automatic assignment for ground location), inventory management, operation management and billing.
Not only the terminal operations, HIT also invested in PCS. In 1998, it launched Customer Plus Programme that enables exchange of electronic messages between HIT and shipping lines. Also, in 2003, it launched a new joint venture called OnePort Limited. The main purpose of OnePort is to improve business processes at the Port of Hong Kong by providing port community with value-added services and electronic information exchange between all port users. The system provides services, such as online customs declaration, paperless container exchange services, paperless container collection and delivery for truckers and services for shipping documentation. HIT also offers EDI for invoicing and container related information through cellular phones.

2.1.5 Port of Rotterdam

Rotterdam is one of the most modern ports in Europe. Europe Container Terminals (ECT) utilises unmanned AGVs to transfer containers from berth to yard, and unmanned yard cranes operate in the yard to minimise waiting times. ECT plans to launch a new terminal system, called total system solution, in order to integrate the information systems in its delta terminals (http://www.ect.nl/).

All available information concerning the port is accessible via one central access point, PortofRotterdam.com. The port authority intended to provide a secure platform for engaging all manners of financial transactions, through a port-wide application of e-business. The site also provides an index of available e-commerce companies. The system is supported by various applications. For example, Virtual Port: Rotterdam programme provides a fast secure and reliable portal platform which enables easy access to electronic message exchange. This enables small companies within the port community to utilise EDI. Gigaport at Rotterdam programme provides services, including electronic verification of financial transactions, paperless transfer of commercial documents and web application for customs clearance. And WebJonas programme, launched by Rotterdam Municipal Port Management allows shipbrokers to announce electronically the arrival of cargo and ships and settle their port dues (Forward, 2003).

2.2 Turkish ports

Having 8,333 km of coastline (Yucel, 1997), Turkey has approximately 150 ports, wharves and marinas (Cubukcu, 1998). Among them seven ports, i.e. Izmir, Mersin, Haydarpasa, Iskenderun, Samsun, Derince and Bandırma Ports are operated by Turkish State Railways, which is abbreviated as TCDD. As it is seen in Figure 2, Izmir, Mersin and Haydarpasa Ports are major container ports whereas other ports handle general or bulk cargo. As TCDD is still the biggest port operator in Turkey, there are 24 ports operated by private sector (Yurt, Yumurtaci and Yercan, 2006; Table 1).
The study of Yilmaz and Cerit (2005) explores strategies to increase the potential of Turkish domestic cargo shipping, by interviewing the field experts using Delphi method. The results are categorised under four main conceptual categories: promotion, cooperation, ports and shipping service characteristics. The paper emphasises the importance of the ports for improving domestic shipping and points out the necessity of quantitative research on this subject.

The research of Tuna (2002) examines the developments of hub ports in Turkey and their impact on national logistics strategy. Turkey’s international trade, relations with European Union and regional developments were considered as major determinants of port development and the Turkish ports were analysed for potential to be a hub port,
mainly based on port location and hinterland connections. The research concludes that Turkish ports have a great potential to be hub ports, but the success depends on various other factors, such as economic and political stability, adequate infrastructure, cheaper costs, simplified customs procedures, adequate information infrastructure and a wide range of port services.

Yeni and Tuna (2003) conducted a review on logistics oriented developments in Turkish container ports. According to the paper, although Turkey has a strategic position in terms of logistics and shipping, Turkish ports are in the initial stage of offering logistics value added services.

Yurt, Yumurtaci and Yercan (2006) analysed the major developments of Izmir port by considering regional developments in the maritime related logistics services. UNCTAD model of port development was applied to Izmir port. As a result, the paper concludes that general characteristics of the port of Izmir illustrate that it is a modern type of a port while adopting the up-to-date activities and services although the port’s problems related to infrastructure, human resources, management and port services affect Turkish economy negatively.

Finally, the study of Oguztimur (2006) concerns with the evaluation of Mersin port according to the recent concept of hinterland and regional economy. The first part of the paper focuses on the change of international port environment and advent of hub-and-spoke system. Then, the position of major Turkish container ports is examined according to their relations with other hub ports in the Mediterranean region. The research concludes that Mersin port has a great competitive advantage by its geographical position to become as a transit hub port for neighbouring, northern and Turk Republic countries, but it is now facing with a number of pressing infrastructural needs for expanding its facilities and enhancing productivity.

All of the studies related above agree on the fact that Turkish ports are very advantageous according to their location and regional developments of the hinterland, but the ports cannot make use of such advantages due to several structural and managerial problems. But study that focuses on information systems in Turkish public ports, especially evaluation of current situation or proposing a direction of improvement, could not be accessed. Although the study of Keceli, Choi and Park (2007) focuses on information systems of Kumport, which is a private port in Istanbul, other major container ports of the country, such as Izmir port and Mersin port are still to be studied.

3 Research methodology

This paper aims to make a review on information systems in Turkish public ports, most of which are operated by Turkish State Railways (TCDD). The past background of information systems were obtained directly from TCDD Directorate through the freedom of information act law. Moreover, case studies were carried out in August 2005 in Mersin Port and December 2006 in Izmir Port, interviewing port officials who are responsible for information systems in order to seize the current situation of the ports. After defining the major administrative and structural problems from which the TCDD ports suffer through these interviews and further literature survey, these problems were matched with cases referred in Section 2.1 to determine how information systems can contribute to overcome such problems. Finally, by adding these contributions up, a direction of improvement for information systems development for the TCDD ports was suggested.
4 Information systems in TCDD ports

On the basis of information obtained port officials supported by further literature survey, the past and the present situation of information systems in the TCDD ports and general administrative and structural problems are described as follows.

4.1 Information system development process for TCDD ports

The TCDD ports started to build container terminals in 1985. Among these, Mersin, Haydarpasa and Izmir ports were the ones with busiest container traffic. Increased traffic in these ports caused congestion due to Turkish customs regime that is not flexible enough to develop regulations to easy such transport and the lack of sufficient control of the port operations with computerised systems. For this reason, ports branch and data processing branch of TCDD prepared ‘TCDD port services telecommunication project’, abbreviated as DELIMTEL, in order to supply computer support to container terminals of Mersin, Haydarpasa and Izmir Ports. The analysis tasks were started in August of 1990. It covered a wide range of purposes, including analysing container terminal activities and needs, developing a management information system for a selected pilot port and implementing the system to other ports. The project was estimated to be finished by the second half of 1992.

Meanwhile European Union (EU) carried out a project called MEDITEL, in order to develop a computer application programme to ease the services of the ports that face Mediterranean Sea and to form an information network that enables information transfer about ship and cargo traffic between these ports by implementing the software package called ESCALE which was developed by Port of Marseille Authority. TCDD declared to be involved in this project in 1991 and Haydarpasa port was offered 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 Port of Marseille Authority. On the other hand, the modifications to be made on ESCALE package in order to fit the differences in management technique and infrastructure could not 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 could not fit the existing system. Negotiations with French officials and EU did not end in any result, and the project was clogged. Therefore, in August of 1995, the technical committee declared to EU officials that developing a new application programme for this port would be more suitable.

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

Finally, a technical committee was formed within TCDD in order to compose required technical specifications for effective terminal and port management in the beginning of the 2000s. This project was also cancelled in the beginning of 2005 due to the decision of High Council of Privatisation Administration that all services except transfer of ownership in all the TCDD ports except Haydarpasa Port would be privatised.
4.2 Current situation in TCDD ports

In 1999, the TCDD project group added ‘fare services’, which was missing in the original project, to the application programme of DELIMTEL and MEDITEL Projects and finished the new programme called ‘computerised tracking of port operations project’. A web-based programme called WinPort, programmed using Visual Basic programming language is being used to control port operations. The programme includes functional parts for operation tracking, billing, reporting, container and operations lists, and gate operations. The programme performs basic database functions to organise operations and reports, but most of the basic operations are still carried out on paper. Even the system has some merits such as receiving service requests from customers through web, essential terminal operation tasks – such as planning – are not supported. Operations in the terminal area are recorded on paper and that inputted to the computer manually. On the other hand, due to bureaucratic problems, official documentation cannot be replaced by computer outputs, thus the effect of the information systems cannot be fully reflected to the speed of the operations.

Based on these case studies, the problems of information systems of the public ports can be summarised as follows:

- Planning and tracking of terminal operations are carried on manually
- Operations are recorded on paper manually and inputted to the system later. Thus, the operations within the port cannot be monitored on real-time basis
- Yard management module is not included to the system. The main reason for this is that the yard itself is not well-organised physically, which makes it impossible to be controlled by a computerised system
- As a result of lack of yard management, allocation of containers within the yard can consume a lot of time
- There is not a portal site for the ports that inform the users about up-to-date information about the ports.

Based on literature survey, basic administrative and structural problems seen on the TCDD ports are stated briefly as follows.

4.2.1 Administrative problems

Port management could not be converted to an autonomous port authority system, so it suffers severe bureaucratic and regulative inefficiency. Port management must be flexible enough to deal with severe competition in the region, to meet the market demands and to be able to manage the port activities with low cost and high service standards. But such requirements are not likely to be realised by the current public administration (Lokmanoglu, 2003). Free Trade Zone in Mersin Region is a good example that same workers in the same port area are working more efficiently, due to the autonomous management.

Since these ports are operated by government organs, port revenues are used for supporting other public services such as railroad expenses (Yucel, 1997), thus capital needed for port infrastructure investments is distributed over those services. As a result of this, required projects for infrastructure cannot be finished as predicted.
Port services are expensive. Turkish ports are indicated as the most expensive ports among the North Europe and Mediterranean ports and this situation is affecting international competitiveness of the ports (Undersecretariat, 2006).

Since most of the tasks are carried out by paper-based manual methods, speed of port and customs services fall behind the commercial activities. Information flow and coordination between port-related parties are inefficient.

The public ports suffer from insufficient human resources. The managers lack modern business management knowledge and trained operational staff, such as crane operators, is scarce.

Other administrative problems cover issues related to insufficient advertising and marketing of the ports, unregistered port land, and insurance policy that does not cover damages given to ships and cargo.

4.2.2 Structural problems

Structural problems of the TCDD ports are about insufficient physical resources of the ports such as quays and wharves, lengths and drafts, equipments and vehicles that serve the hinterland, stacking and storage places and vehicle parking lots.

Provided that private ports in Turkey do not have railway connection, 95% of the cargo handled in the ports is transferred by trucks, indicating that connection of railway and ports could not be realised for inter-modal combined transport. Other structural problems about railway transport – such as lack of easy access cargo tracking system and container land terminals, etc. – are affecting Turkey’s international competitiveness and the cargo route between Europe and Asia is being shifted beyond the borders of Turkey.

Old equipments frequently break down. Maintenance and repair of the equipment cannot be handled in an efficient way because of bureaucratic problems. On the other hand, cranes also break down due to overloading (Gulenc, 2004).

Traffic within the ports is not well-regulated and frequently congests. This is due to insufficient sign tables, lack of control, and uncontrolled and irregular usage of yard area (Gulenc, 2004).

General administrative and structural problems of the TCDD ports are summarised in Table 2.

<table>
<thead>
<tr>
<th>Problems</th>
<th>Source</th>
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<tbody>
<tr>
<td>Slow speed of port and custom services</td>
<td>Yucel (1997) and Cubukcu (1998)</td>
</tr>
<tr>
<td>Expansive port services which are not based on cost analysis</td>
<td>Yucel (1997), The Undersecretariat of the Prime Ministry for Foreign Trade (2001) and Gulenc (2004)</td>
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</tbody>
</table>
### Table 2  General problems of the TCDD ports (continued)

<table>
<thead>
<tr>
<th>Problems</th>
<th>Source</th>
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</thead>
<tbody>
<tr>
<td>Inefficient information flow</td>
<td>Yucel (1997)</td>
</tr>
<tr>
<td>Insufficient trained operational personnel (i.e. crane operators, etc.)</td>
<td>Gulenc (2004)</td>
</tr>
<tr>
<td>Tasks which are carried out by paper-based manual methods</td>
<td>Yucel (1997) and Cubukcu (1998)</td>
</tr>
<tr>
<td>Insufficient advertising and marketing</td>
<td>Yucel (1997)</td>
</tr>
<tr>
<td>Port revenues used for other public services</td>
<td>Yucel (1997)</td>
</tr>
<tr>
<td>Damage given to ships and cargo which are not compensated by insurance</td>
<td>Yucel (1997)</td>
</tr>
<tr>
<td>Improper maintenance and repair of the equipment due to regulation problems and heavy bureaucracy</td>
<td>Gulenc (2004)</td>
</tr>
<tr>
<td>Structural problems</td>
<td></td>
</tr>
<tr>
<td>Insufficient berth lengths and depths</td>
<td>Yucel (1997) and The Undersecretariat of the Prime Ministry for Foreign Trade (2001)</td>
</tr>
<tr>
<td>Insufficient facilities for dangerous cargo</td>
<td>Yucel (1997)</td>
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<tr>
<td>Insufficient facilities to prevent pollution</td>
<td>Yucel (1997)</td>
</tr>
<tr>
<td>Traffic and physical distribution which is frequently congested</td>
<td>Yucel (1997) and Gulenc (2004)</td>
</tr>
<tr>
<td>Combined transport which cannot be realised</td>
<td>The Undersecretariat of the Prime Ministry for Foreign Trade (2001)</td>
</tr>
<tr>
<td>Gantry cranes that broke down frequently due to overload</td>
<td>Gulenc (2004)</td>
</tr>
</tbody>
</table>

### 5 Contribution of information systems to the problems of TCDD ports

In this section, contributions of information systems to solution of the problems stated above are discussed. Most of these problems can be solved, or at least reduced by effective utilisation of IT.
5.1 Contribution of information systems to administrative problems

In order to solve the regulative and bureaucratic problems privatisation was a necessary but late move. The most important contribution of information systems to flexible port management is that it is generally accompanied by its peculiar management method, referred as business process reengineering (Hammer, 1990). When information systems are designed, corresponding business processes are to be transformed in order to ensure flexible management and maximised efficiency of the system utilisation. If the business processes do not accompany information system deployment, the gaps and contradictions between the system and the ongoing processes may cause failure of the system, just as in the case of previous system development efforts in the TCDD ports.

Real-time information exchange between the port administration and the other port-related parties is one of the most important features of the port information systems and it provides coordination and efficient control of the operations. Through the EDI technology, all traditional paper documents can be converted to electronic documents and exchanged between related parties thus the service speed is increased and error rates are decreased.

Another problem stated above is the port service fees. Although determination of port fees is a complex procedure, information systems can help the costs to go down by the efficient utilisation of existing resources. Moreover, information systems decrease the need for human resources, thus decrease labour costs.

The contribution of information systems to human resources problem is that it makes the operations and tasks more human-independent. In most of the advanced ports, even container handling is done by unmanned, automated cranes and transfer vehicles, thus the need for trained and experienced operators is reduced. Even office work can be done by less number of staff, due to reduced paperwork. On the other hand, when a new system is introduced, the staff must be educated about the new system, and it must be considered separately.

As the information systems increase the operational efficiency, they certainly contribute to the competitive power of the port, contributing its marketing and commercial activity within the port.

5.2 Contribution of information systems to structural problems

For most of the time, deployment of new infrastructure and equipment, or expansion of the yard area would be very expensive, or sometimes impossible for certain restrictions. Instead, port administrations should maximise the utilisation of available resources. From this point of view information systems play a crucial role. All the tasks performed in the terminal area can be planned, organised and coordinated by corresponding modules. Moreover, information systems can coordinate the operations of different parties, resulting in more efficient operational performance and less wastes of time and resources. For example, due to its TOS, CITOS, the Port of Singapore can stack containers up to nine high in order make a good use of its very limited land (Applegate, Dustin and McFarlan, 2003).

It is a fact that the equipments used in the ports are old and need to be renewed. Despite, maintenance and repair of the equipment can be controlled efficiently by the help of information systems. An ideal TOS should contain an equipment management module (Choi et al., 2003).
On the other hand, cranes do break down due to overloading (Gulenc, 2004). Again, information systems can help equipment management by controlling time schedules for each crane and vehicle, regulate task dispatching for each equipment and allocate operator to cranes and transfer vehicles. By doing so, the system not only ensures the efficient utilisation of port resources, such as equipment as well as human operators, but also avoids overloading.

To reduce congestions within the terminal area, information systems can allocate each container in the yard in the most efficient manner, and send instructions to trucks and trailers for container movement. The order of tasks can be coordinated by the system in order to minimise equipment moves and time wastes and thus the traffic not only within the yard, but also during entry/exit through gates is regulated efficiently.

The effect of information systems will be enhanced if they are connected to other systems. Integrated information systems, enabling cargo tracking and information exchange between various related parties, should accompany other infrastructural investments for port and rail developments in the future. Such developments will certainly help Turkey to regain its strategic position for cargo flow between Europe, Asia and the Middle East.

The contributions of information systems to the administrative and structural problems are summarised in Table 3.

Table 3  Contribution of information systems to the problems of Turkish public ports

<table>
<thead>
<tr>
<th>Problems</th>
<th>Contribution of IS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Administrative</td>
<td></td>
</tr>
<tr>
<td>Expensive fees</td>
<td>Decrease cost by efficient use of resources</td>
</tr>
<tr>
<td></td>
<td>Decrease labour cost</td>
</tr>
<tr>
<td>Severe bureaucratic and regulative inefficiency</td>
<td>Accompany changes in business processes</td>
</tr>
<tr>
<td>Manual, paper-based management, inefficient</td>
<td>Enable real-time information exchange</td>
</tr>
<tr>
<td>information flow and coordination</td>
<td>Paperless work environment with EDI</td>
</tr>
<tr>
<td>Insufficient human resources</td>
<td>Tasks become more human-independent</td>
</tr>
<tr>
<td></td>
<td>Less labour needed for same amount of work</td>
</tr>
<tr>
<td>Insufficient advertising and marketing</td>
<td>Increase competitiveness</td>
</tr>
<tr>
<td>Structural</td>
<td></td>
</tr>
<tr>
<td>Insufficient land, equipment and facilities</td>
<td>More efficient utilisation of existing resources</td>
</tr>
<tr>
<td>Old equipments, frequent break downs, inefficient equipment maintenance and repair</td>
<td>Optimise work instructions to avoid overloads</td>
</tr>
<tr>
<td>Frequent traffic congestions within the ports</td>
<td>Online control of equipment M&amp;R</td>
</tr>
<tr>
<td>Inefficient connection between the marine and railway infrastructure</td>
<td>Optimise work instructions and yard allocation</td>
</tr>
<tr>
<td></td>
<td>Information exchange between parties</td>
</tr>
<tr>
<td></td>
<td>Online cargo tracking</td>
</tr>
</tbody>
</table>
5.3 Direction of improvement

In the preceding chapter, on the basis of world’s advanced ports and previous academic studies, how IT can contribute to solve the general structural and administrative problems of the public ports in Turkey were discussed. If they are added up, the basic level of information system that needs to be built in Turkish ports should include the following properties.

TOS:
- planning
- yard allocation for containers
- job dispatching for equipment and operators
- work load optimisation
- equipment M&R

PMIS:
- paperless work environment
- real-time monitoring and control of operations
- better marketing through increased competitiveness

PCS:
- real-time information exchange
- coordination between transport modes

On the other hand, a well-designed information system may not always guarantee successful results. The system must be supported with other precautions to ensure efficiency. These are the problems that cannot be solved by information systems directly, and have significant effect on the success of the system. These factors can be summarised as follows:

- legal regulations should be amended to ensure a flexible business environment within the port
- information planning must be well established before the implementation project to avoid future operational failures and user dissatisfactions
- out-of-date business processes within the ports should be improved to be in consistence with information systems
- old equipment should be replaced by high-performance equipment that can operate in harmony with the new system
- both operational personnel and managerial staff should be trained about the new system, since they are the ones who are supposed use the system.
6 Conclusion and future research

In this paper, improvement plan of information systems for the TCDD ports was proposed and some additional precautions to ensure the success of the future projects were indicated. It must be noted that logistics activities are like links of a chain, strength of which depends on the strength of the weakest link. Each and every of the factors above can be a bottleneck for the development of the new system. The failure of the projects in the past can be seen as evidence, so the success of the future projects, especially after privatisation, depends on these precautions.

Development of information systems for Turkish ports is a rich-in-content research field. As this paper suggests what is to be done, future studies must be carried on how these should be done. For example, the information systems in private ports should be examined and compared to those of public ports in order to detect the factors of failure in detail and to establish information systems standard for Turkish ports. Other researches may include an improvement plan for regulative system and bureaucratic problems, and a survey targeting the members of the whole port community, reflect their opinions to system design.

References


