Port Community System feasibility analysis – Case study Split

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Abstract - **In order to increase the competitiveness of Croatian seaports, seaport cluster stakeholders should strive to digitalize and optimize their business processes. A significant part of such digitalization and optimization is constituted by the implementation of a Port Community System. In this paper, the authors will define the theoretical framework of Port Community Systems, and will determine the basic economic indicators and benefits of investing in the implementation of the Port Community System. Potential costs of project development and the costs of maintaining the system within the forecasted period of use will be determined. The potential savings from the digitalization of business processes related to cargo processing will be determined, based on the Port of Split case study. Digitalization of Croatian seaports will create the potential for increasing seaport competitiveness and traffic volumes. Since self-financing of such projects is extremely demanding for individual seaports, Port Community System implementation should be achieved by synergistic efforts of the national and regional authorities, seaports and other involved stakeholders, and by using available EU funding.**

Keywords – Port Community System; feasibility analysis; case study; Port of Split; digitalization

I. INTRODUCTION

Investments in seaports can be divided in two basic groups, traditional investment in port infrastructure, such as construction of warehouse and piers, etc., and investments in improvement of business processes that include heterogeneous maritime ICT systems like, VTMIS (Vessel Traffic Monitoring & Information Systems), ISPS (International Ship and Port Facility Security Code) enhancement systems, IoT (Internet of Things platforms), and WSN (Wireless Sensor Networks).

Seaports are essential for the support of economic activities in the surrounding areas [1]. Each port which aims to be competitive, should accept digitalization [2]. Digitalization and stakeholder connectivity (forwarders, maritime agents etc.) may enable numerous advantages such as: the business facilitation, the reducing of mistakes and impediments. Port community systems (PCS) can be defined as holistic, geographically bounded information hubs in global supply chains that primarily serve the interest of heterogeneous collective of port related companies [3]. In seaports, a communication system such as PCS holds an important role in reducing the operational costs. PCS helps the competent authority to take the lead by providing a logistics solution to private operators, encouraging them to share information that ultimately leads to lowered logistics costs, faster delivery/pickup in the import/export chain, and higher customer satisfaction. Bringing all users together enhances efficiency of the physical flow of freight, drives economic growth, and as a secondary effect, assists in reducing externalities such as pollution, congestion, and land use impacts [4].

Considering that each investment must pass through process of financial and economic evaluation, this paper discusses the economic aspects of PCS implementation in Croatian cargo ports. State Port Authorities in Croatia as non-profit organizations and organizations that manage concessions for all port basins have a major role as project coordinators and, partially, investors in development activities. There must be firm assurances that this kind of public investment presents a positive social benefit, so the government, and in this case the port authority, must find a suitable solution to decrease overall implementation costs. Enabled by the possibilities of newly developed technology, digital initiatives are increasingly more present in port business processes. This type of business innovation is now seen as a game changer. Analyzing the services provided by the ports and maritime sector, the same types of developments are also pursued in the named business sectors [5].

II. FINANCING THE DESIGN, IMPLEMENTATION AND MAINTENANCE OF THE PCS

Each PCS is specific, each country has individual legal regulations and therefore each port community develops its own PCS according to its needs [6]. Furthermore, seaports differ by the number and type of data being exchanged, the actors (businesses subjects) which are exchanging the data and messages, the owners of systems which are exchanging data and messages (for example, private systems or systems managed by government bodies), by way of maintenance and funding of these systems, the potential of evolution of existing systems, etc. [7]. In smaller countries that do not have strong and economically developed ports, large and demanding projects such as building and implementing ICT port systems, i.e. a PCS, requires synergy between a wide range of authorities governed by public law, economic subjects involved in work processes, and scientific community. The European Port Community System

Association defines PCS as a neutral and open electronic platform enabling intelligent and secure exchange of information between public and private stakeholders in order to improve the efficiency and competitive positions of the seaport communities [8].

In Croatian seaports, stakeholders mostly own and operate separate information and communication systems, except in the port of Ploče, where the PCS was implemented in 2012 [9]. At the moment, PCS is not implemented in the Port of Rijeka. Implementation was initially planned for 2008. Four valid offers were received and vendor was selected and started with initial analysis and implementations. Project was suspended in 2011, partly due to the development of the Croatian Integrated Maritime Information System (CIMIS) and change of focus.

The effectuation of PCS has been continued mid-2017 and in 2021, the Port of Rijeka PCS system should be fully developed. The project is being developed in partnership with the European Union through CEF – Instrument (Connecting Europe Facility – CEF), and part of that project is the Contract for technical support in design and implementation of PCS for the project *"Upgrade of the Rijeka Port Infrastructure – Port Community Information System"*. The project is financed in partnership with the Republic of Croatia and the European Union in the following ratio: 85% from the European funds and 15% from the budget of the Republic of Croatia via The Ministry of the Sea, Transport and Infrastructure, i.e. Port of Rijeka Authority. The expected value of the entire project is 1.7 million euro [10]. The agreed price of work and installation, i.e. the entire development costs of the Port of Rijeka PCS is 8.003.100 HRK [11].

The importance of this investment is reflected on the Port of Split because of the similarities between these two ports, so the design of the Port of Rijeka PCS system can be used and adapted to the Port of Split, as further explained below.

When in 2021 (after the end of the Port of Rijeka PCS development) the Croatian Ministry of the Sea, Transport and Infrastructure takes over and adapts the source code of the Port of Rijeka PCS system to the needs of the Port of Split, the authors expect that the adjustment costs should be around 12% of the implementation costs of the system in the Port of Rijeka, based on the adjustment experience of similar PCS solutions. Therefore, the actual adjustment costs of the PCS system for the Port of Split would be 960.372 HRK.

The project holder, in this case the Port of Split Authority, can obtain a product without initial operative problems because the system will go through the testing phase in the Port of Rijeka. The mentioned costs include the takeover of the project from the Port of Rijeka and its adjustment to the specific needs of the Port of Split, under the coordination from the Ministry of the Sea, Transport and Infrastructure.

The adjustment and development of the PCS system in the Port of Split will require technical support in order to develop the system as rapidly as possible. From the authors´ experience, those costs will be equal to the technical support costs for the initial development of the Port of Rijeka PCS system. The agreed price for the technical support in the project for the initial Port of Rijeka PCS system is 2.297.312,50 HRK [12], and this amount will be used as a reference for the Port of Split PCS system development. This includes all the connected costs, such as the cost of foreseen compliance with the National Single Window platform, analysis of the documents flow, and other issues which were (and will be) defined in the development phase of the Port of Rijeka PCS system.

The experience of more developed ports demonstrates that positive economic and financial evaluation of the project is the basic prerequisite for making the decision about the development and introduction of the PCS system. Financing such projects which bring economic benefits to public institutions and legal persons can be done through various models, but the model that is used in the development of the Port of Rijeka PCS system is surely the most attractive one due to the fact that significant European fund grants can be obtained. Since the investment in the Port of Rijeka is supported by the European Union and the Republic of Croatia through co-funding via the CEF fund, the project for the Port of Split PCS system should also be developed using the same or similar funding sources.

The most profitable development model, which enables additional savings in purchase and installation of hardware and program licenses, is the one where Port of Split PCS is implemented using the existing hardware of the Port of Rijeka PCS system. The investment costs would then include the adjustment costs of the equipment of the Port of Rijeka PCS system existing capacities. The important issue is ensuring the safe data storage system. Backup data storage would be stationed in Rijeka, while in case of need for disaster recovery, the Port of Rijeka and Ploče PCS could serve as redundant platforms.

According to projections in the bill of quantities for the Port of Rijeka PCS system maintenance after 31/12/2020, the costs of annual maintenance are 313.824 HRK with VAT, and the costs are relevant to system support licenses for the server and operating system, as well as for data links and SMS gateway.

The costs, which can be planned for the period of 5 years are annual maintenance, hardware adjustment and technical assistance (Table I). Surely the most profitable solution would be that the Ports of Split and Rijeka, as well as other ports, have a standardized maintenance system besides the unique hardware, which could be delivered by the local suppliers.

TABLE I.   COSTS OF IMPLEMENTATION AND FIVE-YEAR MAINTENANCE (PCS SPLIT, IN CROATIAN KUNAS)

Hardware adjustment	960.372
Technical assistance	2.297.312
Maintenance	1.569.116
Total	4.826.800

III. THE IMPACT OF THE PCS SYSTEM ON THE USERS

The basic role of cargo ports is to provide services to end users, ship-owners and cargo owners. Various concession holders also offer their services in the port area, while the control of the business processes is done by the competent institutions. In the Port of Split, providing services to ship-owners and cargo owners is carried out by 67 different legal entities, who conduct their business under the management of the Port of Split Authority which grants concessions. There are 17 shipping agencies, 12 cargo forwarding, 15 port area and warehouses concessionaires, 2 fumigation and pest control companies, 6 ship chandlers, 6 fuel bunker supply companies, 6 cargo superintendence, 1 pilot service, 1 mooring company, and 1 harbour towage company in that area. Institutions that are under the state governance are Customs, Police, Harbourmaster´s Office Split, Sanitary Inspection, and Port of Split Authority.

During the implementation it is necessary to perform process re-engineering in order to achieve a high level of optimization and avoid multiple data entry. The success of the re-engineering will be limited by the current legislation and the sole will of participants who will need to change their established business methods. The re-engineering should be used for the process standardization in all ports of the Republic of Croatia, however the methodology of doing the same business processes may differ from port to port. The interpretation of the procedures not only differs from port to port, but different officials within the same port interpret legislation and procedures differently, which often leads to one institution implementing different procedures in different shifts. According to [13], by re-engineering only a part of the administrative processes, 48,5% of time needed to perform tasks within the port cluster can be saved, which can also bring financial savings to all companies which run their businesses in the Port of Split. Except for the financial savings, the use of PCS in the port cluster would also enable the standardization of electronic documents and business procedures. This way, multiple data entry would be avoided, which would consequently minimize errors during the data entry process.

Shipping agent needs about 7 hours to complete the tasks related to ships' arrival. Cargo forwarder needs around 6 hours per bill of lading, for ships with more bills of lading, e.g. container ships, more time is needed because more stakeholders are included in those processes. The time needed for concession holders in port areas and warehouses to perform customs procedures is very difficult to determine, but time saving will surely be achieved by facilitating communication with stakeholders and customs. Disposition of cargo would be delivered to the customs through the system. In the process of obtaining licenses and permission for bunker delivery on ships, it takes 3 hours for obtaining licenses and 30 minutes for procedures per bunker delivery. Ship chandlers spend 45 minutes per delivery of goods due to customs procedures, for example in 2017 in the Port of Split 218 ship supply were made in international transport [14]. Concession holders participated in surveys, and according to their experiences, the time needed to perform the same processes is listed in Table II below.

TABLE II. AVERAGE TIME FOR ADMINISTRATIVE PROCESSES OF EACH SERVICE

Activity	WH	Index	SH
Shipping agent	7	0,485	3,395
Forwarder	5	0,485	2,425
Stevedores	0,5	0,485	0,2425
Pilot	1	0,485	0,485
Customs Office	2	0,485	0,97
Total hours	15,5		7,5175

WH - Working hours,

SH - Saved hours,

Index - Possible savings with PCS.

Data was analysed only for the processes which are mandatory in procedures related to the cargo processing during the vessel call in port analysis does not include processes performed by companies, and which are not included in every call e.g. towing services, Harbour master´s Office which processes most data through CIMIS and Border Police information management system.

From the period of 2013 until 2017 the Port of Split had an average of 642,6 calls from merchant ships per year.

AAC - average annual number of calls in Split cargo port,
THwh - Total working hours on each call,
TH - Total number of working hours.

$$AAC * THwh = TH \qquad (1)$$

$$642,6 * 15,5 = 9.966,5$$

The previous calculation shows that the mentioned participants annually spend 9.960,5 administrative commercial hours on average. As it has already been stated, the full use of the PCS system can be obtained by re-engineering administrative and legal processes and then the time savings can amount up to 48,5%. The mentioned data will be used as an index in the calculation below.

TH - Total number of working hours,
INDEX – 0,485,
Tsh - Total saved hours per average year.

$$TH * Index = THsh \qquad (2)$$

$$9.966,5 * 0,485 = 4.833,75$$

According to the above calculation, the use of the PCS system and process re-engineering in the cargo Port of Split in an average year can lead to savings of a minimum of 4.830,75 hours.

Since the motive for this research was to perform a preliminary analysis of cost-effectiveness of the PCS system for the entire port cluster, the next step will be to determine how much time can be saved by its implementation. The total savings will be calculated in

such a way that the expected number of saved working hours is multiplied by the average gross hourly wage in the transport and storage sector. The average hourly wage is set by the data form the Croatian Bureau of Statistic (CBS). The hourly wage for May 2020 in the previously stated sector was 59,22 HRK [15] gross.

Tsh - Total saved hours per average year,
AHW - Average hourly wage,
GS - Gross savings for 1 year.

$$Tsh * AWH = GS \qquad (3)$$

$$4833,75 * 59,22 = 286.254,67$$

As it is obvious from the calculation, expected savings in one year of use for participants that were part of this research are 286.254,70 HRK. In the 5-year period, the amount of savings is 1,431,273,5 HRK. If the average annual traffic growth in the port of 0,64% is calculated as well, then the possible savings in the observed part of administrative and legal affairs in the 5-year period would be 1.440.433,65 HRK.

According to these calculations, using the PCS system for the processes included in this research, savings can be obtained in the amount of 1.440.433,65 HRK, which constitutes 29,80% of total investment with 5-year maintenance. If the Port of Split PCS system is financed by the same model as in the Port of Rijeka, where the project is developed and financed in partnership with the European Union through CEF – Instrument in the ratio of 85%-15%, adjustment and implementation of the PCS system for the Port of Split would cost 4.826.800 HRK, and the amount which would be financed by the Republic of Croatia would be 724.020 HRK, as shown in the Table III. Finally, all participants who will be included in the Port of Split PCS system operation obtain savings in the observed processes in the amount of 778.576 HRK, which makes 107.53% of the investment, i.e. that part of the investment which was supposed to be financed from the Croatian sources. It is important to emphasize that the mentioned amounts make the minimal expected savings since the calculations involve only one part of the business process which will be included into the PCS system. The complete calculation will be possible after all business processes are defined which will include the Port of Split PCS. From everything stated above, it can be concluded that the PCS system is an indispensable investment which will ensure a faster development of business in the port and increase competitiveness among cargo ports in the Adriatic, while the port development will consequently carry more cargo and more business opportunities to cluster participants.

TABLE III. INVESTMENT AND SAVINGS RATIO FOR THE REPUBLIC OF CROATIA (IN CROATIAN KUNAS)

Business subject savings	1.440.433,65
Investment for the Republic of Croatia	724.020
Economic benefits of the investment	778.576
Index of cost-effectiveness	1.04

These are mainly cost saving benefits arising from reduced operating expenses and reduced overall inland transport costs. Much of these savings are realized outside of the immediate port area and do not produce direct revenue to the area. However, the reduced costs could result in improvement of the ports competitive position and in the attraction of additional cargo to the port, thereby producing revenues and benefits noted in the above section. The transportation savings can also improve competitiveness of the port area, which can result in the expansion of the markets of the industries in the area [16].

A challenging period awaits the Port of Split Authority, since the authorities in charge of the port must create business plans which will optimize business methods and aim to increase the volume of business activities in the future. The optimization of business methods represents the transition from ″AS IS″ to ″TO BE″ condition [17].

- "AS IS" state represents continuing business operations with a lower level of ICT technology implementation, i.e. continuing the conservative business methods of the port cluster in the Port of Split, maintaining increased administrative and legal costs, which in the long term can result in the loss of market share and less traffic in the port.

- "TO BE" state, which includes the implementation of the PCS system and process re-engineering, should bring financial savings and accelerate administrative, legal and commercial business procedures related to the ships and cargo. Increasing the level of use of ICT technologies is one of the segments which help port systems to provide the most quality services to the users, with the aim of increasing the competitiveness of the port business.

IV. DISCUSSION

The operative PCS system generates expenses which are related to the management of the system operation and periodic (annual) maintenance. Financing these expenses will be crucial to the use of the full potential that the PCS system offers to the port cluster. If the development and implementation of the system are financed in the anticipated way, by co-financing 85% from the European funds, the use of the system should be free of charge for all users in the first five years of exploitation, and the system should be managed by the Port of Split Authority, which should have capable personnel for those needs.

Annual costs for the system maintenance should be circa 313.824 HRK if the system is hosted on the Port of Rijeka PCS system hardware, the mentioned amount regards the hardware licenses and the system software as well as data traffic. Service desk employees' costs are not listed, but they should be determined by an annex to the contract for the Port of Rijeka PCS system maintenance.

A legal framework that prescribes the business methods for all economic subjects in the port area of ports open for public transport requires participants to hold a concession or approval for work from the competent port

authority. This excludes public institutions that deal with process surveillance and coordination.

Concession holders or holders of approval for work must pay a fee whose amount is set by the contract between the Port Authority and the holder. Since the Ministry of the Sea, Transport and Infrastructure does not foresee paying for the use of the PCS system, and the Port Authority already charges holders a fee for conducting their business in the port area, the PCS system should be the contribution of the Port Authority to raising the quality of port services. If the use of the PCS system is free for all participants, this will surely motivate all potential users to start using it for all the benefits it offers. The Port of Split Authority should present the PCS system to all participants in the port cluster through seminars and workshops before the implementation and release of the system, and motivate cluster participants in that way. Unfortunately, at the moment it is not possible to force the stakeholders to use the PCS system.

The authors believe that a system which is free for users is an optimal model of exploitation, enabling users' access to modern information technologies without new expenses, which can often be de-stimulating. If the users recognize the advantages and adjust to the new business methods accordingly, and adjust internal organizational business processes, they can obtain significant financial savings. Those who manage to use the given opportunities and make savings by re-engineering internal business processes can offer their services at a lower price on the market in order to increase competitiveness of their own business or lower the price of services and increase profitability. Finally, the effects of business informatization will increase the competitiveness of the traffic route and the port.

V. CONCLUSION

The purpose of this paper was to determine the economic effects of the development and implementation of the PCS system based on the example of the Port of Split, which could continue as a follow-up of the CEF instrument project whose aim is to develop an information infrastructure in the Port of Rijeka through the project ″Upgrade of the Rijeka Port Infrastructure – Port Community Information System″. As the basis for the calculation a medium number of calls was determined that was made in the period from 2013 to 2017 and a potential number of saved working hours for all those included in the administrative and legal business activities. The basic prerequisite for achieving the savings can be obtained in the case of reengineering of business processes, but that reengineering can be achieved only as far as the current legal provisions allow it. The results show that savings of 1.440.433,65 HRK can be made in the 5-year period, which is 29.80% of 4.826.800 HRK, which is the amount of the expected adjustment, implementation and maintenance costs of the Port of Split PCS system. The Croatian side would finance this project in the ratio of 15%, which represents the amount of the investment of 724.020 HRK. Maintenance costs in the period of 5 years are expected to be 1.569.116 HRK. Development, implementation and maintenance costs are determined using premise that the Port of Split system will be running

on Port of Rijeka hardware, which would enable significant savings in the initial development of the project.

Since the port is being managed through the public institution of the Port of Split Authority, which in its essence is a non-profit organization, and it makes significant income from the activities of companies that are concession holders in the port area, the Port of Split Authority has the obligation to enable all participants the use of the PCS system in their business activities to help the development of the entire port community. This way the Port of Split Authority can add to its function in the community and become the economic development holder in the traffic route and business competitiveness of its surroundings.

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