The Integration of Albanian Seaports Towards Smart Ports

Amarildo Rista[a], Olta Llaha[b]

[a] *South East European University, Arhiepiskop Angelarij, Skopje 1000, North Macedonia, Skopje, North Macedonia*

[b] *South East European University, Arhiepiskop Angelarij, Skopje 1000, North Macedonia, Skopje, North Macedonia*

Abstract

Nowadays Albanian ports are facing with great difficulties in managing traffic generated by port actors and stakeholders witch exchange thousands messages per day related to ships and cargo sailing to the seas. The lack of intelligent platforms brings: poor traffic management, reduced port activity in Albania, reduced transport and logistics industry revenues and consequently a decrease in the national economy. Information systems have become indispensable in facilitating communication and decision making for enhancing the visibility, efficiency, reliability, and security in port operations. Implementation of intelligent information systems would provide the real time information for the ship owners that want to know about the itinerary, owners of goods and shippers that require access on-line at the information they need, port operators trying to allocate their resources, container operators require to know the location of each container, port firefighters want to have information on the arrival of dangerous goods ect, making them so vital to seaports. This paper aims to study the Maritime Information Systems, analyze and evaluate the current Information Systems in Albanian ports and gives some recommendations for the integration of these systems towards modern intelligent platforms.

Keywords 1

Maritime Information Systems (MIS), Intelligent Platform, NSW, VTS&VTMIS, Smart Port

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EMAIL: amarildorista@gmail.com

olta.petritaj@fshn edu.al

1. Introduction

Information systems have a great importance and comprehensive to the development of maritime transport [1]. Through information systems can be monitor and manage all traffic caused by port actors and stakeholders. Seaports have a major role in the economic growth of a country. Through the ports are exchanged tons of different goods each day between a country and the trading partners with whom it does business, directly affecting the economic growth of the country [2]. Albania has a very favorable geographical position in the southeast of the Balkans, with a coastline about 420km with favorable natural conditions to give priority to the maritime sector. In recent years there has been a significant increase in maritime traffic in Albania related to the transport of people and goods. Currently in Albania operate 5 ports [3]:

1. The port of Durres which is the biggest port in Albania. It covers about 75% of imports / exports and has a processing capacity of 4 million tons of goods per year.
2. Port of Vlora is the second port in Albania, 90 km from Durres Port. This port serves passengers and goods, covering about 10% of imports / exports.
3. The port of Himara which mainly serves tourism in Himara and surrounding areas.
4. Port of Shengjin is about 60 km far by Durres ‘port. It is in the process of development in order to increase its processing capacities, to be as an important link to Kosovo in access to the sea.
5. The port of Saranda is in the south of Albania which serves passengers and goods.

Currently, Albania is in the transition phase of maritime information systems, where most port operations are performed manually. In ports are performed a large number of operations between port actors and stakeholders such as [4]: Owners and carriers require on-line access about the information they need; Traders buy their goods online and want information about the goods; Ship owners want to know about the itinerary, departure and arrival of their ship and container; Maritime agents want to timely submit relevant information to ensure passage for ships and cargo; Container operators want to know the location of each container to avoid delays and create traffic; The Port Captain and Port Operators require information on the ship, cargo, arrival time, departure to organize their operations also in relation to marine life and safety; Environmental specialists want information on goods, ships, the possibility of pollution from them to take preventive measures ect, making the ports thus face great difficulties to manage created traffic. Information systems and digital data transformation play a vital role in managing these operations [5]. The integration of ports towards smart ports provides a high reliability, fast response, high economic benefits, low energy consumption, sustainability, low pollution and more scalability and flexibility for all port actors [6]. This paper presents a study of marine information systems. First, are analyzed the current

information systems in Albania, analyzing the problems that they have and after this are proposed some intelligent solutions that meets the requirements of all port actors and stakeholders according to international standards. The rest of the paper is structured as follows: Section 2 presents the MIS in modern transport and logistic industries. Section 3 presents the current MIS in Albania. Section 4 presents the discussion and some recommendations. And some conclusions are listed in the section 5.

2. Maritime Information Systems in Modern Transport and Logistics Industries

This section present various MIS that store, manage, analyze and disseminate information about traffic created between port actors and stakeholders.

A. National Single Window (NSW) and EU's Single Window facility

NSW is considered as a platform that have integrated some heterogeneous information systems into a Single Window environment, by serving all participants actors with the information they want [7]. A NSW allow all participants involved in trade and transport to exchange information about exports, imports, taking into account all their requirements. The SW platform take into account three main management levels such as presented in [8]: Local SW are systems that manage data from all actors of the local port. NSW are systems that manage data from all ports of the country.EU SW are systems that manage and exchange seaports data internationally.

To improve information sharing and management these systems should be synchronized and integrated with the Port Community System (PCS) [9]. The PCS combines and exchanges data among all the stakeholders. PCS provides a communication link between organizations that operate in the port environment including shippers, shipping lines, terminal operators, drayage companies, and port authorities. The main goal of PCS is to improve administrative and logistics processes on a long term basis [10]. PCS is considered as a local platform that is built upon EDI standards [11]. Specifically regarding customs handling, the PCS should comply with certain requirements in terms of information exchange between customs administrations and economic operators, and with national and international authorities.

B. Vessel Traffic Service (VTS) and Vessel Traffic Management Information Systems (VTMIS)

Vessel Traffic Service (VTS) [12] and Vessel Traffic Information System (VTIS), [13] have an important role in maritime traffic management and are responsible for the collection, processing and dissemination of information obtained from various sources related to the itinerary that ships make. To achieve this purpose, VTS are based on different technologies that gather, process, and share information between involved actors. This includes radar systems [14], CCTV Systems [15], VHF systems [16] ect. The automatic identification system (AIS) is one of the most used technologies for tracking vessel positions [17]. This technology is based on Automatic Identification System Satellite [18] which monitor real-time ship positioning in accordance with the requirements of

the International Maritime Organization [19]. GPS devices also enable the identification and exchange of data for the positioning of vessels which are usually connected with VTS systems [20]. The application of WSN [21] widely used in the localization of vessels, containers, which can be integrated with VTS systems, by define coordinates of all objects that the port authority needs. Different technologies of wireless sensor networks can be used: based on GPS [22] or based on itself localization [23]. VTS are usually part of a National Port. Services offered by VTS such as: ship data, ship processing hours, radar surveillance, marine information usually need to be shared between port actors and stakeholders. Vessel Traffic Monitoring Information Systems (VTMIS) is consider as is an extension of the VTS, in the form of an Integrated Maritime Surveillance. VTMIS has in itself an integrated set of information systems that monitors maritime traffic; provide the exchange of information at national, regional and international level; prevent and detect ship contamination ect, based on EU directives [24]. Fig.1 present the diagram of the input and output components and subsystems of a VTMIS.

Fig.1.Schematic diagram of the input and output components and subsystems of a VTMIS [24]

VTMIS has a Management Information System (MIS) integrated [25], that hold intelligent processing capabilities of information passed on by the VTS, or fed directly by database. Information collected by a VTS should be processed and made available in order to improve and facilitate performance management of the port activities. SafeSeaNet is consider as a traffic monitoring information system [26] that can be integrated into the VTSMIS system and it is meant to serve: Port Security, Protection of the Marine Environment and Traffic and shipping efficiency. This system exchanges data internationally between countries that have integrated it.

C. Port Management Information Systems (PMIS)

Nowadays in modern ports management of operations between port actors and stakeholders have a very important role. Ongoing efforts to modernize and maintain operational services have led to the development of process-oriented toward PMIS. This way ports can better address sustainability through a comprehensive approach that encompasses the four dimensions economic, environmental, social, and time [27]. Such a platform is DAKOSY [28]. The DAKOSY platform offers intelligent transportation and logistics solutions through business partners, port authorities and global PCS. This platform shares all the necessary documents for transport and logistic such as: shipping orders, customs orders, dangerous goods notifications, port orders, consignment sheets, etc. according to EU standard. The DAKOSY platform includes several local SW platforms integrated into it. Import Message Platform (IMP) supports the requirements of carriers, terminals, freight forwarders, transport

companies, importers and the relevant authorities to operate as a Single Window environment. It allows electronic and automatic exchange of information by speeds up the process of work. For each import process, IMP creates a database that is updated and helps improve planning and scheduling options for all participants. The Export Message Platform (EMP) is another system integrated into DAKSY. This system exchange messages and customs information with all business partners at the port, including terminals and carriers as well as relevant authorities. All messages can be shared via interface to IT systems or communicated to business partners and authorities via software solutions. DAKOSY has developed the ZAPP-Sea platform specifically tailored to the Customs export processes of the Port. ZAPP-Sea is connected to the central customs system, enabling automated, fast and electronic export processing which takes into account all requirements of customs authorities. The dangerous goods information system GEGIS is another system integrated at DAKOSY for the safety and monitoring of dangerous goods transports in the port. It provides the water police and fire brigade real time information of all dangerous goods movements to, from and within the port area. PRISE information system is integrated at DAKOSY for information all ship arrival and departure paths. It supplies terminals, pilots, carriers/brokers, tugs, belayers and the harbour master's office with a wealth of up-to-date information. The data provided includes berth planning and registration at the terminals, status information about ship positions, ship notifications from pilots, responsibility reports for tugboats and belayers as well as water level predictions from the Federal Maritime and Hydrographic Agency. Freight forwarders and loaders simplify their processes by using the eBooking systems for bookings. The booking requests are sent via DAKOSY or via the INTTRA booking portal directly to the addressed carriers/brokers. The freight forwarders also receive booking confirmations and further status information electronically. Through eDeclaration system, carriers and vessel declarants can fulfil all reporting requirements when entering and/or departing from EU ports. The messages are recorded electronically in eDeclaration and sent to the NSW. The eDeclaration is also used by many port authorities. They can use the software to collect and process vessel information from carriers and vessel declarants in the NSW. Additional modules have been developed for ports to simplify their work processes. These include a berth management module, a dangerous goods module, a statistics module and an easy way to export documents. Using the VGM Portal, forwarders and loaders can communicate all information regarding the verified gross container weight to the carrier. Customers can choose between the EDI platform and the web application. Recently the DAKOSY launches myboxplace.de, the digital exchange system for empty containers. The goal of this system is to reduce transports of empty containers and to save time and money. So, through the DAKOSY Intelligent Platform all port actors and stakeholders, receive the information they want in electronic form according to EU standards.

D. Smart Ports

A smart port is an automated port that uses new technologies such as big data, Internet of Things (IoT), blockchain solutions and other smart technology to improve performance and economic competitiveness [29]. The first step in the transition of seaports from traditional ports to smart ports is the development of both the Port Community Systems and the National Single Window [30]. Smart ports integrate a range of applications into a smart platform. These applications are classified as follows [31]: NSW is considered as a platform that have integrated some heterogeneous information systems into a Single Window environment [7];Port community system (PCS) that is deployed to share information among port users and port managing bodies [8];Vessel traffic services (VTS) [13] and Vessel Traffic Information System (VTIS) [14] which allow port authorities to control vessel movements approaching the port or within port areas;Terminal operating systems (TOS) that are used for managing container terminal operations [32]; Gate appointment systems that have been deployed to managed arrivals of trucks at terminals [33]; Automated gate systems, which facilitate the management of port or terminal gate systems automatically [34]; Automated yard systems, which allow the automated management of terminal yards [35]; Port road and traffic control information systems that are used to measure and control the traffic flows into and from the port [36];Intelligent transport systems (ITS) that make use of sensors and IT systems to managed transport infrastructure [37];

Recently Internet of Thing (IOT) technology provides intelligent solutions to collect and monitor data in the seaports [38]. As the presence of sensing solutions in ports becomes a reality, different operation areas are working today in automatic mode. In this way IOT helps to make intelligent decisions about logistics and transportation management. The application of blochchain technology is another key tool in smart ports [39]. This technology has a wide range of applicability, allowing connecting the supply chain more efficiently, providing the exchange and visibility of time-stamped proofed data, decreasing the industry operational costs with intermediaries and increasing security. Another key issue in smart ports is big data generation and the need to process them in real time. In order to process big data in real time and extract the required information from it, cloud computing and distributed technology are applied combined with data mining and machine learning methods [40]. This technology is feasible which has practical value and significance. Applications of Big Data in maritime industry, improve logistics optimization, safety and energy efficiency improvement, as well as the challenges that systems involving Big Data are faced [41]. The integration of seaports into smart ports has a number of advantages such as [42]: low labor costs, low transportation costs, little pollution, high intelligence, high reliability, fast response, more safety, sustainable development, low energy consumption and high economic benefits.

3. Current Maritime Information Systems in Albania

Currently Albania is in the first steps of integrating information systems towards intelligent platforms. Most operations in Albanian ports are still carried out manually. This paper is focused mainly on the port of Durres, which is the main port operating in Albania. The Port of Durres operates in several directions, such as: passenger ships, RO / RO ships, container ships and general cargo ships. Also Porto Romano in Durres is the first port in Albania that operates in the import / export of oil and its sub products. Currently the technical and managerial level of maritime transport is low, lacking many elements of modern and necessary infrastructure. Considering the traffic created by goods, passengers, maritime tourism, the infrastructure of this port must be developed in many ways. The main actors causing traffic in the port of Durres and the current MIS are:

A. Durres Port Authority(DPA)

DPA requires information from all port agents. Currently in the port of Durres is used a software that operates locally, prepares the bill and delivery it in the electronic form and does not communicate online with other stakeholders.

B. Institutional actors

- The General Port Captains receives manually information from agents on arrival of a vessel and plans resources and input for vessel navigation, towing, launching, surveillance of port security measures, and maritime traffic control at the port.

- The Regional Directorate of Border Police & Immigration aims at border protection and is currently working with professional police TIMS system [43] on the national network but has no communication with almost all other port actors.

- Customs system uses Asycuda software [44] to connect customs agents with the central customs system.

C. Port Services Agency (PSA)

PSA include: Naval Service Ships (NSSH), Marine Cleaning (MC), Shipyard, Import-Export Agency(IEA), Custom Agency (CA), Maritime Transport Agency (MTA), Passenger Transport Agency(PTA), Goods Transport Agency(GTA). MTA and PTA use the software Forth Crs [45] and Citrix [46] for coordinating work with global operators and communicating only traditionally with local operators and DPA. ATM spend a lot of money on mobile phones and communicate only traditionally with port operators. AIE use digital platforms providing real-time website information but the problem is that the platforms are not unified, while exchanging information with institutional actors is performed with papers and faxes.

D. Port Operators (PO)

PO communicate with other actors traditionally, there is no information system to communicate between operators.

E. Shipowners

Shipowners request information for port rates, traffic, facilities by DPA regarding the availability of information from PO and ship information from GTA so that his ship can stay in port as little as possible. The information comes late, fragmented at a time when the global market is operating electronically.

F. Buyers of goods

Buyers of goods request real-time information from the IEA on the location of their goods, information from DPA for the facilities for the rapid discharge of its goods and continuity. IEA receives information from digital platforms and continue communication with buyers of goods traditionally, in the same form and with the customs agency. So by doing a summary analysis, the current situation in the Port of Durres is as follows:

- Communication between local port operators is done with letters, faxes, telephones, e-mails, lacking an information system to present real-time port traffic
- Only a few operators have installed professional global e-commerce software
- Bills and bank payments are scanned and resend with fax and email on global trading platforms
- Billing of services for the local market continues to be with paper bill
- Bills are delivered manually
- Payment of bills is done manually or sent scanned to the bank via email.

In the maritime transport strategy, port captains have an important role related to safety, health and vigilance of marine life. On one hand, the captains monitor port security measures, control maritime traffic on sea routes, and monitor the protection of the marine environment from pollution and on the other hand, they coordinate services by surveying the coasts. Currently, the port of Durres has an information management infrastructure consisting of: CCTV [15], VHF & MF/HF [16], Radar [14,47], NAVTEX &AIS [48], GPS [49]. Captains communication about VTMIS requirements is done mainly by paper correspondence from shipping agents or operators. So management of port traffic is far from managements of modern European ports. For passenger traffic in 2013 it was installed by DPA, the “eBoarding” system [50]. The eBoarding system is an applicative platform that is used for centralized check-in in port environment that allow the management of the entire process of check-in and verifying border crossing cards, both during the transit phase at the port and during the access phase at the crossing areas. It also enables real-time control of all vehicles that have entered and are present at the port. All management and monitoring functions are accessible via a Web interface. Another important issue in this domain is Environmental Pollution Monitoring at the ports, where a platform called ECOPORT [51] currently operates at the Port of Durres. The goal of EcoPorts is to raise environmental protection through cooperation and sharing of knowledge between ports and improve environmental management.

4. Discussions and Recommendations

Referring to the current situation of MIS in Albanian we can say that the Albanian’ MIS are fragmented and far from international standards. This is accompanied by risks to the performance of port regions and the maritime transport and logistics industry. The lack of an intelligent platform to manage port traffic brings: poor port traffic management, reduced port activity in Albania versus regional ports, reduced transport and logistics industry revenues and consequently a decrease in the national economy. Taking into account the geographical

position, freight and passenger traffic, the development of maritime tourism, current information systems and literature review, we propose a strategic plan to develop IS of Albanian ports towards the intelligent platforms that consists from three phase:

I. Analysis and stabilization of information systems that serve port management

II. Analysis and stabilization of information systems that serve stakeholders

III. Integration of ports towards smart ports

During the development of the first phase, it is recommended to implement VTS and VTMIS systems integrated according to European standards. These systems will monitor maritime areas and manage traffic between port actors. The integration of these systems would be ideal in terms of maritime traffic management, as the most advanced intelligent platforms of European ports such as Dakosy are solutions that do not serve the Albanian ports, as Albanian ports are relatively small. During the second phase it is recommended that the Port Authority should completely unify and digitalize in an integrated system the information of the national seaports by providing access for both state institutions and private actors and port services operating in the Port of Durres and other ports of the country. Referring to the intelligent platforms implemented in European ports, this phase requires large-scale computerization; connection of regional companies with global partners; goods owners and all logistics chain actors should be given online access about the information they want; buyers of goods that buy electronically should be given the coordinates of their goods at any time; port operators must be informed in real time about the location of the ships and the time of arrival at the port; the customs authority must submit on time the ship's documentation to the port authority and the customs system to ensure the free passage of the ship and the goods ect. In order to accomplish these operations and other, during this phase it is recommended to implement the "Single Window" platform as the most suitable for the MIS of Albania. In the third phase, it is recommended to integrate the port of Durres and other Albania ports towards smart ports. During this phase it is recommended to implement technologies such as: Internet of Things, Blockchain, Big Data, Data Mining and Machine Learning applications. This is considered the future of Albanian ports. Referring to studies conducted by the literature, Table 1 summarizes a comparison between technologies implemented at each phase.

Table 1. Comparison between technologies implemented at each stage

Characteristics	Current state	Phase 1	Phase 2	Phase 3
Operation	People and Machine Manual Low efficiently	People and Machine Semi-automatic Medium efficiently	People and Machine Semi-automatic Medium efficiently	Machine Full-automatic High efficiently
Ekonomic Efficiency	Low construction costs Low maintenance costs High labor costs High transportation costs Low economic benefits	Medium construction costs Medium maintenance costs Medium labor costs Medium transportation costs	High construction costs High maintenance costs Medium labor costs Medium transportation costs	High construction costs High maintenance costs Low labor costs Low transportation costs High economic benefits
Security	Low intelligence Low reliability Low response Low safety	Low intelligence Low reliability Low response Low safety	Medium intelligence Medium reliability Fast response Medium safety	High intelligence High reliability Fast response High safety
Environmental protection	High energy consumption High pollution	High energy consumption High pollution	High energy consumption High pollution	Low energy consumption Low pollution

The implementation of these technologies provides a structured channel of communication between ports in locally, nationally and

internationally level to manage ship traffic and all other port elements electronically according to EU recommendations. These platforms dialogue with existing information systems in Albanian ports and remain open to connect with the most advanced platforms. Also these platforms will provide Albanian ports with a high level of flexibility in managing processes and information as well as provides communication and integration between different information systems according to European standards.

5. Conclusions

Referring to the current maritime information systems in Albania we conclude that they are fragmented which means that there is no platform to interconnect communication between port actors and stakeholders. This is accompanied by risks to the performance of port regions and the maritime transport and logistics industry. The lack of an intelligent platform to manage port traffic brings: poor traffic management, reduced port activity in Albania versus regional ports, reduced transport and logistics industry revenues and consequently a decrease in the national economy. Referring to current problems in maritime traffic management at Albanian ports, we have proposed a strategic plan to integrate IS of Albanian ports towards the intelligent platforms that consists from three phase:

1. Analysis and stabilization of information systems that serve port management
2. Analysis and stabilization of information systems that serve stakeholders
3. Integration of ports towards smart ports

During the development of the first phase, it is recommended to implement VTS and VTMIS systems. During the second phase it is recommended to implement the “Single Window” platform as the most suitable for the MIS of Albania. And during the third phase it is recommended to implement technologies such as: Internet of Things, Blockchain, Data Mining and Machine Learning applications. These technologies will provide a structured channel of communication between ports locally, nationally and internationally, to manage ship traffic and all other port elements electronically according to EU recommendations. These technologies will offer Albanian ports a high level of flexibility in managing processes and information as well as communication between different information systems. Also, these technologies will provide a high reliability, fast response, high economic benefits, low energy consumption, sustainability, low pollution and more scalability and flexibility for all port actors.

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