

An Analysis Present Condition of Information Systems in Turkish Ports and Direction of Improvement

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Abstract

The international business environment of port logistics has changed drastically in the last few decades. The increase in international trade, advent of ultra-large vessels, changes in customer needs and development of new cargo handling technologies, the competition between container ports has become very severe in the last few decades and ports started to invest in their infrastructure and information systems in order to increase their efficiency and to sustain their position as a hub of their region. On the other hand, Turkish ports fell behind in this competition of efficiency, and although it has a very strategic position in the intersection of three continents, this situation is causing the logistics route between Europe and Asia to be shifted beyond the borders of Turkey.

This paper aims to offer the direction of information systems in Turkish public and private ports. For this purpose, the current information systems in Turkey's major ports were examined by multiple case study methods, general problems were appointed and the direction of improvement was offered. According to the results, the low level of information technology utilization is due to administrative deficiency, such as out-of-date business processes, severe bureaucracy and insufficient human resources, rather than any technical incapability.

Keyword

Turkish ports, information systems, improvement direction

1. Introduction

In the world of globalization, the conditions of international business environment have changed tremendously, and seaports are deeply affected by this change. The increase in total international trade, the impetus of containerization, and the advent of ultra-

large container vessels— enforced the seaports to a fierce competition to invest in port infrastructure in order to decrease service time, thus increase port's overall efficiency. Recent developments in information technology have deeply affected almost every field of industry and ports are no exception. Since ports are places where various tasks must be carried on in harmony by various bodies, utilization of information technology is inevitable to coordinate and harmonize these activities, ranging from basic tasks like cargo handling to auxiliary tasks such as communication between port-related bodies, in order to increase operational efficiency.

On the other hand the level of information systems in Turkish ports is relatively low and inefficiency is affecting Turkish economy severely [1]. Due to undeveloped transport infrastructure, international cargo routes between Europe and Asia is being shifted beyond the borders of Turkey [2]. 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 import and export cargo due to expected foreign investment drawn to the country, because of low land and labor 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. Therefore, low efficiency of Turkish ports will be a bottleneck for such improvements.

In this research, the level of information systems in Turkish ports was studied by multiple case study method. For this purpose survey studies were carried on Mersin Port (August, 2005), Kumport (August, 2006) and Izmir Port (December, 2006). During the survey, port officials were interviewed about the information systems used in their ports. The principle problems of these ports were seized by literature survey in addition to the results of these surveys. Finally based on the collected information and

applications in other ports of the world, a direction of improvement for information systems in Turkish ports was suggested.

2. Literature Survey

2.1 Port Information Systems

Utilization of advanced technology is common in almost every application of a port. The term “port information system” is used for every kind of information technology –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 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 [3] intelligent use of information technology 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 et al. [4] emphasizes the importance of information technology for port terminal operations. The paper compares two container terminals, one with electronic devices, such as microwave technology, RF tagging and voice recognition, and one without such devices by developing a computer simulation model using the data 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 organizing the container terminal itself” [5]. The study of Choi et al. [6] suggests an enterprise resource planning (ERP) system for solving the problems of existing terminal operating systems. In this research, the functions of terminal operating systems 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; and
- 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 port management information systems. In the study of Park et al.[7], which compares such information systems according to port’s organization 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).

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” [8]. According to Rodon and Ramis-Pujol [9] it is “an electronic platform that connects the multiple systems operated by a variety of organizations 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 et al. [10] examines PCS in B2B context and emphasizes the importance of standardization 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.

2.2 Turkish Ports

Having 8333 km of coastline [11] Turkey has approximately 150 ports, wharves and marinas [12]. Among them 7 ports –i.e. Izmir, Mersin, Haydarpasa, Iskenderun, Samsun, Derince and Bandirma Ports– are operated by Turkish State Railways, which is abbreviated as TCDD. As TCDD is still the biggest port operator in Turkey, there are 24 ports operated by private sector [13].

The study of Yilmaz and Cerit [14] explores strategies to increase the potential of Turkish domestic cargo shipping, by interviewing the field experts using Delphi method. The results are categorized under four main conceptual categories; promotion, cooperation, ports, shipping service characteristics. The paper emphasizes the importance of the ports for improving domestic shipping, and points out the necessity of quantitative research on this subject.

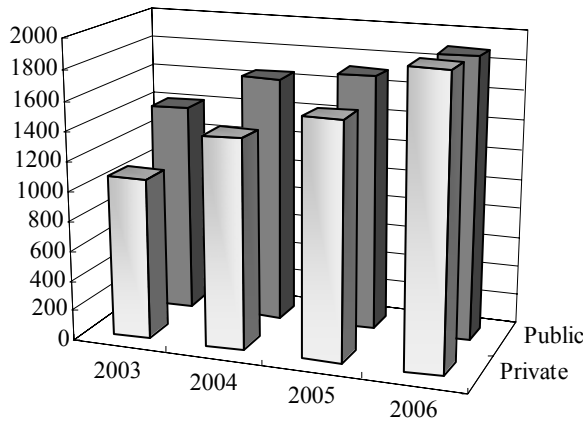


Figure 1. Container throughputs of Turkish ports (*1000 TEU) [15]

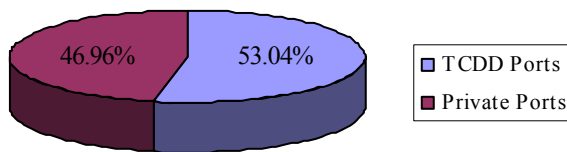


Figure 2. Average percentage of container throughputs of public and private ports between 2003 and 2006 [15]

The research of Tuna [16] 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 analyzed 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 conducted a review on logistics oriented developments in Turkish container ports [17]. 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 et al. [13] analyzed 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 [18] 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 neighboring, 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, was scarce. The study of Yucel [11] mentions the importance of information systems to increase the productivity of Turkish ports, and the study of Cubukcu [12] tried to design a management system for Izmir Port using Ms Access. Study of Keceli et al. [19][20] studied information systems of Kumport and TCCD ports as case studies, but there is still need for a study to investigate the information systems of Turkish ports

comprehensively, including both public and private ports.

3. Information Systems in Turkish Ports

More than 60% of Turkey's export takes place by maritime transport [11], which makes the seaports very important for Turkish economy. Major general-purpose ports in Turkey are operated by TCDD. On the other hand the number of private ports and their container throughput has been increasing rapidly. Obviously, private ports are in a better situation than the public ports in terms of information systems, since the managements of private ports are able to move autonomously without tackling bureaucracy and develop their own strategies for port operations. Among them, Kumport is acknowledged as the most high-tech container terminal [21] and thus awarded by a "Golden Anchor" for being the most efficient port in Turkey [22][23]. The basic characteristics of information systems in Kumport and TCDD ports, i.e. Mersin and Izmir Ports, are studied in this paper. Since other private ports deployed package programs, they are mentioned briefly, but detailed specifications are not included.

3.1 Background of Information System Development

TCDD ports started to build container terminals in 1985. Among these, Mersin, Haydarpaşa and Izmir Ports were the ones with busiest container traffic. Increased traffic in these ports caused congestion due to Turkish custom regime that is not flexible enough to develop regulations to ease such transport and the lack of sufficient control of the port operations with computerized systems. For this reason, Ports Branch and Data Processing Branch of TCDD conducted several projects since 1990 but these projects did not yield the expected results. First, a project called DELIMTEL was prepared in order to supply computer support to container terminals of Mersin, Haydarpaşa and Izmir Ports in August of 1990. But the project was canceled in order to participate MEDITEL project conducted by European Union in order to develop a computer application program to ease the services the ports that face Mediterranean Sea. TCDD declared to be involved in this project in 1991 and Haydarpaşa Port was offered as the pilot port. But the software package called ESCALE, which was developed by Port of Marseille Authority, could not fit the characteristics of the ports, thus the technical committee gave up the project in August of 1995. Meanwhile, another project was being developed in 1995 and 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. Finally a technical committee was formed within TCDD for another attempt in the beginning of 2000's, but this project was also canceled in the beginning of 2005 due to privatization of port services.

In the case of private ports, all of them deployed package terminal operating systems, whereas Kumport preferred to develop its own operating system. System development process in Kumport dates back to 1999, where improvements in information systems always followed the developments in the port industry and container throughput. Development of new yard management system started in 2002 and the system was implemented in the middle of 2003. Kumport had its own system coded by a domestic company called Solon. Starting from 2006, Kumport is undergoing a system renewal project, which is supposed to continue for 2 years.

Unlike Kumport, the other ports in Turkey preferred to deploy package programs, such as Navis, Cosmos, etc. Unfortunately all of these programs are developed by foreign companies and are not compatible with the administrative requirements of Turkish government. For example package programs like Navis regulate the movement and allocation of containers, thus container is treated as the unit item and defined by its number and other properties (i.e. 20 ft, 40ft, reefer, dangerous cargo etc.). On the other hand, Turkish Customs Law requires that the port management must keep track of the list of the commodities in a container and their properties. Thus the ports needed some workaround programs to fill such deficits, after all increasing the cost and decreasing the overall efficiency of the system.

3.2 Current Situation

In 1999, 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". A web-based program called WinPort, programmed using Visual Basic programming language is being used to control port operations. The program includes functional parts for operation tracking, billing, reporting, container and operations lists, and gate operations. The program performs basic database functions to organize 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.

During our studies, the problems of information systems of the public ports were summarized 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-organized physically, which makes it impossible to be controlled by a computerized system.
- As a result of lack of yard management, allocation of containers within the yard can consume a lot of time.
- There isn't a portal site for the ports that inform the users about up-to-date information about the ports.

In the case of private ports, although Kumport is the best case in Turkey, the system still depends on human intervention in its most basic functions [20]. Although shipping companies can input their requests and cargo information directly through a dedicated line, most of the firms prefer to send their information via e-mail or fax. These requests are manually inputted to the system, and based on these data yard planning is also done by the staff semi-automatically where the system assists the staff to determine the positions of the containers in the yard. If the containers are to be exported, the bayplans are also obtained from the ship captain and entered the system manually. Since the whole yard area is covered by wireless network, all equipment operators and staff can access the system to receive job instructions and to report the completion of the job through touchpad screens or hand-held terminals. At the gate, gate clerk enters the vehicle number into the computer using and if the information about the truck and the cargo appears in the screen, the driver is given as printed on paper. The system also provides several management functions, such as container tracking in the yard, monitoring the current situation of all the tasks in the terminal area, completion rates of loading and unloading tasks, automatic service assessment and billing, and reporting. Every realized service throughout the day is

reported to the customers next morning until 10 am via e-mail. The firms are allowed –in fact recommended– to deploy this program in order to track the current situation of their containers on a real-time basis, but only a few of them actually do so.

3.3 General Problems

Turkish public ports suffer from severe administrative and structural problems. These problems are given in Table 1.

Table 1. General Problems of TCDD Ports

Administrative Problems	Structural Problems
<ul style="list-style-type: none"> • Severe bureaucratic and regulative inefficiency. • Slow speed of port and custom services • Expansive port services. • Lack of long-term planning • Inefficient information flow • Insufficient human resources and trained operational personnel (crane operators, etc.) • Tasks carried out by paper-based manual methods. • Insufficient advertising and marketing • Port revenues used for other public services. • Given damage which is not compensated by insurance. • Improper maintenance and repair of the equipment. 	<ul style="list-style-type: none"> • Insufficient land • Out-of-date handling equipment • Insufficient berth lengths and depths • Insufficient facilities for dangerous cargo • Insufficient facilities to prevent pollution • Traffic and physical distribution which is frequently congested. • Combined transport which cannot be realized • Gantry cranes that broke down frequently due to overload.

Although information system usage in private ports is higher than public ports, they are still exposed to several problems. For example none of the private ports in Turkey have railroad connection [11]. And the port managers are not allowed to access the EDI system of the customs, thus confirmation of customs declarations and actual cargo status must be done manually.

The ports that deployed package programs were faced with the problem that the modules and functions

of their system couldn't fulfill the requirements of governmental offices, such as customs. So they had to supplement their systems with workaround programs, which decrease efficiency and increase cost. In the case of Kumport, the information systems are developed in-house and totally compatible with the legal requirements of Turkish government agencies. But some basic functions such as yard planning, bay planning and inputting customer requests to the system are not automated and still depends on human intervention. In the near future Kumport is planning to make up for these weak points.

Since ports like Arkas operate for the cargo of its own shipping company, they don't have any problem on customer relations or information exchange. But for port's like Kumport experienced severe difficulty to make its customers understand the system and cooperate efficiently. Only big and international agencies accepted to use the system, but small and local agencies refused to use and continued to send their requests via e-mail or fax [20]. Not only the customers but also the workers of the port resisted the system at the beginning, even cutting the wires and vandalizing the equipment. The port management had to deal with these internal and external resistances with enforcement, incentives and education.

Since port management information systems are not studied as a special subject, hiring specialists who are educated and experienced on the subject is a big issue. It is stated as critical success factor for information system development in Kumport [20]. For other ports, insufficient know-how to develop in-house and lack of trust to "table and chair" local IT firms in Turkey led them to deploy package programs. This case incompatibility of foreign package programs arose as another issue, and it was tried to solve by workaround programs. Absence of experienced developers and academic research to lead the port managers and establish cooperation between the members of the whole port community still remains an issue to be solved.

4. Discussion and Direction of Improvement

4.1 Information Systems

In the study of Keceli et al. [19], it was shown that information systems can be a solution for most of the administrative and structural problems of Turkish public ports. Mainly contribution of information systems to administrative problems includes decreasing costs, enhancement of business processes, enable real-time information exchange, provide

paperless work environment, making the tasks more human independent, and increasing the ports' competitive force. Besides information systems can decrease the effects of structural insufficiencies by enabling more efficient utilization of existing resources, optimizing work instruction and online control of equipment maintenance and repair to avoid overloads and malfunction, optimizing yard allocation, regulating traffic within the yard, enabling on-line cargo tracking and information exchange between different transport modes. On the basis of these contributions, the minimum level of information systems for Turkish ports should include:

1. Terminal Operating System (TOS) :
 - planning
 - yard allocation for containers
 - job dispatching for equipment and operators
 - work load optimization
 - equipment M&R
2. Port Management Information System (PMIS):
 - paperless work environment
 - real-time monitoring and control of operations
 - better marketing through increased competitiveness
3. Port Community System (PCS):
 - real-time information exchange
 - coordination between transport modes [19]

As referred in the previous chapters, the current systems used in Turkish public and private ports have some of these functions, such as job dispatching to cranes and stackers, semi-automatic yard allocation and real-time monitoring; they still suffer from automated planning, automated yard optimization, paperless work environment and real-time information exchange among the members of the port community, especially between different transport modes.

4.2 Regulative and administrative system

In the study of Lee-Partridge et al. [24], it is stated that the success of information systems in Port of Singapore depended on entrepreneurship of the government. Unfortunately Turkish government is pretty far from being such as "developmental state" and Turkish maritime industry is suffering from severe bureaucratic inefficiencies and multiple-governance [11][25]. The port management has legal responsibilities to Customs, Customs Enforcement, Ministry of Finance, Directorate of National Estates, Undersecretariat for Maritime Affairs, and Regional Directorate for Undersecretariat for Maritime Affairs

of that city. All these government organs require different conditions to be fulfilled and the multiplicity of regulatory organizations cause time delays and operational inefficiency. Thus there is a lot of literature about necessity of establishing a ministry maritime affairs and unification of all maritime regulation activities under the roof of this ministry [11][12]. Some of these regulatory bodies and the relations between the port management and them are peculiar to Turkey, so the information systems package programs that are provided by foreign companies –such as Navis, Cosmos, etc.– do not contain modules or functions for such local conditions and legal requirements that exist only in Turkey, as explained above. Thus standardization of information systems for Turkish ports and improvement of administrative system to decrease the level of bureaucracy plays a crucial role for the success of the future information system development projects.

As an example to such bureaucratic problems, the port managements are not allowed to access EDI system of the Customs Office. The agencies submit their customs declarations to the port management and the Customs Office separately, thus duplication of data may cause inconsistencies and increase the rate of error. Among these ports, the management of Kumport is planning to overcome this problem by cooperating with the agencies in order to retrieve custom declaration information from the agencies on an online basis. Such solutions can comfort the port managers to decrease error rates, but for the long term process innovation is necessary.

4.3 Resistance to the system

When a new system is introduced, it may not be accepted by its users easily even it yields certain benefits. These users may be interior and exterior to the port, but resistance to change is same.

As internal users of the system, laborers and employees of the port can refuse to use the system for a couple of reasons. During our survey in Kumport, we found out that the resistance of the employees can reach such a level that they can even attempt to cut the wires and vandalize the equipment. The reasons for the resistance of the employees cover low education level and not being computer oriented, fear for losing their jobs, being unable to predict the benefits of the system to their tasks and prevention of some illegitimate activities of the employees, such as bribing the truck drivers, by the deployment of the new system. On the other hand the response of the customers, which are the external users of the system, may be diverse. The big and international agents may appreciate the system, since they are experienced and realize the benefits of

the system to their businesses. But in the case of small and local agents, besides lack of experience and understanding of the convenience brought by the system and resistance to change the way of business they are used to, they may also consider it as an extra workload that is passed from the port to themselves.

In order to solve the resistance to the system, education and training is the basic solution. As applied in Kumport, training programs and enforcement of the port management managed to break the resistance of the workers, and now the employees are so used to the system that they cannot work without it [20]. On the other hand in the case of customers, Kumport couldn't break the resistance even with enforcement and incentives, since the customers still insist to send their requests via fax or e-mail. For the near future, Kumport is planning to overcome this problem by a web based solution, which is used by Izmir and Mersin ports. Also, the port managers are planning the force the customers to some extent by adding the usage of information systems to their terms of contract with the shipping agencies. Time will show whether this will have a positive effect on customer reaction.

4.4 Research Centers and Academia

An information system for a Turkish port would either be developed within the port itself or it would be outsourced from somewhere else, but it seems that other Turkish ports couldn't succeed both of them. When they tried to deploy a package program, which is developed by a foreign company, it didn't match the legal requirements, because most of these are unique to Turkey. In order to fill the gaps between the system and the requirements, other supplementary programs were developed, increasing the cost and decreasing the efficiency. On the other hand, none of these ports had sufficient human resources to develop the system by themselves. Another option was to outsource the system from a domestic IT company. But the port management couldn't trust "table and chair" IT firms, whether they could provide enough service, since the operations in the port may cease because of a possible failure in the system. Moreover, there is not enough academic research on this subject to guide the industrial organizations.

It is a fact that none of the Turkish ports managed to succeed with the system at the first trial; rather the current systems were developed by the end of a series of failures. Since none of the related parties, i.e. government, port management, shipping and logistics industrial organizations, IT firms and academic units, do not have adequate expert knowledge and experience on this subject, development and standardization of information systems for Turkish ports must be put into

practice as a collective effort of the whole port community.

5. Conclusion and Future Research

In this paper, results of our survey studies in Mersin, Kumport and Izmir ports were presented in order to seize the current situation of utilization of information systems in Turkey's major container ports and several directions of improvements were suggested. According to the results, utilization of information systems is rapidly gaining ground in Turkish ports but the levels of the systems are still below the international standards. Moreover, the essence of the problems in front of the information systems in Turkish ports appears to be administrative, rather than technical or economical. For this reason improvement and simplification of regulative system of the state, standardization of information system specifications for Turkish ports and establishing the understanding of the members of the port community is essential for the future development of information systems for Turkish ports.

Among these ports, Kumport clearly represents a best example of successful deployment of information systems, where it is self-developed and totally in accordance with the legal requirements of Turkish government. On the other hand, Kumport's system still depends on human intervention in some basic functions, such as planning and inputting customer requests. The other private ports preferred to deploy package programs, but faced some problems since those programs are not compatible with local legal requirements. The program used in public ports, i.e. Izmir and Mersin ports have the function of accepting customer request via web, but the system does not run on real-time environment, the tasks are recorded on paper and than inputted to the computer afterwards.

Information system development for Turkish ports is a rich in content field for future research. For example the current situation of all public and private ports should be reviewed and classified, and the factors that caused previous failures should be detected. Thus the similarities between them can be discovered and a base for information systems "standards" can be established. On the other hand government's policy and the legal requirements imposed on the ports should be reviewed and an improvement plan should be proposed. Finally, a survey research targeting other port community members can be conducted in order to seize their doubts, perceptions and expectations about the information systems, thus these results can be reflected to system design.

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