

# Importance of Communication and Information Technology and Its Applications in the Development and Integration of Performance in Seaports

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**Abstract** - The maritime industry is a global transporter of the goods of modern globalized economies. Shipping plays a vital role in today's economy, with over 90% of the world's trade carried by sea. The efficient transportation of cargoes impact on both consumers and the global economy.

In order to improve the safety and efficiency of maritime transport and the protection of the sea and marine environment, it is inevitable to use modern information and communication technologies when collecting, storing, processing, presenting and distributing relevant data and information to the participants in maritime transport. The Smart Port used information technology (IT) extensively to create a high-tech port.

The key factors contributing to the success of the IT and communication infrastructure in the Smart port are the ability to meet the changing demands of users and to keep up with the rapid developments in IT and the ability to accommodate new technology developments without having to constantly restructure.

This paper presented the key issues related to navigation systems, communication networks and information technology and its applications to secure the ships and the development of business performance for the transfer and circulation of goods within the seaports with high efficiency and the impact of this on the national economy.

**Keywords** - Communication networks and information technology; Navigation Systems; Smart Ports.

## I. INTRODUCTION

Navigating the seas safely is not just important for the lives of the people on board; shipping plays a vital role in today's economy, with over 90% of the world's trade carried by sea[1].

The maritime industry is regulated by the International Maritime Organization (IMO) which is responsible for the safety, security and efficiency of shipping and the prevention of maritime pollution. Technology and innovation, such as the Internet of Things (IoT), are said to be a driving force behind smart port productivity. This type of technology, in the form of physical and IT infrastructure could be the best way to see benefits in a smart port environment. The ultimate smart port may be the fully automated port where all devices are connected via IoT. In port operations, the integration of various infrastructures, both physical and IT, includes different network technologies like radio, LAN, WAN and WLAN, RFID and positioning technologies. The effectiveness of the smart port environment may lie in the technology and smart practices' ability to be able to work together to effectively share information, both for the benefit of ports and for its customers.

A key element to all this is some sort of internal cloud gathering information about all events related to the port. When analyzed and presented in a smart way, that data can help to achieve the goal of doing things smarter.

The efficient transportation of cargoes impact on both consumers and the global economy. The correct planning and execution of operations on a container-carrier vessel is a decisive element in the strategy of a seaport. The operational process of a container terminal can be considered as a large productive process where the final element is not a physical product but rather a specified service. The handling and storage of the containerized goods of a particular customer need to be delivered as rapidly as possible to enable the vessel to spend the minimum time necessary in port and, consequently, to obtain maximum economic utilization and to be both Energy and Environmentally efficient.

Communication networks and Computers technologies and all their associated equipment present the technical foundation of smart ports. Computer technology is experiencing a rapid development geared towards increasing processing speed, increasing capacity of the memory, mobility and the use of all media designed for receiving and storing data, greater compatibility and continuous price cuts, etc.

In order to improve the safety and efficiency of maritime transport and the protection of the sea and marine environment, it is inevitable to use modern information and communication technologies when collecting, storing, processing, presenting and distributing relevant data and information to the participants in maritime transport.

In order to meet rising customer expectations and stay ahead of the competition, the overall port operation services can be enhanced by moving to a paperless environment and providing a valuable and relevant solution that completely restructures the manual process of documents exchange among port community members. Automation aimed at and achieved the optimization of the Port Management processes by decreasing the vessel and cargo turn-around time to making available the necessary real time data for yard operations and performing all statistical and data analysis for decision makers.

This paper is organized as follows: Section 2 outlines wireless and satellite communications networks for maritime sector; Section 3 presents navigation and tracking systems and their applications; Section 4 outlines sensing technologies and services provided for the maritime sector; Section 5 presents a glance at some of the technological applications and services offered in Smart ports; Section 6 presents information technologies and integration between different Maritime services; and Section 7 concludes the paper.

## **II. WIRELESS AND SATELLITE COMMUNICATIONS NETWORK**

The communication infrastructure currently available in the maritime sector has enabled shipping companies to integrate their ships within their own overall IT networks. However, integration technology for the shipping industry must take into account the communication systems in use today and the ones which will be available in the foreseeable future.

Communication systems available to and used by the maritime and transport industries cover the terrestrial

networks (HF/VHF/UHF radio, land lines, fiber optics) and satellite communication systems; the availability of these has enabled the use of the internet, web-based processes and the possibility of real time information flow. The choice and availability of the different types of communications depend on the geographic location.

Wireless and satellite communications are keys to the success of the maritime industry because they provide the medium by which maritime safety information, ship position reporting and weather forecasts, as well as other information, can be passed to ships at sea. For a vessel in trouble, the accuracy and update rate of the reporting of the ship's position aids rescue, potentially avoiding the loss of the ship, saving the lives of the crew or preventing an environmental disaster.

Seaports are relying more and more on wireless technologies to enhance the flexibility of operations and improve efficiency. Wireless network equipment is used for better handling of equipment, to improve cargo integrity, real time surveillance, effective administration through building connectivity etc. Radio data communications are widely used within the port environment today. Common use includes communication from a central computer to mobile computers, such as those that are hand held or fixed and used by personnel on site or drivers of trucks, cranes and straddle carriers.

The significant benefit from using radio data communication is that it allows transfers within the container terminal to happen in real time, with the immediate updating of container movements. The central computer can assign a carrier to do a particular job based on what equipment is most suitable. The radio data communication link can also be used to transmit sensor data from the container moving equipment to the central computer, for example giving details about its location obtained using positioning techniques and satellite communications.

In a world where most workers still record container numbers on clipboards, wireless solutions can drive significant cost savings and faster operations. Smart Port is set to strengthen significantly through a range of innovative communication technologies, which will increase interconnectivity and enhance the port's overall competitiveness.

Smart Port can harness the use of mobile technology and wireless connectivity to enhance

communications, productivity and crew welfare at the maritime center. These include providing 3G/4G broadband mobile telecommunications technology access for vessels operating within waters of the port and the immediate maritime community. The low-cost, secure wireless 3G/4G broadband service and WiMAX network will be available to users within 15 km of the coastline to further enhance network coverage across the port to benefit the maritime community[2]. Wi-Fi services at the port and launching new mobile application for the maritime community and members of the public to conveniently access maritime information and services on their mobile phones will further enhance passenger experience and business operations at ports.

### III. NAVIGATION AND TRACKING SYSTEMS AND THEIR APPLICATIONS

The global navigation satellite system (GNSS) is a navigational system of satellites that provides autonomous geo-spatial positioning with global coverage. It allows small electronic receivers to determine their location (longitude, latitude, and altitude) within a few meters using time signals transmitted from navigational satellites. GNSS technology is the backbone of traffic management and modernization at seaport container terminals. One of the most important properties of GNSS-enabled systems is the ability of tracking container arrivals and their docking at the port [3].

GNSS improves navigation, transport economics and consumption at sea; on the other hand, it can avoid casualties like collisions helping to limit risk to safety and the environment and has an effect on transport quality, loading factor and service. The ability to accurately determine and communicate one's position at any moment, thanks to GNSS, is starting to have a major impact on the management of ship and lorry fleets, road and rail traffic monitoring, the mobilization of emergency services, the tracking of goods carried by multimodal transport and air traffic control.

A Smartphone application can use GNSS to capture information about location, speed, acceleration and driving times. Based on the specific freight, vehicle weight and predefined reference profiles, this data can then be used to

calculate the exact fuel consumption, which can then be integrated with the specific route parameters. The logistics company and the driver will immediately receive these metrics via the specific server. This will help reduce emissions and save fuel, which in turn will help to reduce the overall costs for the providers of logistics services. An additional benefit will be that an efficient driving style also reduces the amount of maintenance required on vehicles and can thereby help to increase their periods of active usage.

There are obvious examples used as application for tracking and monitoring vessels during sailing in the sea such as long range identification and tracking system (LRIT) and automatic identification system (AIS).

#### A. Automatic Identification System (AIS)

The Automatic Identification System (AIS) is a ship-borne transponder system designed in the first instance for maritime safety and, in particular, for collision avoidance. It consists of a transponder unit including GPS, VHF transmitter/receiver and display/terminal. The unit broadcasts a message at regular intervals containing its identification, position, speed, course plus a number of detailed items about the ship and its cargo. The broadcast carries VHF range which is basically line of sight[4]. It is used for identifying and locating vessels by electronically exchanging data with other nearby ships and VTS stations. AIS displays incoming vessel information on a suitable device, collects vessel movement information and assembles it into an AIS compliant data sentence, and initiates and controls the flow of data sentences between participating units. Figure.1 depicts AIS tracking system for vessels.

The AIS sender and receiver are generally present on the big ship and the information is often available through dedicated internet sources. An AIS system has limited coverage based on radars specifications but this problem will be overcome with the implementation of satellite AIS.

AIS information supplements marine radar, which continues to be a vital method of collision avoidance for waterborne transport, hence it avoids marine casualties and environmental pollution.



and may also employ video automatic number plate recognition or vehicle magnetic signature detection technologies at desired intervals to increase sustained monitoring of vehicles operating in critical zones. Some examples for sensing technologies are RFID, OCR and CCTV.

#### A. Radio Frequency Identification and Tracking (RFID) Technology

RFID are deployed to support the identification and tracking of assets typically associated with operations within a facility, to automatize processes, to improve operational productivity and equipment utilization as well as for safety of people and assets and security of containers.

RFID is a technology that uses radio waves to transfer data from an electronic tag, called RFID tag or label, attached to an object, through a reader for the purpose of identifying and tracking the object. RFID can be applied to all transport modes and to all transport and supply chains.

With RFID transport, chains can significantly improve loading factors as well as increase cost efficiency.

RFID technology can be used efficiently in container ports to improve container security and regulatory compliance, improved quality, container identification, location and tracking, and access control. Human errors can be reduced by up to 70% and in-port transaction completion time can be reduced by up to 50% [6]. RFID real-time data allows for dynamic optimization yielding better planning, higher efficiency and overall performance as a whole. An important advantage is that it enables dynamic optimization in container ports, a much needed tool for solving increasingly complex problems. The high level of flexibility and dynamic optimization allow the achievement of real time solutions that could have neither been obtained nor reached otherwise. The following figure.3 is an example of used RFID with GPS and mobile network technologies in order to track containers in Chennai Port of India.

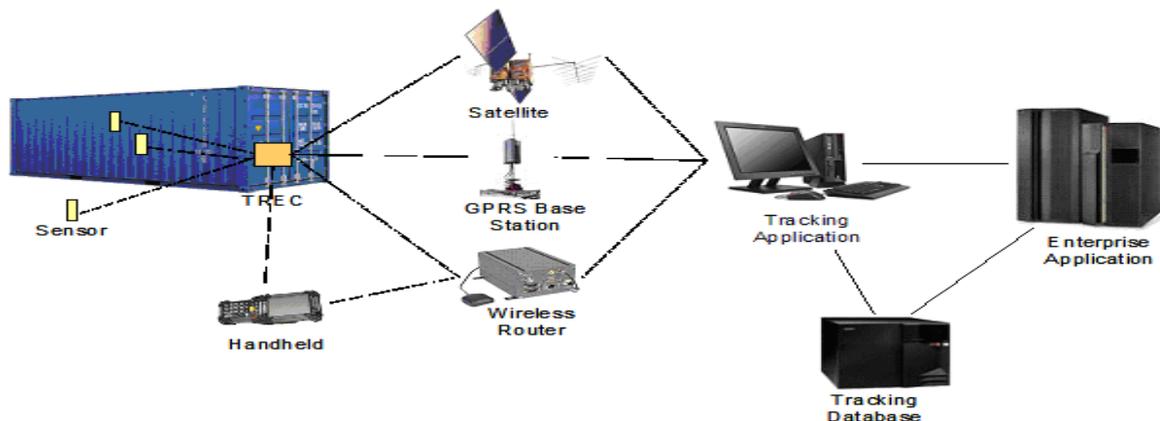


Fig .3. RFID in container[3].

The container freight station operator based in Chennai India, A.S. Shipping Agencies, is mixing both RFID with GPS/ GPRS technologies in order to track containers throughout its yard, situated 16 kilometers away from the Port of Chennai. RFID interrogators, antennas, and GPS receivers are fixed on cranes. Once a container arrives at the storage yard, it is weighed and by means of a small touch-screen device, the crane operator enters its information into the system. Then, a passive RFID tag is linked with the container number and mounted on the top of the container. The tag data is updated with the GPS latitude and longitude information, and then conveyed via GPRS to a central server database. The container's location is then visualized on a Web application. The container's location is thus updated automatically as the container moves through the yard

area [7]. The main advantages of this system are the clear reduction in the container's location time in the yard, better yard capacity planning and accurate customer billing knowing the exact storage time. Moreover, container information can be accessed, through a Web application, by clients anywhere in the world. All these factors increase the service level provided by the company. However, this system still needs to be integrated with the company's billing system [7].

A joint venture of IBM and Maersk Logistics resulted in a development of a system for tracking shipping containers around the world. This system goes beyond RFID technology and uses it just as a part of a collection of wireless technologies to transmit location and sensor data [8]. This system, called later the

Secure Trade Lane (STL) solution, is using tracking devices called TREC's (Tamper-Resistant Embedded Controllers), which are small intelligent wireless monitoring boxes mounted on containers [9] and making them smarter.

TREC's perform an automatic container events data collection including physical location based on GPS and state of the container (temperature, humidity, acceleration, door status.., etc). TREC's communication can be achieved through communicating over a satellite, a cellular system (GPRS/3G), or a Wireless Personal Area Network (WPAN) based on ZigBee3 /IEEE 802.15.4 radio. A handheld device can also communicate with the TREC's over a WPAN for the automatic creation of the container manifest, invoices, bills of lading, etc. The Shipment Information System (SIS) ensures that the information provided by the TREC is available to the supply chain authorized actors with the appropriate information sharing among them [9]. This STL platform enables real-time access, tracking and monitoring of containers each participant with its authorized view, thus granting a full visibility of the supply chain from the manufacturer to the store.

#### *B. Optical Character Recognitions (OCR)*

In addition to the RFID, optical character recognitions (OCR) is one of many technologies now available for asset identification and process automation in ports and terminals. The key advantage is that it enables not only the automated 'hands free' identification and locating of assets, but also the recording of an object's visual condition at that time. It also provides a deviceless method of identification, without requiring the application of any tag or device to the asset. OCR scans the ID numbers while the truck is in motion, based on a set of sensors. It automatically operates the illumination, takes pictures from a number of cameras, extracts the ID numbers, classifies the type of containers, verifies the results, then outputs the results to the Port Automation and Control System or a local terminal operating system.

#### *C. Closed Circuit TV(CCTV)*

The Port Management Entity can supplement both perimeter and access control systems with new arrays of high resolution, low-light and/or infrared closed circuit television (CCTV) cameras to determine the nature of any alarm or intrusion and to guide response by law enforcement personnel. The CCTV deployment can be extended to other perimetral

sensitive locations in and around the ports and can be fully integrated with port operations and control centers Advance Perimeter Security Improvements. The Port Entities can deploy a combination of advanced security technologies to support surveillance of port perimeters and to improve detection of unauthorized intrusions. This package of technologies can include the innovative use of ground-based radar and state-of-the-art motion sensors that can activate alarms at Port Security Centers, indicating the specific location of a potential intrusion of persons or vehicles.

### **V. A GLANCE AT SOME OF THE TECHNOLOGICAL APPLICATIONS AND SERVICES OFFERED IN SMART PORTS**

Port e-services can be categorized as based on the functionality offered, their integration/maturity level, and their business and organizational sophistication. Regarding their integration and maturity level, port e-services can be divided to informational and transactional. Informational are the services that only provide information regarding the port and the provided services. Transactional are the services that enable the users to perform transactions, payments, bookings and to interact with the port authority or other port service providers.

The services can be further "functionally" distinguished to navigation, ship, cargo, logistics, business intelligence, security and environmental safety related. Navigational services are the services that assist the navigation of the ships to and from the port. Ship services help the communication of the ship with the port authority and port service providers regarding ship and crew related documentation, supplies and parts. Cargo related services concern cargo documentation and cargo handling/tracking. Logistics e-services assist the connection with the logistics chain. E-services regarding business intelligence assist the shipping companies' and industry actors' decision making by providing information and management supporting tools. Security and environmental safety related e-services provide information regarding security and environmental safety matters in port area.

- Vessel Traffic Management and Information System (VTMIS): Addressing traffic congestion was one of the initial motivations to look at intelligent transport systems solutions for a better utilization of transport capacity through the exchange of real-time information on infrastructure

and traffic conditions. Since then, new transport applications based on ICT have emerged and continue to emerge, ranging from basic traffic management systems (e.g. navigation, traffic control) to management of containers; from monitoring applications such as closed-circuit television (CCTV) security systems to more advanced applications integrating live data and feedback from a variety of information sources.

the VTMISS functions and VTMISS subsystems. VTMISS functions are grouped into operational and complementary roles, while VTMISS subsystems include communication networks, sensors (the automatic identification subsystem and a marine radar subsystem), operator consoles, servers, databases, system software, application software and web services. The integration between various port entities is very important.

A common structure of the VTMISS system consists of

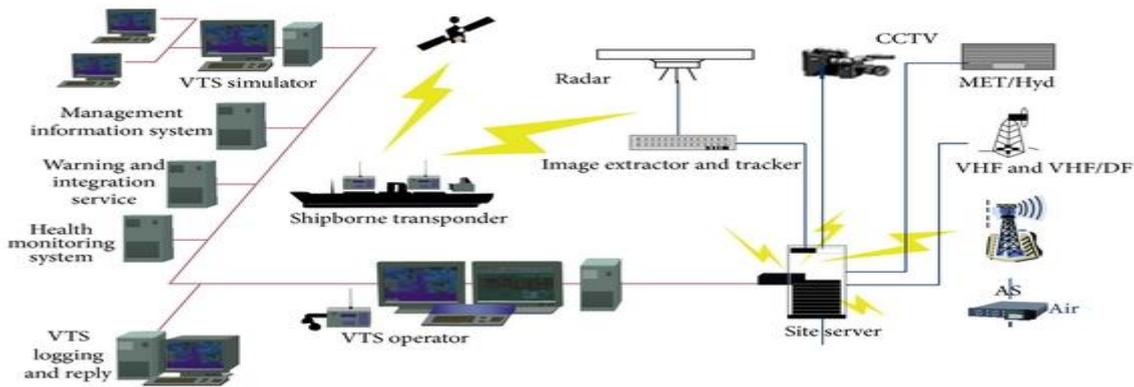


Fig .4. System architecture of VTS service.

This includes conducting all necessary studies to reorganization procedures among different parties in order to regulate the operational cycle for integration purposes.

In general, the elements composing VTS are shown in Figure.4. VTS is the system in which the followings are connected to one another: the VTS center on the land, the base station site on which various sensors (sensing devices such as CCTV, Radar, DF, MET, etc.) and AIS are installed, the control center that actually operates VTS, and it is a complicated system consisting of various types of telecommunications networks that connect ships, satellites, and sensing devices [10].

Technologies provide a broad range of sophisticated systems for wide area security, automated surveillance and instrument controls for the private sector and for governments. Artificial intelligence-driven digital security systems integrated with actionable video-based surveillance intelligence are technical solutions with potential to be tailored for the maritime industry includes:

- Security Corridor Systems: This system could easily be adapted to isolated fence line perimeters as well as rail lines entering and exiting port

facilities both overland and also across water. The Virtual Fence is based on digital video recorders driven by the innovative intelligent sensor detection suite which integrates fixed and high resolution, color, day/night cameras, RFID active scanners and other sensor types, positioned at strategic locations along the line of the asset. The system establishes virtual fence lines within the field of view of each of the cameras. Live streaming video is interpreted to deliver low false alarm, real-time vigilance for common behaviors that can indicate a security breach. Data is encrypted and transmitted using TCP/IP based communication either via a chain of Wi-Fi radio transmitters, satellite, and fiber optic or hard-wire connectivity to local and remotely located command and control centers. The Virtual Fence is fully integrated with all other system components to provide centralized command unity [11].

- Virtual Gates: Virtual gates are installed in conjunction with the Virtual Fence application. These are installed at a pre-determined distance from the actual port/marine facility entry point, thus creating a buffer zone. The Virtual Gate serves as a remote controlled advance checkpoint for inbound traffic. Gates include vehicle presence

sensors, cameras, chemical detection sensors, radiation detection sensors, and I/O controllers. Vehicles and personnel approaching the Virtual Gates are detected and the real time video together with potential rule breaches are presented and routed simultaneously to the command and control center and other locations where operators can view live, streaming video images and alarm events in real time.

- Smart Yard Digital Management System: Port facilities are typically large, asymmetrical activities dispersed over hundreds of acres of land and water so that they can simultaneously accommodate ship, truck and rail traffic, petroleum product/liquid offload, storage or piping, and container storage. Like a rail yard, they are crowded, and with huge stacks of containers, warehouses and cranes, and often have limited visibility.

Installation of a Smart Yard Digital Management Solution in the port area provides robust, fully scalable live video with real-time, intelligent video capability. This enables the central port authority to coordinate the activities of its personnel and assets day-to-day by monitoring critical road or rail transit areas, checkpoints, or container offload/stack locations. Unprotected crossings can be monitored and critical navigational assets can be monitored for operation or critical change.

SMART Yard employs a network of fixed and digital video cameras connected to digital video servers. Each digital video recorder includes the rule-based intelligent vision suite to automatically deploy audio and visual alarms, process live video feed and create a video digital archive. The cameras also function as intrusion detectors providing live streaming video of vulnerable security areas and potential threats to vulnerable areas within the facility viewed on a customized Graphical User Interface (GUI). The GUI shows intrusion points and critical port locations so that port authority controllers can simultaneously view and control cameras positioned throughout the facility to analyze incoming video and sensor feeds, and thus maintain a real time situational awareness of container operations, truck transport on-load/off-load activity, crane operation, warehouse security, and shipping movement in and out of the port facility and adjacent areas[10]. In addition to remote real-time viewing of events, images are also automatically digitally recorded, time stamped, and stored for later retrieval. A

powerful video search engine allows for easy retrieval of stored video files.

- Intermodal Container Exit System (ICES): Port security and operations are particularly vulnerable to theft, smuggling and vandalism. Terrorism is also an increasingly significant concern, particularly with respect to the movement and identification of containers and contents. Technologies have developed a system that can identify and track containers and link them to transport companies, drivers and specific vehicles. The system gives law enforcement a significant tool to track containers of concern, and at the same time allows port authorities to keep their operations running smoothly.
- ICES is a completely automated application for tracking and recording intermodal containers exiting, or entering, a container yard. The core technology of the system is the Video Optical Character Reader (VOCR) which takes video imagery from moving containers, extracts relevant data (user defined) and populates a database with the extracted data. ICES will capture and store the following information in a simple user interface: Container numbers; Trailer numbers; Front and rear license plates; Driver's license data; Video of vehicle and container; Video and audio of driver and guard interaction at the port; Biometric capture of fingerprints.
- Friend or Foe Detection System (FFDS): This system component is achieved and can be incorporated into a Port Authority's overall security plan by adding an RFID technology layer. It can be an especially important element of protection of critical infrastructure and hazardous material or loading points within the port. All personnel and visitors authorized to access the facility would receive an active RFID tag, which is constantly scanned by an array of scanners installed throughout the facility. Tag geo-spatial information (achieved through scanner triangulation) is displayed on the GUI, thus revealing the location of each person at any time. If the Virtual Fence is breached, FFDS automatically validates approaching "authorized" personnel to prevent false alarms [11].

## VI. INFORMATION TECHNOLOGIES AND INTEGRATION BETWEEN DIFFERENT MARITIME SERVICES

Information systems are used to enhance the

efficiency of terminal operations and improve turnover. The important competitive advantage of a port is to move cargo quickly and safely through the port. Ports face increasingly complex range of operational challenges in management of highly complex, multi-tenant port environments. From the operational point of view, a consolidated, reliable, flexible and secure flow of information is vital in order to provide quick, reliable and cheap services at seaports.

Container and other marine terminals require increasingly versatile terminal operating and other IT systems to plan, schedule and manage operations for efficient cargo handling. Terminal Operating System (TOS) is key part of the supply chain and primarily aims at controlling the movement and storage of various types of cargo in and around a container terminal or port.

Ports are natural bottlenecks in the transport chain. Port Community Systems have played a major role in facilitating the most efficient movement of goods, while allowing Customs and other government departments to maintain effective controls. Such systems reduce the overall amount of administrative work by providing some means of capturing information at once and allowing controlled access by all appropriate members of the port community. Wasted effort is avoided because duplication of entry and storage of data is reduced to a minimum. The time required to release cargoes is reduced because the necessary information is instantly available to those who may need it.

It is important to integrate the electronic business workflow in the port community via port single window including Port Authority, customs, shipping agents, transportation companies, etc.; the system simplifies and accelerates data exchange between different entities by providing the needed tools and procedures including message exchange system and portal that enable a single authorized entity to collect all business documents from customers and coordinate document processing with other entities until reaching Custom Declaration/Cargo Release or Cargo Shipping/Vessel Departure.

Integration between various port entities is very important. This includes conducting all necessary studies to re-engineer procedures among different parties in order to regulate the operational cycle for integration purposes. In order to meet rising customer expectations and stay ahead of the competition, the

overall port operation services can be enriched by moving to a paperless environment and providing a valuable and relevant solution that completely restructures the manual process of documents exchange between port community members.

Automation aimed at and achieved the optimization of the Port Management processes from decreasing the vessel and cargo turn-around time to making available the necessary real time data for yard operations and performing all statistical and data analysis for decision makers.

The agent of the shipping company access the web-based system to prepare and sent the necessary documentation to customs office and port authorities. The customs office receives through the web-based system the documentation and processes it to provide customs clearance. Through the system the customs office sends the clearance to the agent and the port authority. The port authority enters the cargo data into the port management system which automatically assigns personnel and equipment to discharge the cargo according to port's current condition and shipping company's needs. The system auto arranges storage and sends data through the wireless system to stevedores and warehouse. The port authority also forwards information to the agent.

Through the web interface, the agent tracks the procedures and the cargo current position with the use of the port's container tracking system. Through the web interface it contacts the logistics provider and sends the information regarding the ships location as well as the necessary documentation. Through the web interface the agent has access to a database of suppliers.

During the procedures we can see the interaction between the various actors with the use of the two distinguished information systems. The web interface enables the shipping company agent to interact with the Port Authority, the Customs Office and the logistics provider, while the integrated management system supports the port authority's decision making and communication with the stevedores and the warehouse.

## VII. CONCLUSION

The growth of e-business is having major effects on the maritime transportation industry including increasing pressures for advanced integrated, intermodal transportation and logistics systems and

technology applications. The growth of maritime transportations and port services requires highly flexible, information-intensive and efficiently integrated transport systems. Key elements for developing such systems are the development of integrated applications of Intelligent Transportation Systems and the creation of electronic business applications for intermodal transport, with port being a major node of the transport value chain.

At the same time, ICT technologies in ports and terminals are becoming a key to absorb the growth linked to world trade expansion to achieve the integration of ports in logistics and intermodal transport systems. With the advent of ICT enabled network business models, port product and processes are considered as “augmented” products and processes, as their traditional, physical nature is overlaid with an informational and electronic transactions component. Thus, inter-organizational network models provide a great opportunity towards the ‘smart networking’ of the plurality of port actors, including public port authorities, terminal service providers, shipping companies, customs, logistics and transportation companies and other third parties.

Overall, ‘networking’ as based on the advancement of a rational coordination, for operating and strategically developing a port can renovate port authorities in a new blended virtual agency role, that is a combined physical and electronic mode of operation. Against this background, a classified port services for systematic identification, assessment and selection of individual port e-services is presented, as based on port e-service categorization by the level of integration, sophistication and functionality.

Deployment of consolidated technological solutions based on the IT is considered as a crucial factor in sound and efficient operation of the ports that considerably contribute to the ports’ competitiveness and efficiency. The ongoing revolution in ICT, smart devices and IoT can interconnect port with high-speed internet, extensive use of data analytics and innovative mobile solutions to enhance services in the Smart Port and this will benefit all users at the Smart Port.

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