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THE NECESSITY OF PORT COMMUNITY SYSTEM IMPLEMENTATION IN THE CROATIAN SEAPORTS

ABSTRACT

The paper researches the necessity and requirements for Port Community System (PCS) implementation in Croatian seaport clusters. The authors define the Port Community and analyze the basic features of seaport clusters and Port Community Members (PCM). The most important documents in seaport operations are identified and analyzed. The role of Port Authority as the most important factor of PCS implementation in the Croatian seaports is defined. The Seaport Information and Communication Technology (ICT) systems are defined and analyzed, and phases of ICT integration in Port Community are determined, along with the current status of the Croatian seaports regarding ICT integration. The potential benefits of PCS implementation in the Croatian seaports are stressed. Finally, a definite need for PCS implementation is determined, in order to achieve and maintain the Croatian seaport competitiveness in global maritime transport industry.

KEY WORDS

Port ICT Systems, Port Community Systems, Port Community Members, Croatian Seaport traffic

1. INTRODUCTION

Seaports are hubs in the international trade as well as in the supply chain, the links between land and sea transport. Seaports are faced with continuous changes and challenges in the international trade. Information technologies play a vital role in seaport competitiveness, since information is one of the key resources of any seaport. Seaports are faced with strong competition and times of economic stagnation or recession. By investing in information and communication technologies, seaports will be capable of surviving and prospering on a very demanding transport market.

A large number of companies (or Port Community Members – PCM) conduct their business in the Croatian seaports, and in order to maintain the coordination of work plans in the seaport, so-called "coordination meetings" are held on a daily basis. The paper documents which are exchanged between the PCM and the necessity of physical presence during the "coordination meetings" slow down the business processes and produce higher costs. Modern transport and logistics environment therefore calls for investments in an integral IT solution implementation – a Port Community System (PCS), in order to maintain effective communication among the Port Community Members (PCM), as basis of seaport competitiveness.

The Croatian seaports should definitely recognize the importance of PCS implementation in their business. Coordination among the PCMs in Croatian seaports is still taking place via traditional methods of communication (paper documents, telephone...). To maintain competitiveness and to prevent stagnation, the Croatian seaports need to take the necessary steps towards PCS implementation.

The PCS implementation in the Croatian seaports is a large infrastructural investment. It should eventually result in substantial savings by reducing the time necessary for coordination and by reducing paper documentation, and it should definitely increase the competitiveness of the Croatian seaports.

From the above stated, it seemed prudent to research the global practices regarding seaport ICT systems and to validate the need for PCS implementation in the Croatian seaports.

2. PORT COMMUNITY AND PORT CLUSTER

A Port Community consists of Members, private and public entities, operating within the seaport area and providing port services. A 'port cluster' consists of all economic activities related to the arrival of ships and cargoes and located in the port region [1]. The area of the seaport cluster varies from port to port, depending on the seaport size and development, but generally includes a narrower or wider seaport surrounding area with the developed logistic - transport network.

During regular seaport operations, the entire Port Community should act in coordination and should agree on a work plan on hourly basis. The complexity of the Port Community and the vast number of exchanged data, messages and documents between the PCMs emphasizes the necessity of implementation of integral ICT systems in order to maintain competitiveness and to achieve higher service quality. A large number of stakeholders, depending on their activities and type of work, perform a role in functioning of the Port Community [2]. The stakeholders communicate with each other by different means (paper documents, fax, telephone, e-mail, radio communications...). Data are often copied several times, from document to document, or sent/received from multiple PCMs, leading to errors and slowing down the seaport processes. The PCMs and the complexity of communication are shown in *Figure 1*. Members can be divided in four groups:

- Coordinators and regulators: this group consists of two subgroups. The first subgroup consists of Port Authority, Harbor Master and Port Control Center, responsible for planning, coordinating and controlling the seaport activities. The second subgroup consists of Members who conduct the activities in order to maintain a high level of security within the seaport: Customs, Maritime Police and various Inspection services.
- Concessionaires: includes Port transshipment companies, Pilots, towing companies (tugs), service companies, maritime agents and freight forwarders (logistics-forwarding operators).
- Carriers: rail and road transport operators.
- Other Members: PCMs who do not directly participate in the seaport operations, such as banks and insurance companies.

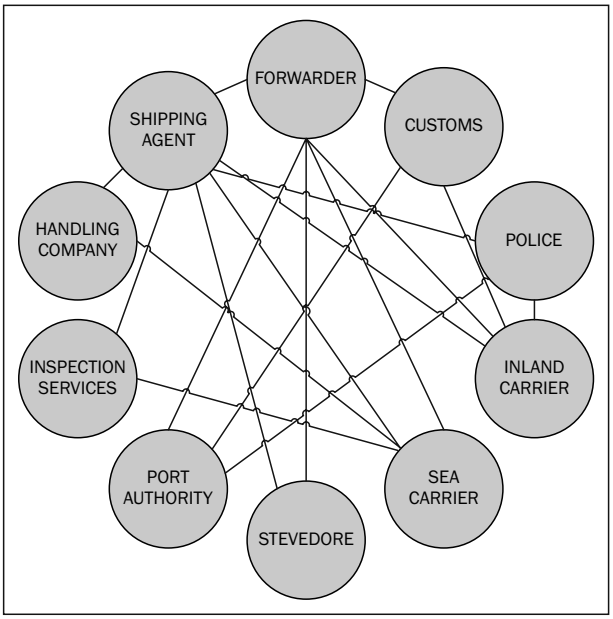

Figure 1 - Traditional communication between PCMs

Each PCM provides a set of activities and thus participates in seaport operations. The Port Authority holds the most important role as an initiator and creator of the port development strategy, and coordinator of the entire Port Community. The Port Authority is a land manager with responsibility for safe, sustainable and competitive development of the port [3]. The Port Authority carries out the strategic developmental changes, and the implementation of complex integral ICT systems is indeed a strategic endeavor. Among other activities the main activities of the Port Authority are [4]:

- Development and management of port infrastructure;
- Assignment of concessions for port operations and additional services to commercial companies;
- Traffic control (in collaboration with the Harbor Master office);
- Safety control and management;
- Dangerous cargo management, and
- Coordination of port operations.

From the above mentioned it is obvious that the implementation of complex ICT systems, which would greatly facilitate seaport operations, lies within the Port Authority's scope of jurisdiction and therefore should be initiated by the Port Authority.

The seaport operators perform cargo planning and handling activities. To ensure that the seaport business processes are conducted according to regulations, Maritime Police, Customs and Inspectorates supervise the transport of goods and ensure the safety within the seaport. Customs is also responsible for collecting certain government fees. Concessionaires (port transport companies, stevedores, maritime agents, freight forwarders, municipal workers, etc.), on the basis of concession contracts, perform various activities in the seaport area: towing, stowage, cargo handling etc. Maritime agents and freight forwarders play a special role as coordinators in carrying out the processes of vessel arrival/departure, and import or export of goods through the seaport. The carriers are very important PCMs because they enable the flow of goods to and from the port by road, rail or sea. Other PCMs do not directly participate in the seaport operations; for example, banks and insurance companies.

Considering the large number of PCMs and the totality of activities and jobs that they perform, the disadvantages of "traditional" (paper-based) methods of seaport operations become clearer. The implementation of modern integral ICT systems is therefore one of the key factors for seaport inclusion in modern logistic flows, with the end result of achieving and maintaining competitiveness in the world maritime trade.

3. INFORMATION FLOWS IN THE CROATIAN SEAPORTS

In the Croatian seaports, a large number of data, documents and messages circulate, which are exchanged on a daily basis between PCMs. The exchange of documents is mainly conducted in paper form, which implies higher costs, the possibility of errors (largely due to multiple entries of the same data), etc. The slowness of the entire process alone should be a significant motivator for the implementation of modern ICT systems. The most important documents in Croatian seaport operations are:

- Port Operations and Services Order (POSO): the basic document for order of seaport services. Provides the description of services required, as well as instructions for the operations and inspections in the port service. According to the services required, there are various Port Operations and Service Orders: vessel discharge/loading POSO, Gate-in POSO, Gate-out POSO, Container filling/emptying POSO, etc.
- Minutes of Coordination Meeting: Seaport Coordination document that states all activities which are planned daily, according to the requested services and announced arrivals of vessels.
- Notice of Arrival: provides details of the vessel's arrival and the characteristics of a vessel.
- Declaration of Dangerous/Polluting Goods: statement about the presence of hazardous cargo on board, and vessel's regulatory compliance in carrying dangerous cargo.
- Dangerous Goods Report: report to the Port Authority of loaded/discharged goods, classified according to International Maritime Dangerous Goods (IMDG) Code.
- Permission for vessel to have communication with shore: vessel's inward clearance, in order to issue a permit for the vessel to access the inner seaport area
- Permit of vessel's departure: vessel's outward clearance in order to issue a permit for the vessel to leave the port.
- Berthing report: report of berthed vessels and the activities provided for berthing.
- Cargo Manifest: description of a cargo to be loaded or unloaded to/from the vessel.
- Railway cargo announcement: daily announcement of rail cargo and rail cars accessing the seaport.
- Bill of Lading: confirms that the carrier received the cargo for transport on the vessel and agrees that after the trip is charged to submit cargo to the authorized holder of a Bill of Lading. The amount of goods specified in the Bill of Lading must be equal to the amount in the Cargo manifest.

Each of these documents is exchanged in multiple copies for multiple import or export transactions, and between large numbers of PCMs. For example, in the preparation of vessel's departure from the seaport, when cargo is loaded onboard, the quantity and quality of cargo must be confirmed with the Cargo Manifest. The agent issues the Cargo Manifest to seaport operators, Customs and Police. After the verification of cargo on board and confirmation of Cargo Manifest from the operators, Customs and Police, the Cargo Manifest is delivered to the Captain of the vessel. This process can be automated by creating the Electronic Cargo Manifest, which will enable faster and more reliable information flows. Discrepancies in the exchange of information in the entire Port Community are forcing vessels to needlessly stay anchored in front of the seaport. The usage of ICT in seaport services will minimize the negative effects and accelerate the cargo flow inside the port [5].

Another method of minimizing bottlenecks in the transport process in seaports is eliminating waste processes and even some of the traditional stakeholders, to secure efficient organization of agile services in the ports. All of the stakeholders must be efficient in information flow and aligned with each other's needs. Efficient IT tools should be worked out for information exchange, in order to speed up the cargo movement of the entire logistics chain and make the information exchange between logistics subjects more efficient [6]. According to [7], the Croatian maritime economy has stayed underdeveloped due to several reasons, which include: inadequate technical and technological equipment (interoperability aspect) and non-harmonized development of single segments of the maritime system.

The Croatian seaports have not yet reached a sufficient level of informatization in document and data exchange, although some seaports have already started the informatization process of their Port Communities. The majority of documents are exchanged by fax, voice or regular mail, and some are exchanged via e-mail. In modern business conditions, such mode of communication within the Port Community is becoming a limiting factor for the development of the Croatian ports. Paper documentation implies significantly higher costs and increased possibility of errors; therefore one of the main objectives of integral ICT system implementation in the Croatian seaports should be the reduction of paper administration costs.

Integral ICTs system implementation in the Croatian seaports would mean simplifying the processes, faster exchange of data and replacing the physical presence of actors in Port Community coordination meetings, which are currently held twice daily.

4. SEAPORT ICT SYSTEMS

ICTs are the key enabler of internal and external integration. According to Sweeny and Evangelista, different types of ICT enable internal (Port Community) and external level of integration as well as integration of processes inside and outside the seaport area [8]. Hsu and Lalwani consider ICT implementation as a facilitator of international transport with the emphasis on seaports as central places in transport chains. By providing a survey on challenges of ICT implementation, the use of e-services and public-private participation in building a web portal for transport industry, they conclude that ICT integration is an important task for the transport industry [9]. The United Nations in "Study of good practices in information and communications technology (ICT) applications in seaports in Economic and Social Commission for Western Asia member countries" researched the importance and benefits of ICT application in seaports and gave an overview of ICT applications in the selected seaports worldwide. They regard the ICT as a vital instrument in achieving substantial improvements in internal and external business procedures, mainly through the implementation of port and terminal operating systems and electronic data interchange (EDI) [10].

A PCS can be defined as an entity delivering information to supply chains operating in the port [11]. According to Smit, the PCS is responsible for data supply, data control, data distribution, and data conservation [12]. Another definition by Rodon and Ramis Pujol emphasizes the role of PCS in the integration of PCM that have different information systems: PCS is an electronic platform that connects multiple systems operated by a variety of organizations that make up a seaport community [13]. Srour et al. define PCS as holistic, geographically bound information hubs in global supply chains that primarily serve the interest of a heterogeneous collective of port related companies [14]. According to De la Guia and Llop, the aim of PCS implementation is to gather the PCM around a ''virtual table'' and to maintain a ''virtual coordination'' through accurate information of cargo handling and shipping operations [15].

Rodon and Ramis-Pujol studied a Spanish PCS (ePortSys) in order to provide a framework for development of Business-to-Business (B2B) concept in seaports [13]. Long emphasized a decisive role of PCS development and implementation in efficient movement of cargo across international borders and gave an example of PCS implementation in Port of Felixstowe (Great Britain) describing the evolution within 25 years [16]. CrimsonLogic Pte Ltd. in their "Study of System requirements specification for Port Community System" elaborated the necessary system interfaces in import and export transactions between PCM, based on a survey conducted in twelve Indian seaports [17]. Smit analyzed the two generations of PCSs. The first generation is related to transfer of transport messages based on a post-box principle, while the second generation is systems which are based on central (smart) databases. The core issue of her research is comparison of three PCSs: Seagha (Port of Antwerp, Belgium), DAKOSY (Port of Hamburg, Germany) and Port Infolink (Port of Rotterdam, Netherlands). The author also identified three levels of PCSs: contextual level, conceptual level and logical level [12].

Keceli et al. conducted a research in Port of Busan (South Korea), regarding the impact factors in PCS implementation, and found out that the most important role in PCS implementation lies within the top management. Non-technical readiness (know-how transfer, human resources cultivation, training, etc.) is more significant than technical readiness (IT sophistication - hardware and software capabilities) for PCS implementation. Alongside the supportive top management, the entire Port Community must be ready to accept the changes in seaport business processes and procedures [18].

Connecting the Port Community in a unique information community by integral ICT system implementation is a necessary step in the future operations of the Croatian ports. Although the integral ICT system implementation is an investment that requires significant funds, it is crucial for the future of the Croatian seaports.

ICT in seaport operations has evolved over time. It is possible to identify four phases in the informatization process of the Port Community [15]:

- Isolated Port: PCMs are isolated, only internal processes are conducted via ICT systems
- Communicated Port: The Port Community informatization goes beyond the scope of internal cohesion, and also opens up to the wider community and users of port services by an EDI system which is used to exchange documents and information. Port Community is now connected by a common ICT system.
- Port Community: Port Community informatization continues by creating special communities, together with land and sea carriers. New technologies are introduced, such as RFID technology (Radio Frequency Identification). Port Community is interlinked through web applications.
- A Port Community worldwide communicated: the highest level of integration and informatization of a Port Community, which consists of a complete re-

placement of paper-based processes by e-processes, modernization of logistics management, full integration with external entities and informatized cooperation among ports. Technologies which are used are Microsoft Net Solutions, Service Oriented Architecture, RFID and OCR (Optical Character Recognition) Solutions, based on Extensible Markup Language (XML).

Figure 2 shows the four phases of ICT development and integration in the Port Community, and the current stage of ICT development and integration of the Croatian seaports.

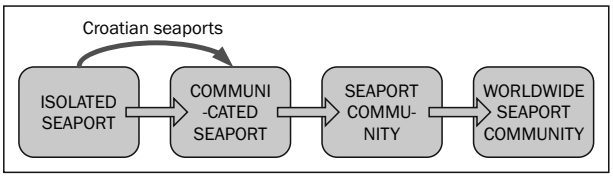

Figure 2 - Phases of ICT development and integration in the Port Community

Source: adapted from De la Guia and Llop, Valencia PCS Development Strategy & Practice, Autoridad Portuaria de Valencia, Gijon, p. 6

The Croatian seaports are currently between the first and second phase of ICT development and integration in the Port Community. The reason for this lies partly in reduced investments in the Croatian seaports during the 1980s, when the neighbouring seaports invested significant resources in the ICT development. Furthermore, the Croatian seaports were significantly hindered by the war during the 1990s which diverted the flow of cargo from the Croatian seaports. After the end of the war, investments were directed in order to return the lost cargo volumes to the Croatian seaports, and through the help of the World Bank loans, the Croatian seaports began investing in the port infrastructure.

The Croatian seaports need to realize the importance of PCS implementation in order to achieve and maintain competitiveness. Through PCS implementation, the Croatian seaports will achieve better connectivity within the Port Communities and will become "communicated ports". During further development of PCS in the Croatian seaports, a step forward in the coordination process will be possible by creating a national Croatian Port Community.

Implementing of the PCS in the Croatian seaports is a complex and demanding process, and therefore requires an active participation of all PCMs during all phases of PCS implementation. The whole process of PCS implementation in the Croatian seaports must be based on appropriate standards to ensure efficiency, simple data and document exchange, and information security.

Information and documents/messages that circulate among the PCMs must be based on the standard message formats, which can be achieved by choosing proper programming languages and standards for data exchange. Managing the central database (a repository of all messages) is a challenge in PCS implementation, due to complexity of organizational and informational systems of various PCMs. In order to ensure the functionality and efficiency of the PCS database, it is recommended to integrate the DC – Data Classification and ILM - Information Lifecycle Management standards. The DC paradigm is a process that defines the access, recovery and discovery characteristics of an enterprise's (in this case, PCS's) different sets of data, grouping them into logical categories to facilitate business objectives. The ILM presents a sustainable storage strategy suited to balance the costs of information storage and governance with its business value that changes as the process is being developed and implemented [19]. These two standards are coherent and interconnected, and provide the possibility for effective and efficient data management.

Security standards are another important segment of the PCS; they ensure proper and unobstructed PCS functionality. The information within the database must be secured from any unauthorized and/or inappropriate use by entities involved in the system, or any external entities.

Finally, to facilitate the PCS operation, it is necessary to educate PCMs during the setup and the implementation of the system. In addition to education, PCMs must be willing to implement new procedures and standards in their business and operations.

5. DOCUMENT ANALYSIS AND SIMULATION OF ICT ENABLED ADMINISTRATIVE PROCESSES IN THE CROATIAN SEAPORTS

The administrative processes related to the arrival and departure of vessels to and from the port (and also the shifting of vessels within the port) contain numerous documents and certificates. During research, the data in the forms which are related to the vessel arrival have been analyzed, in order to identify repetitive entries. The analysis has shown that a large number of ship-related data is repeated several times, increasing the possibility of errors and causing unnecessary waste of time due to multiple manual data entry. Substantial time savings and increased data accuracy (reduced errors) could be achieved by using ICT, for the purpose of single data entry, and multiple data usage by all interested stakeholders included in the administrative and commercial business processes in seaports. Consequentially, by saving time necessary for the completion of business processes, substantial financial savings could be achieved by all stakeholders operating within the seaport cluster.

In order to prove the above hypothesis, simulation experiments were performed with the purpose of calculating the potential time savings, and consequentially, financial savings. Three business processes were simulated: the existing administrative process of the arrival of vessel to the port, the ICT-enabled process of the arrival of vessel to the port, and the reengineered process of the arrival of vessel to the port. In the end, the potential yearly financial savings were calculated.

The modelling and simulation method has been used because it enables the quantitative analysis of the business processes, which take part in real time and consume business system resources. The most important system characteristics have been singled out, and system elements and element interaction have been described. Based on that, the three simulation models were constructed. Those three models are by all means not definitive, because seaport business processes (especially administrative processes) are prone to change due to legislative or technical/technological changes. In other words, the models should continuously be updated and revised, and new simulation experiments should be performed [20].

In simulation experiments, the Flexsim software for modelling and simulation has been used, which is a program tool used for modelling, simulation and business process visualization. Prior to creating the simulation model, several basic premises have been set regarding the administrative process of vessel arrival to the port. Schematic drawings of document population (data input), document delivering and document checking have been constructed, for all three business processes (existing process, ICT-enabled process and reengineered process of vessel arrival to the port). By field research (interviews with the involved stakeholders), data have been gathered and inserted into the simulation models. In other words, each element in each simulation model has been programmed with the respective times necessary for the completion of the respective sub process (process times), obtained from the interviews.

In the ICT-enabled administrative process, apart from the time savings obtained due to elimination of the time necessary for the physical delivering of paper documents (documents circulate through the ICT system), further savings could be achieved by eliminating multiple data entries (the ICT system should be capable of reusing the previously entered data which are repeated in other documents or forms). In the reengineered process, the time wasted for delivering the documents and waiting for document approval has been eliminated, contributing to great overall savings in time. In the ICT-enabled and reengineered simulation models the sub-processes of delivering documents and certificates have been removed, because the documents are being delivered electronically, via ICT system (the documents and certificates are no longer in paper format, and are delivered by the ICT system).

Based on the above mentioned simulation models, 100 simulation experiments were performed using each model (300 in total), and results have been gathered, representing total time (in minutes) which is necessary for performing all administrative procedures related to the vessel arrival into the port (preparing, delivering and checking the documents and ship certificates), as shown in *Figure 3*. The first column shows the time for the existing process of vessel arrival to the port, the second column shows the ICT-enabled process of vessel arrival to the port, and the third column shows the reengineered process of vessel arrival to the port.

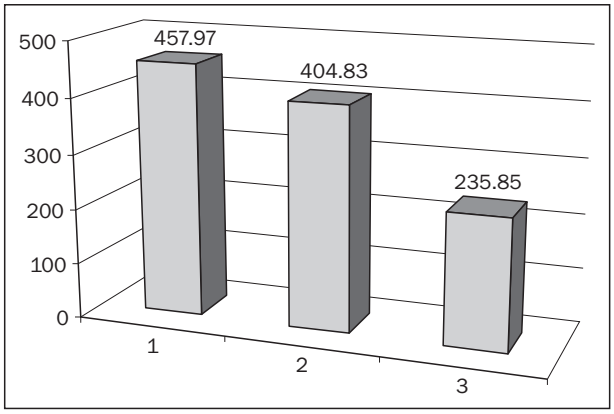

Figure 3 - Comparison of times necessary for the completion of administrative processes related to the vessel arrival to the port

From the performed simulation experiments it is evident that substantial time savings could be achieved by ICT-enablement of the existing administrative processes (document creation, delivering, checking and approval by the authorities). Even larger time savings can be achieved by reengineering the business processes.

By comparing the results (the average values of total times for each set of simulation experiments) it can be concluded that the time necessary for document creation, delivering, checking and approval by the authorities could be reduced by 11.61% just by automizing the data entry and document delivering (53.15 man-minutes or 0.89 man-hours per each process). However, if the business process is reengineered, the total time necessary could be reduced by 48.50% (222.14 man-minutes or 3.70 man-hours per each process). If the time saving are converted to financial savings by using the average hourly wage for the stakeholders involved, the savings could be 52.10 Croatian kuna or 217.76 Croatian kuna, respectively for each vessel. For example, in the port of Rijeka, based on the number of 500 vessels per year, the savings of up to 26,050 Croatian kuna could be achieved just by ICT

enablement of administrative processing of vessel arrival. If the administrative process of vessel arrival is reengineered, the savings could amount to 108,880 Croatian kuna (*Figure 4*).

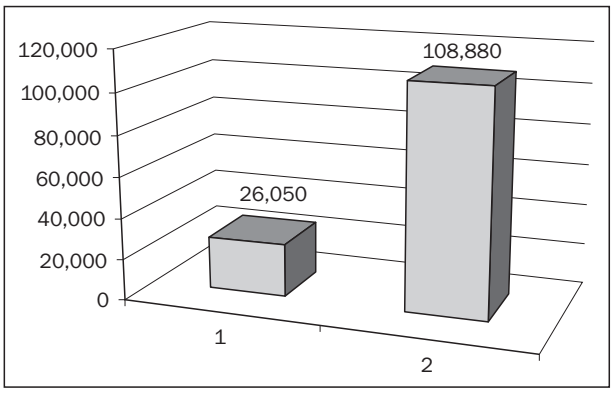

Figure 4 - The comparison of yearly savings (Croatian kuna) for the ICT-enabled administrative process of vessel arrival to the port and the reengineered process of vessel arrival to the port

Given the fact that the above-stated savings can be achieved within only one business process (the administrative process of vessel arrival to the port), and bearing in mind that the seaport business encompasses several dozen business processes (both administrative and commercial), it is evident that potential savings within larger Croatian seaport clusters (Rijeka, Ploče) could be much higher, measuring hundreds of thousands Croatian kuna by simply ICT enabling the existing business processes, and even millions of kuna by reengineering the existing business processes [20].

6. BENEFITS OF PCS IMPLEMENTATION IN THE CROATIAN SEAPORTS

By implementing the PCS, the Croatian seaports will obtain significant advantages and generate significant benefits for their business. By evolving and leaving behind the stage of internal communication among the PCM (characterized by paper documents and uncomputerized daily coordination of seaport activities), the PCS implementation in the Croatian seaports will result in greater efficiency in communication, as well as in better coordination of seaport operations.

Before considering the specific advantages and benefits of PCS implementation in the Croatian seaports, it is appropriate to consider the general positive effects that the application of electronic data (and document) interchange has on an enterprise. The application of electronic data (and document) interchange can produce the following advantages: faster and more efficient information exchange, reduced lead time, lower costs by reducing paperwork, reduced errors, better sharing and tracking of data and higher inventory turnovers [21].

From the above stated advantages it is evident that the usage of electronic data interchange allows detachment from slowness and inflexibility of traditional data exchange and increases savings by reducing paper documentation. When considering the labour price, time and cost of document processing, the application of e-documents could be a very significant source of savings and can lead to the accumulation of funds for investments. For instance, the savings obtained by the use of e-documents (compared to traditional, paper-based documents) can amount to 38.79%. The average cost of e-document is $4.52 (compared to $7.39 for a paper document) while time savings achieved by using the e-document are 39.64%. Electronic communication can result in savings of up to 39% in the document flow and will affect the profitability of the entire Port Community [22].

PCS implementation in the Croatian seaports could be a key factor in increasing productivity and quality of seaport services, which in turn will lead to greater competitiveness. “Ports are in a high stakes information game, where great communication improves port attractiveness. Great communication allows the port to provide effective and efficient service to their Customers and stakeholders” [23].

Advantages of PCS implementation in seaports, as a framework for better communication and coordination of PCMs can be summarized in the following [24]:

- Single Window System,
- Standardization of information exchanged,
- Convenient 24/7 submission,
- Centralization of IT operation for Port Community Members,
- On-line request for services,
- On-line payment for services,
- Flexibility in submission of information in multiple formats,
- Management Information System for reporting,
- Cost saving for all PCMs,
- Statistical Analysis of Data generated for improving the services, and
- Enhancement in the trade.

As stated before, the Port Authority is the responsible entity for PCS implementation in the Croatian seaports. The implementation of the PCS will provide benefits for the Port Authority in the following manner: easier coordination of PCMs, better control over the activities of PCMs, better control of port operations, setup of timely and accurate database for decision-making and development of strategic plans, etc. Forwarders and maritime agents who are dealing with numerous documents and are interacting with other PCMs in arranging import or export transactions, will gain significant advantages through PCS implementation, by the following [25]: faster and better work organization, reduction of transaction expenses (expenses of finding potential business partners, negotiation ex-

penses, contracting, agreement protection, expenses of contract induction, expenses that occur if the contract does not run as planned, expenses regarding conflicts and disputes during the contract realization, and finally, reduced service expenses). Advantages for forwarders and maritime agents will affect the entire operation process in the seaport.

The information about the movements of vessels, available to authorized parties involved in shipping operations would be of particular interest in PCS implementation. The data would cover the following processes: pre-arrival notice, notice of arrival, entry of vessel, vessel's removal, notice of departure, vessel's departure, announcement of the loading/unloading operations, announcement of land operations, resource allocation, loading/unloading operations, the execution of land operations, dangerous goods, etc. [26]. The importance of information regarding the movement of vessels results from the purpose of port operations in which the vessels' loading/unloading takes the central place, and therefore all seaport activities are planned accordingly.

The functionalities and advantages of PCS implementation in the Croatian seaports could yield the following benefits [26]:

- information about announcements and movements of vessels will constantly be available to PCMs,
- allocation of resources per shift: a group of workers, machinery, warehouse space, cars, etc.,
- continuous data update,
- development of operational plans within schedules, and
- rapid action during emergency situations.

Information regarding the allocation of resources per shift, according to announcements and movements of vessels is of high importance. The optimal combination of resources facilitates the progress of seaport operations, as well as the achievement of individual objectives of PCMs. Furthermore, it facilitates achieving the ultimate goal: providing a high-quality port service.

By connecting PCMs through PCS implementation, the Croatian ports can achieve multiple benefits, such as [27]:

- development of information systems, which enables timeliness, accuracy and availability of information in every situation, flexibility and connectivity within the system as well as effective exchange of information with potential Customers and provides better efficiency in decision-making process,
- computerization of the entire system of individual activities, functions or processes within the organization,
- harmonization and standardization of IT applications, and general acceptance of communicating via Web-based services within the seaport system,
- the introduction of organizational resource planning information system, and thus the formation of Corporate portals, and
- linking organizations interested in integration of business processes in supply chain, which will be based on extranet.

PCS implementation in the Croatian seaports implies significant changes in overall organization of seaport operations. Activities, functions and processes on the individual level, coordinated by paper documents and marked with the absence of ICT will be moving to a higher level of a common ICT system. Furthermore, the new coordination will include various organizations interested in the port business and will enable better communication in order to provide a higher quality port service.

Finally, the benefits of PCS implementation in the Croatian seaports can be summarized by optimizing the processes in providing seaport services [28]:

- Access to services: high usability through the interaction of Windows applications and web services. Access to services is possible just by a click as well as the statistical follow-up of service processes.
- Booking: flow of information and documents is under better control, which enables better visibility and reduces errors. Preparation of shipping instructions and response times are minimized. Overall transactions are provided in a more secure way.
- Shipping instructions: better integration with carriers increases the control of information and documents. Furthermore, it increases productivity by homogenized shipments to carriers and reduces costs by optimizing processes.
- Vessel operations: information regarding the movement of vessels is available 24/7 via an online portal. Administrative processes of vessels: arrival, loading/unloading and departure are accelerated. The contact with the Port Authorities, government authorities etc. is provided by a ''single point'' access.
- Cargo documents: monitoring information is available to all agents involved in import or export transactions. Communication with Port Authorities about dangerous cargo and cargo manifests is also provided by a ''single point'' access. Information regarding container status is available online, and Customs documentation is completely paperless.
- Cargo operations: online monitoring of container and cargo status, as well as ''single point of entry'' for all port terminals.
- Inland logistics: documentation is generated independently. Orders are automatically accepted and delivered. The system allows multiple containers per transport order and information monitoring. It is possible to use the system for road, rail and inland water transport information.

– Integrated track and trace: increases the process efficiency and information. An important feature is the possibility of integration with management systems. The notice of events could be sent and received by e-mail.

PCS implementation in the Croatian seaports will affect and benefit the entire process of providing seaport services, both at sea and on land. Various services will be available to the entire Port Community through simple applications. Monitoring of information will provide clear visibility of processes. PCS implementation in the Croatian seaports will minimize the necessary time for communication within the Port Community, and will support business decisions.

7. CONCLUSION

Seaports act in a competitive environment marked with strong involvement of ICT in the integration of Port Community, and the process of providing seaport services. ICT integration in seaports is a continuous process, which evolves over time. In the first stages, PCMs were isolated and used ICT only for internal processes. Further integration of ICT bonded PCMs into one common information system, based on EDI/XML for exchange of documents and information. The improvement of ICT in seaports continued with the implementation of new technologies such as RFID, OCR, etc. The highest level of ICT integration in seaport implies a completely paperless communication between PCMs, a variety of e-services, integration with external entities, as well as cooperation between different seaports, nationally or internationally. Acknowledging the importance of effective communication, the usage of ICT to connect PCMs by PCS implementation is definitely a necessary step towards achieving seaport competitiveness.

The Croatian seaports are currently in the phase of transition from isolated seaports to communicated seaports. PCMs in the Croatian seaports perform various activities, which are preliminarily agreed during daily “coordination meetings”, which shows the need of modernizing and optimizing the communication process. The overall coordination is still traditionally achieved by phone calls, faxes and sometimes e-mails, which have become a serious obstacle in terms of competitiveness. It should be noted that the Croatian seaports have omitted infrastructure investments during the 1980s, and have been handicapped by the war in the 1990s which diverted cargo from the Croatian seaports. After the recovery process, with the help of the World Bank loans, the Croatian seaports need to allocate the necessary funds for PCS investments.

Through PCS implementation, the Croatian seaports can obtain various advantages and benefits. The replacement of paper documents with electronic documents implies minimizing the document processing time, faster exchange of information, reduced errors (mainly due to single data entry), minimizing the cost of document transfer and increasing information accuracy. The process of providing seaport service is mainly determined by the movement of vessels, therefore the information related to vessels is of special importance for the Port Community. PCS will provide detailed information on vessel movements to the stakeholders involved in seaport operations. PCM will be ‘’virtually communicated and coordinated’’ through the PCS, gathered around the ‘’virtual table’’, which will eliminate physical presence and reduce the time and cost of coordination.

PCS implementation in the Croatian seaports will enable a new dimension of seaport service and Customer satisfaction, which in turn will lead to competitiveness as well as more active inclusion of the Croatian seaports in the demanding transport market.

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SAŽETAK

NUŽNOST IMPLEMENTACIJE INTEGRALNIH SUSTAVA ZA ELEKTRONIČKU RAZMJENU PODATAKA U HRVATSKIM MORSKIM LUKAMA

U radu se istražuje nužnost i razlozi za implementaciju integralnih sustava za elektroničku razmjenu podataka (Port Community System – PCS) u hrvatskim lučkim klasterima. Definiran je PCS i analizirana su osnovna obilježja lučkih klastera te dionici koji posluju u lučkim klasterima (Port Community Members - PCMs). Navedeni su i analizirani najvažniji dokumenti koji se pojavljuju u lučkom poslovanju. Determinirana je uloga lučkih uprava kao najvažnijih čimbenika u procesu implementacije PCS-a u hrvatskim morskim lukama. Definirani su i analizirani informacijsko-komunikacijski sustavi u morskim lukama te su opisane faze integriranja informacijsko-komunikacijskih tehnologija u lučkom klasteru, kao i sadašnje stanje u hrvatskim morskim lukama s obzirom na integraciju informacijsko-komunikacijskih sustava. Istaknute su potencijalne koristi koje će hrvatske morske luke ostvariti uvođenjem PCS-a. Konačno, naglašena je nedvojbena potreba za implementacijom PCS-a kako bi se postigla i održala konkurentnost hrvatskih morskih luka na svjetskom pomorskom tržištu.

KLJUČNE RIJEČI

lučki informacijsko-komunikacijski sustavi, Port Community System, dionici u lučkom klasteru, promet u hrvatskim morskim lukama

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