DigLogs

Impact Analysis of process informatization trends in the Programme area

Deliverable 3.1.3

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Table of Contents

Introduction

The purpose of this deliverable is to choose the most attractive solutions to deploy and analyze the impact on technical operation side as well as labor market for of process informatization trends in the Programme area, gathered in D3.1.1 and analyzed in D3.1.2. The activity has been carried out by Actual I.T. involving other PPs.

In this Deliverable the top interesting innovations, voted by All PPs are analyzed:

- Document digitalization
- Freight PCS
- Warehouse management system (WMS 4.0)
- DSS (Decision Support Systems)
- Mobile solutions for Safety/Security

The choice of the first four is due their strong contribution in the speed-up/simplification/automation of the logistic processes, while the latter was considered a very effective method to increase safety and security onboard and in port areas. The analysis of these innovation is described in detail in D3.1.2.

The impact analysis also includes brief guidelines for the sector stakeholders on how to react and be ready for the change.

Impact analysis presents the current scenario and compares it with expected scenario (after the innovation deployment/implementation). Examined aspect are:

- consequences/repercussions
- expected changes
- assessment of what should be modified in order to cope with expected changes
- assessment of potential risks (e.g., identifying most problematic changes from a technical, organizational and stakeholder-role viewpoints)

Impact analysis is carried in order to support the change management process and overall decision-making process.

1. Selected innovation: Document digitalization

Digitalization of documents in logistics process is a base technology that allows to reach the vision of digital-only logistic chain. Document digitalization encompasses both transformation of manually handled documents into digital equivalents and application of innovative technologies to complement the digitalization process, like introduction of structured Smart Bill of Lading and electronic signature for document confirmation.

1.1. Impact on technical operations

1.1.1. Consequences/repercussions

Document digitalization is an enabling technology for all further digitalization and modernization initiatives in logistic and maritime sector. Handling of data in digital, structured and standardized ways is a major prerequisite for innovative solutions and processes built on top it.

Documents in structured digital form can allow faster execution time, easy reutilization, routing and verification of data. Structured and standardized documents like Smart Bill of Lading can allow universal exchange and access to relevant data of cargo, easier notification and processing of data. Digitalized documents can be available for the next stops in transportation chain well ahead of the cargo, which allows better preparation, planning and forecasting of services.

Digitalization of data can lead to fare less errors in data handling, prevent loss of documents (with digital copies), much faster search of requested information and transparency (example, publishing the document on a logistic blockchain)

Possibility of digital signature of documents can vastly speed up process of document processing and increase the security of the document with digital signatures that can easily proofed for authenticity.

1.1.2. Expected changes

Document digitalization can be a disruptive technology for the environments that are still working mainly with traditional non-digital documents. It can allow to fill the gap between best companies and followers. Furthermore, a digitalization in a logistic company and/or port community can have a beneficial impact on work of other subjects, because the improved work of one element in chain makes better the whole supply chain.

Document digitalization usually makes a big change in work process in the companies that are implementing advanced document digitalization process. It is important, that technology changes are matched with review and modification of work process to gain the best results. Some processes might become obsolete, new processes that streamline operations are usually brought to existence.

Form the technical standpoint document digitalization means usually a major upgrade or replacement of working tools, applications and underlying infrastructure. There is also a matching change in ways digital documents are generated, forwarded, stored and archived. Capacity planning becomes a key planning factor to adjust the business needs to the new toolsets.

1.1.3. Assessment of necessary modifications

Necessary technical modification with the introduction of a new document digitalization project depends on the state of existing of technologies used in a company and requirements of new technology. In some cases the new innovative solution can be added as an additional service connected to existing operations management solution. In these cases, the digitalized documents are a complement to the existing set of data used in documents. It can also allow an interfacing and transformation of data from new, standardized format to a custom format used in legacy applications.

In other cases, the best option is to entirely replace the existing operations management applications with a new one, that natively handles new types of documents and document processes.

Document standardization in most cases needs also revision on the document standards used inside the company, because data exchange with other parties requires more and more the communication in a standardized way.

1.1.4. Assessment of potential risks

Introduction of large-scale document digitalization project can be a major disruption to the workflow in logistic chain, so the careful and well-planned approach is mandatory to assure the business continuity. This is not true only for the company that is doing the new document digitalization project, but also for the rest of port and logistic community. Any problems in one of the logistic subjects can lead to the disruption and downtime in much borader part of logistic chain.

One of the major risks is compatibility of data and standards. Not all document digitalized solution and project follow the same standard or the same version/variant of the standard. Well defined rules and test should be put in place to avoid later surprises in the management of workflows related to digital document handling

Document digitalization allows much easier way of handling business data, but at the same time bring new risks regarding authorizations of access to document, attempts of forging and deletion of documents. Security and transparency must be built in the technology and processes on all levels. It is important, that used solution allows easy revision trail, logging of activities and using some innovative new technologies to assure the proof of authenticity (digital signature, blockchain).

Document digitalization generates large quantities of data, so there must be a comprehensive plan and policy of handling, storing and archiving of digital documents.

1.2. Impact on labor market

In a world where digital is becoming a standard for all aspects of the society, most enterprise processes must become more digitized. A critical element to start with is to digitize existing documents and create all new ones in the digital form.

While there are obvious similarities to historical observations from times when new technologies were introduced, digitalization creates new kinds of possibilities, the consequences of which were and are sometimes harder to predict.

1.2.1. Consequences/repercussions

Digitaliation has opposing effects on labor markets. Although the overall pie might grow bigger, severe structural changes and therefore challenges for society at large will definitely occur.

In economic textbooks, it is normally assumed that new technology drives growth and therefore has also a net positive impact on employment. For the past, this was certainly true, as the replacement of the typewriter by personal computers still required a person behind a desk, which now however could offer more and better services. This relationship between technology and the labor market might be about to change in our digitalization era.

The new feature of this technological change is therefore that not only muscle but also brain work will be replaced by robots—given it is not only technological feasible but also cost-efficient

At the same time, digitization, like previous technological advances, will also have repercussions on labor markets in a way that some jobs will be replaced, some jobs will be created, and many jobs will be transformed. For the moment, it is impossible to estimate the job replacement and job creation effects with any degree of certainty. Moreover, new jobs may not go to the same people as the old ones and may not go to the same geographic areas.

1.2.2. Expected changes

Digitalization in general and document digitalization in particular will most likely induce structural changes. If we assume a large impact of digitalization on the technical equipment of the economy in the future, then considerable effects on the composition of employment can be expected.

Digitalization may – if everything is assumed equal – increase job turnover and, in doing so, facilitate an even more efficient division of labor within the economy.

Besides structural change we can also expect other impulses of digitalization for the future world of work. Digitalization has the potential for humanizing jobs in terms of ergonomics. Jobs associated with unpleasant conditions such as physically demanding work may increasingly be substituted by new technologies.

Digital technologies can also contribute to a more flexible time management of both employers and employees.

Mobile work based on information and communication technology (ICT) may reach completely new dimensions in quantitative and qualitative terms. This means that document digitalization has the potential to offer more opportunities for participation and that in a digital world worker is probably more in control.

The digitization of many traditional aspects of document management is under way, as companies use a variety of big data tools and techniques to connect more closely with suppliers, customers, partners and it also aids the planning process, improve sourcing and boost collaboration.

This results with:

- Increased number of jobs in the supporting industries (e.g. ICT engineers, system administrators)
- Decreased number of jobs in the document management and creation

All this indicates that main impacts of document digitalization – like in previous waves of technological change – is that jobs will be reshaped rather than disappear.

1.2.3. Assessment of necessary modifications

In addition to the general change by digitalization of document management, it could be the case that societies have to react differently to this ongoing process given their demographic transition and their education system.

Necessary skills that labor force will be needing to adapt to the new digital environment include the ability to work within the digital tools and also the capacity to go beyond the logical reasoning at which computers excel.

New, digital document management will require companies to determine strategy that will ensure that they transition from the paper era goes as smoothly and cost effective as possible especially when talking about labor.

Once the strategy is determined, companies must put into place several key capabilities needed to carry it out and help transition the existing labor force and integrate the new one.

These key capabilities include the following:

- Processes. Establish the new end-to-end processes connecting suppliers, partners and customers that digitization makes possible, such as how to exchange documents on cloud-based platforms.
- Organization and skills. Generate an end-to-end understanding of the mechanics of the document flow. That means switching from an existing mentality, flowing physical documents around, to becoming an "orchestrator" — seeing, managing, and optimizing the entire document chain. Achieving this will also require a shift to an open, fast-learning digital culture that promotes communication across different media, programs, and user groups. Develop the talent and expertise needed to build the technology and carry out the new digital operations.
- Performance management. Develop a set of straightforward business rules covering the management of the document flow, and the key performance indicators needed to measure outcomes.

- Partnering. Focus on boosting your ability to partner with other companies, as the fully digitized operations cannot be built without collaborating with a wide variety of suppliers, distributors and technology providers.
- Technology. Devise a road map for the many technologies, old and new, that will underpin the digital document creation and management, including the information integration layer, database and analytics capabilities and the cloud.

Dynamics in skill requirements may cause more problems in the future to provide skills on time. The pace of vocational education and subsequent further training is, therefore, crucial in order to avoid unnecessary shortages.

All in all, the future labor force will need a particular mix of skills, knowledge and competences for the emerging digital technologies in document creation and management which enables a wide and rapid adoption as well as diffusion in the economy.

One requisite is that companies need to ensure that available skills and competences are utilized as far and as possible.

This implies that in the future it may not only be important to optimize skills for evolving jobs but also to optimize jobs for available skills.

1.2.4. Assessment of potential risks

There are many types of risks of concern to the companies and the economy in general when future of labor is discussed in the scope of document digitalization. These risks can result in cost, schedule, or performance problems and create other types of adverse consequences for the organization.

For example:

Governance risk relates to board and management performance with regard to ethics, community stewardship, and company reputation.

Strategic risks result from errors in strategy, such as choosing a technology that can't be made to work.

Operational risk includes risks from poor implementation and process problems such as procurement, production, and distribution.

Market risks include competition, foreign exchange, commodity markets, and interest rate risk, as well as liquidity and credit risks.

Legal risks arise from legal and regulatory obligations, including contract risks and litigation brought against the organization.

Risks can also include both internal risks and risks that are beyond the control of the companies. These latter types include external risks that arise from outside the organization but affect the ultimate value to be delivered. In all cases, the seriousness of the risk depends on the nature and magnitude of the possible end consequences and their probabilities.

Table below lists some of the mayor risks for the mentioned topics, their perceived importance and the means of mitigation.

Risk	Risk impact	Probability of occurrence	Risk mitigation
Existing work force resistance to change	High	High	Prepare the work force well in advance to the impending change
Inadequate resources	Moderate	Low	Secure adequate resources prior to starting digitalization process
Change in Technology	Moderate	Moderate	Constantly following technology trends
inadequate skills within the workforce	High	Moderate	Train the workforce adequately
Stakeholders resistance/lack of cooperation	High	High	Preparing stakeholders for eminent change and making the transition easy for them
Regulatory changes	Moderate	Moderate	Take active role in the process of creation of new regulations

Failed procurement	Low	Low	Performing all procurement with extra vigor
Information security failure	Moderate	Low	Implementing high level of information security

2. Selected innovation: PCS

The term PCS is widely spread and in use in different port environments in the whole world. PCS is a neutral and open electronic platform enabling intelligent and secure exchange of information between public and private stakeholders in order to improve the competitive position of the sea ports communities.

Port Community Systems can play a major role as countries move towards the Single Window environment and contribute to the harmonization and coordination of reporting formalities, processes and procedures.

2.1. Impact on technical operations

2.1.1. Consequences/repercussions

PCS optimizes, manages and automates port and logistics processes through a single submission of data, connecting transport and logistics chains. It connects multiple systems operated by many different organizations and it is used to standardize message exchange among port community members and centralize all port community information as much as possible.

Ona of the innovative ways of utilization is gathering the data and making it visible to interested and entitled stakeholders, providing operational data for planning purposes. It can serve as

exchange platform between different application and systems, for example between operations management application in the company and national Single Window environment, for example for approval, notification, authorization. It can lead to innovative ways of reusage of data, like exchanging the requests for mooring and berthing in ports and marinas of all sizes.

The PCS is determined by the operation of a port and this is determined by the location of the port and its surrounding. Furthermore, the functionality of a PCS depends on the initiators of the system as they have a large influence on the development of the system. In short, a PCS can be described as a central point for an organization to deliver or receive information.

PCS provides full transparency on the movement of goods, including dangerous goods and other notifiable cargoes, status information and control, tracking and tracing through the whole logistics chain as well as full range of cargo and the maritime statistics. It provides real time information to allow the next step of the process to proceed immediately, elimination of paper transactions, personal visits to multiple agencies and in general faster cargo movement processes.

It provides significantly better quality of gathered and exchanged data, that allows better accuracy, objectivity, and reputation.

2.1.2. Expected changes

PCS offers process automation that transcends single applications used in logistic and transport operations. It fills the gaps between applications and processes allowing much faster operations, notification, less errors in documents and data and a possibility to move from reactive to predictive planning.

Best practices of usage of PCS systems include the following functionalities: fast, easy and efficient EDI information exchange allowing for the centralization and one-time lodging of documents and information which allows for the re-use of information which is available 24 hours a day, 7 days a week and 365 days a year. Interaction with Customs systems and submission of the necessary declarations. All information regarding import, export, transshipment and

transit cargo is handled electronically, substantially reducing the need for phone, fax, email, paper messages and personal visit transactions for the stakeholders.

2.1.3. Assessment of necessary modifications

Introduction of PCS systems augments and, in some ways, changes the existing processes in port community. The main purpose is to facilitate and integrate the data without necessarily replace existing operations management solutions.

In addition to the existing application portfolio the PCS represents additional platform for messaging, transformation, notification and other management of data workflows. It can be used also as a business monitoring tool that allows checking the regular execution of processes, quality of data and eventual errors in other subsystems.

Preparation of right processes and development of required interfaces are key elements in using PCS in port communities.

2.1.4. Assessment of potential risks

Regardless of the size of the port, it is very important that members of the port community agree on the system's requirements. A true sense of community and a general feeling of involvement need to be established. Different prerequisites and interests of e.g. major multi-national companies and one-person service providers need to be overcome.

The success of a PCS can only be maximized if all member groups of the port community realize benefits and thus share information. A PCS also should not duplicate functions that are already existent in other systems, but rather focus on general operational processes. It is also very important that sensitive information in the PCS be safeguarded.

2.2. Impact on labor market

2.2.1. Consequences/repercussions

The introduction of the new application, that will become a communication channel between the Port Authority and CIMIS (Croatian Integrated Maritime Information System), will simplify the work and increase the effectiveness of the Port Authority. The direct utilization of this application will manifest in the increase of the effectiveness and the speed of port processes, enabling easier administrative and commercial processes, including the processes of port logistics and coordination, as well as enabling the maintenance of all the data in the same place of storage and overview. Thus, the data accessibility and the production of statistical basics would be simplified and alleviated.

2.2.2. Expected changes

The system will greatly affect the mode of work and processes of the Port Authority. Firstly, it enables the automatic linkage of the entered data relating to the vessel in the port. Furthermore, its usage reduces the administrative burden imposed on the employees in a sense that it enables simplified operational dana entry and processing, as well as faster and more effective data collection and exchange. A distinct change compared to the current mode of work, manifests in the minimalization of the data nonconformity from different platforms that are used daily by the actors in the Port Authority and which enable a communication with the national bodies (Captaincy, Ministry of Finance, Ministry of the Sea, Transport, and Infrastructure, etc.) and the users. Consequently, the introduction of this system in everyday work contributes to the increase of the effectiveness of maritime transport.

2.2.3. Assessment of necessary modifications

In order to enable a functional usage of this unique application, it is necessary to analyze the data and processes that must be processed through this application, develop and implement the new software solution for the port management, and form the specific application which would connect with CIMIS and, thus, enable fast, simple, and safe input.

2.2.4. Assessment of potential risks

Considering that it is a custom-made application, its development and implementation are at a certain risk of failure in every phase. It is necessary to include all the key stakeholders in the process of system development, who will use the application for communication purposes. In that way, their permission for communication and data transfer will be enabled. On the other hand, there is a potential risk of impossibility of complete data linking. Moreover, a successful implementation underlines the accuracy of the application, while considering the actual situation in the port. Untimely update of the data is definitely another risk that needs to be taken into consideration during the development because, otherwise, it might lead to the complete ineffectiveness and inutility of the system.

3. Selected innovation: Mobile solutions for Safety/Security

On a large passenger ship, safety and security is a key factor, especially during emergencies. In fact, after a fire/flooding casualty ship abandonment could be necessary requiring a fast evacuation procedure. In such cases, passengers must be guided to the safe area and then to lifeboats and a mustering procedure is needed to ensure the complete evacuation of the vessel.

3.1.   Impact on technical operations

3.1.1. Consequences/repercussions

Informatization can aid to manage the evacuation procedure on passenger ships as well as other safety and security issues. With the help of innovative technologies like biometrics (e.g. fingerprint/iris/facial recognition) or wearable devices, passengers and crew can be authorized for access to cabins, restricted areas or to count passengers during mustering operations.

Similar results can be obtained also with the usage of dedicated mobile application. Because of the widespread usage of smartphone by passengers, this solution can be easily implemented and allows also a better customer service and user experience for the passengers.

With the implementation of such location-based services and authorization methods, safety and security procedures can be better organized, tracked and measured. With the respect of privacy, it can give better service for both passengers as ship crew.

A smart mobile solution can lead to shorter times of security procedures (emergencies and regular security procedures), less errors and can serve for better notification and information spread to every passenger and crew member.

3.1.2. Expected changes

On-board passenger ships, mobile apps can be developed to localize passengers on-board, to identify easily an unauthorized access to restricted areas, to guide people during evacuation procedures and/or to communicate to the crew a potentially dangerous situation, resulting in a more rapid reaction to emergencies.

The result of introduction of mobile solution for safety, security and informatization purposes can lead to a modification of security procedures. Technology in this case opens the opportunity

to better handling massive amount of data (large number of passengers) within shorter periods of time, with greater accuracy and less unwanted waiting/burocracy check points.

Apps can be used also for commercial purposes (e.g. payments, location-related adverts) and opens the possibly for new, innovative services on board of ships, that are not possible within current processes. Moreover, all the main cruise companies already encourage the usage of mobile applications with commercial purposes (e.g. book cruises/excursions, schedule activities onboard, receive commercial information, etc.). Many of these applications provide also the map of the decks and the most advanced includes also a guiding system based on Bluetooth beacons, which helps passengers in finding attractions or other people onboard.

With such an application passengers could communicate to the crew a potentially dangerous situation concerning a safety or security issue and receive instructions or communications too. All the collected data, properly stored and analyzed respecting passengers' privacy, can allow a faster reaction of the crew facing safety issues and a reduction of security threats (e.g. sabotage, terrorism).

3.1.3. Assessment of necessary modifications

To allow the use of such innovative mobile solution a ship infrastructure and application support should be upgraded. A beacon solution shall be installed on a vessel, supporting passengers in case of emergency. It will orientate them creating the conditions for safe boarding and un-boarding. A mobile solution will be elaborated to provide the necessary information and to collect information from the people on board.

Onboard localization system should contain emergency evacuation plans and feed mobile apps with the data for real-time guide of passengers during the evacuation procedures and allow automatic passenger recognition during mustering operations. The sets of data and procedures are similar to the technology studied for building evacuation.

The solution could be based on the eVACUATE project founded by the European Union, a mobile application devoted to reducing evacuation time has been developed to reduce the evacuation time.

3.1.4. Assessment of potential risks

Introduction of mobile solution for safety and security can bring quite a lot of benefits, but not also quite a few risks. First of all, not all of passengers are equipped with mobile phone, so there should be a hybrid solution put in place to cover all the passenger list.

The passenger also doesn't necessarily carry their phones with them all the time, so the alerts and security services could not be carried all the time and not with the exact precision (phone might not be where a passenger is).

The implementation should also find a way to guarantee, that passengers will have the required application installed on their phones and configured in the right way (permission granted for location-based services, message exchange allowance). Passengers will probably have to be registered to match their identity with the phone app in particular if a selective authorization access should be performed with the mobile app.

Usage of private phones for security and safety functions must also address concerns about the privacy. The usage of the app should be transparent towards passengers and respect the applicable GDPR and other privacy related requirements. There should be no additional acquisition, storage and utilization of data about the passengers without their consent.

There is also a risk, that such mobile application would not work in a way that is intended in circumstances, when is much needed. Beacons and mobile server could not cope with the load of data in emergency instances. Communication and energy could be disrupted thus disabling the use of phones. Usage of mobile application should have a backup plan to mitigate the risks in these cases.

Mobile application that is used for safety and security can be also subjected to hacking and intentional disruption, so all of the information security principles and technologies should be

applied to make the application a useful tool, not an (unintentional) weapon of hackers and terrorists.

3.2. Impact on labor market

3.2.1. Consequences/repercussions

The application of Mobile technologies in managing onboard safety and security issues is not expected to have a very strong impact on the labor market. In fact, although the application of such technologies can reduce the reaction time to face a threat, to perform an evacuation procedure or to locate a passenger, these advantages do not change the nature of the operations to be carried out to face a safety/security issue, but only slightly change the procedures, in particular concerning the issues detection and the definition of a proper reaction. Therefore, it is not expected that the number of onboard employees will considerably change due to the introduction of mobile applications. However, some new skills will be required onboard to properly use the new systems and, thus, gain an advantage from them. Thus, some minor changings regarding the required crew expertise or the definition of proper training courses will be probably be coupled with the introduction of mobile applications. The introduction of mobile solutions on safety and security is not expected to cause any repercussion on wedges.

3.2.2. Expected changes

As mentioned, the expected changes in the labor market due to mobile solutions for safety/security are mainly related to the onboard personnel expertise. Namely, the crew members will be required to know the functionalities of the new systems and the related procedures. Besides, it will be necessary to train a few crewmembers from each passenger vessel in the management and maintenance of the onboard servers and sensors.

Moreover, the introduction of mobile applications will create new opportunities for software houses, which will be involved in the development and maintenance of the systems, leading to the creation of new jobs.

3.2.3. Assessment of necessary modifications

It is not expected that relevant modifications of the labor market are required for the introduction of mobile solutions to face safety and security. A brief course including drills will be probably sufficient to train current employees.

At the same time, for the development of mobile solutions for safety and security are not required new figures from the labor market: the effective collaboration between current professionals and researchers in marine engineering, information technology and automation fields are expected to allow the development and installation of these new solutions.

3.2.4. Assessment of potential risks

It is not expected that the introduction of mobile solutions for safety/security will entail relevant risks. Due to the possibility of a faster reaction, some shipping companies could be encouraged to slightly reduce the number of employees, especially the ones devoted to security. However, this reduction should not be as relevant to be considered a threat to the profession. Besides, the drills without the mobile applications could be reduced, leading to lower preparation of crew members (and also passengers) in case of a critical failure of the new systems. In such a case, operations could slow down an be more chaotic than present. This consequence can be mitigated by maintaining the current training for crewmembers together with the one related to the adoption of new applications and by developing resilient applications based on redundant hardware.

4. Selected innovation: Warehouse Management System 4.0 (WMS)

Warehouse management system (WMS) is defined as a software application, designed to support and optimize warehouse functionality and distribution center management. Such systems can facilitate management and operations planning, organizing, staffing, directing, and controlling the utilization of available resources, to move and store freight into, within, and out of a warehouse, while supporting staff in the performance of material movement and storage in and around a warehouse.

4.1.   Impact on technical operations

4.1.1. Consequences/repercussions

WMS system that is tightly connected to all other information system in port community and broadly in the transportation chain processes (for example utilizing estimates of ship arrival or departures) can substantially improve the goods warehousing process, speed up operations, reduce the requirement of storage space and prevent errors.

An automation of storage processes with an intelligent WMS system can contribute in much faster management of distribution center and whole port community. If the WMS is regularly fed with current data and estimates of goods movement it can even offer predictive optimization as a consequence of events that affect the usage of space and manipulation of other goods in warehouses.

4.1.2. Expected changes

Most of the port communities and distribution centers already employ some kind of WMS systems. The expected changes depend of the level of maturity of currently employed WMS system, desired level of automation, integration with additional information sources and specifics for handling different types of goods (packages, pallets, cars, cars,…)

The characteristics of an innovative WMS system is high level of automation, so it is feasible, that the process for the employees will be simpler and more error-proof. A WMS system that is efficiently connected to the other port and logistic chain management application can result in storage strategy of goods that requires minimum necessary storage manipulation during the permanence in warehouse.

An innovative WMS can offer different types of optimization, like minimum time for access and manipulation of goods or minimum space used in the warehouse facility. WMS system can suggest strategies to shorten the manipulation time for example by grouping the cargo based on the next destination, next transport and by customer.

With the use of innovative sensor technology, the smart WMS system can automatically track the location of cargo and allow automatic and semi-automatic movement, check-in/check-out, internal re-optimization of space and other activities that can lead to the desired goals.

4.1.3. Assessment of necessary modifications

To better utilize the automation capabilities of WMS system it has to connected to the sources that can be used for description of the goods (type, size, weight), quantity, estimated times of arrival and departure, next destination, type of transport and other useful data.

At the same time, WMS data can be reused in the processes that follow check-out of goods in the process with a better estimates of check-out time (finding, preparing for check-out) of goods in warehouse. At the same time in can contribute to traceability and visibility of status of the cargo packages.

To allow such advanced automation, the system must have adequate data interface, sources of data with good quality and timely information. For internal automation, it has to be connected to a network of sensors and smart (IoT) devices) for storage space, cargo tracking and equipment tracking purposes.

One of the crucial parts of advanced WMS system is warehouse optimization module, that can process and interpret acquired data and perform operational decision and actions to automatic on manual storage manipulation.

4.1.4. Assessment of potential risks

Just-in time approach to warehousing manipulation and optimization of storage activities can be only as good as the estimates and data that can be provided for planning and optimization. Without good and reliable sources, a modern WMS system cannot perform up to its capabilities.

If data about the cargo is not available or is available too late in the process, the WMS system cannot include this information in the planning process. This has not only the consequence on the performance of warehouse, but also on the later stages of logistic process following warehousing.

The risk of lack of information about the cargo is a multiplicative factor. If data for one group of cargo goods is not available, this can potentially affect all other optimizations in WMS, because these are related. These risks can be mitigated applying right strategies in cargo handling, dividing storage space in sections that can individually optimized and applying other methods for limitation of repercussions based on such event.

Lack of quality and timely information on the other hand still allows a regular warehousing functionality, which is a good starting point, because this type of problems don't disrupt the entire warehousing process. There can be procedures in place that can correct temporarily problems and bring the WMS to its desired state.

4.2. Impact on labor market

[In order to gather first-hand and current market information, PP2 has carried out a structured interview with Marco Crasnich, CEO of OVER-LOG Srl, experts and consultants for warehouse software solutions and services, based in Udine, Italy]

WMS 4.0 bring changes and impacts on several aspects: the technological aspect is often a web cloud-based interface, that can be accessed anywhere from a multitude of devices and therefore is independent from the physical warehouse facility. Typical specialised devices are barcode readers including pick-to-light (with light indicating which items need to be picked) and "voice picking" (warehouse operators wearing a headset delivery voice instructions). Some specialised warehouse area can also include ASRS (automated search and retrieval systems) unmanned solutions. Orders can even come directly from the ERP software to the WMS..

Note: Internationally standard WMS 4.0 solutions are not currently present in Italy, due to their cost being too high for most companies (from 400k to 1m euros).

4.2.1. Consequences/repercussions

WMS 4.0 allows also transformation of good to take place in the warehouse, as well as packing, end-of-line customisation, e-commerce distribution and end client operations also can happen within a WMS-enabled warehouse. The growing complexity in operations is generally calling for automated processes or even automated decision-making, and that can impact on labour market.

It will not be easy for everyone to adapt to the evolution of WMS. Often logistics operators are not as fast to respond as the manufacturing and distribution industry are. There is a limited drive towards investments for logistic operators: with no guarantees of long-term contracts it's very difficult for them to make such investments.

4.2.2. Expected changes

Probably low-level job positions will be reduced, since the WMS will make its own decisions and instruct operators. Higher-level position will be needed in order to develop strategies and deal with a more sophisticated system than before.

The collaboration with manufacturer will be much closer than before, this will also have an effect on specialised jobs jobs to deal with co-designing.

Many steps have already made by logistics operators for tracking and tracing. Now, if operators will also be able to obtain a role in the end-of-line operations market and added-values services, then they will be more motivated towards investments.

4.2.3. Assessment of necessary modifications

A change at the organizational level is fundamental. The traditional freight-forwarder job becomes process-oriented and somehow more similar to the manufacturing industry.

Manufactures and distributors will keep moving faster, so logistic operators will also need to do the same.

Operators need to keep up-to-date and make use of all available incentives for modernisation, those should not be missed out. Deliveries will be even more fragmented and that also impact on labour, since more transportation agents will be required to deliver small quantities to very many destinations.

4.2.4. Assessment of potential risks

What represents a risk for somebody may become an opportunity for somebody else: avoiding the risk of making an investment now could become the risk of losing market in favour of competitors who instead made that invementment previously and at the right time.

Since manufacturers and distributors will keep speeding up their operations and needs, slower logistic operators and their infrastructure risk to remain isolated, become obsolescent and thus lose business is they do now keep up with the pace of the industry.

5. Selected innovation: DSS (Decision Support Systems)

The application of decision-making techniques, can replace a subjective synthesis processes with more objective ones, leading to a reduction of human error. The information from all crucial systems should be collected in a single DSS capable to perform a reliable analysis, providing the outcomes by means of user-friendly interfaces. Moreover, DSS could bring together European and international evidence on accidents and injuries causes, suggesting links between those risk factors and the respective countermeasures.

5.1. Impact on technical operations

5.1.1. Consequences/repercussions

DSS solutions can substantially help the decision-making process, on operational and tactical levels. The key capability for DSS solution is the extraction and synthetization of operational data with the knowledge about the processes from historic data, industry comparison and other sources of data, that contribute and impact decision making process.

To assemble meaningful, most important and critical information, a complex processing of large amounts of data must be processed in short time to allow up to date results, particularly for operations DSS solutions.

Several innovative techniques, like Big Data Analysis, Machine Learning and other methods can be used to help assemble a DSS solution that I supportive and can even improve in time. DSS systems usually require substantial investment in building a dedicated infrastructure to load such amounts of data, so that systems for operational management are not affected in performance and scope.

The results of DSS systems should contribute to make quicker, more accurate decisions and follow the notification for anomalies and changes that might in time lead to the problems, either in operations or business goals.

5.1.2. Expected changes

Proposed DSS systems generally does not require changes to the existing supply and transport chain solutions and are used on separate systems. The usage of DSS system usually does not affect operational data, which serves only as a source (although the most important) for building a decision-making tree.

The opportunity of using a specialized DSS system is the ability to collect and interpret data from other sources in Maritime industry and brother communities, that was previously impossible to collect, correlate and analyze in effective ways.

A DSS system can better take in advantage the comparison and analysis of historic data, predictive analysis data, forecast and other relevant sources for preparation one or more (alternative) proposals for decision making process.

DSS system will affect and change mostly management (operational and strategic) decisions, but typically not directly and immediately the operational processes. DSS system can be used as a verification and cause-result analysis in the process of planning od business and operations activities.

5.1.3. Assessment of necessary modifications

To effective use a DSS, a separate dedicated database of synthetic data should be built and maintained in time. Since a DSS system works better when multiyear data is used in consideration, the database for DSS system will grow in time, with speed that depends on level of details that should be maintained for long term planning and decision making.

A new connectivity, messaging and transformation processes will have to be put in place if there is the need or interes to connect the data, that is not available inside the local port systems. Algorithms for data collection, cleaning and transformation should be tailored for the specific DSS needs.

5.1.4. Assessment of potential risks

Besides of the identified benefits, DSS system brings also quite some risks. First and foremost, the suggestions from DSS system should be understood to be used for the good results. It is feasible the specialized data scientist will need to help decision makers to understand and get used to DSS systems. This is usually ongoing process since the scope of DSS system often changes after initial use. The frequency of requests for change can also present the risk in a sense, that trial and error approach can be quite expensive in time, resources and costs.

Apart from failing to assemble a good DSS process and interpret the presented data for decision making, the risk is, that the data or results of DSS process are simply wrong. That could have a serious consequence for the ports. Carefully verification (with an alternative methods), parallel running and analysis of gaps should be put in place before putting DSS system in full production.

One of the risks is also ability to prepare relevant suggestions for DSS process in a timely fashion. This is particularly important if DSS is applied for operational processes that have limited time to be put in action. There is a chance, that for this kind of decision the suggestions would be simply too late or too complicated to be realistically used in decision process.

5.2. Impact on labor market

5.2.1. Consequences/repercussions

The application of onboard DSSs is not expected to have a very strong impact on the labor market. In fact, the purpose of DSSs is not to replace human beings but to help them in taking faster and more rational decisions. The main repercussion will probably be the request of higher expertise necessary for using the DSSs. These additional skills will be mainly required onboard for masters, deck officers, engineer officers and technical personnel, but also for personnel in fleet operation centers or port control centers located onshore. Besides, new opportunities will arise for the design, development and maintenance of DSSs. It is not expected any impact on wedges.

5.2.2. Expected changes

As mentioned, the main expected changes in the labor market due to DSSs are related to the users' expertise. Namely, the officers and technical personnel will be required to know the functionalities of the new systems and the related procedures for evaluation, planning, alternative solutions/countermeasures computation. Besides, especially onboard, wider maintenance competences will be required in order to assure the proper functionality of new systems.

Moreover, the introduction of DSSs will create relevant opportunities for research institutions and software houses. Namely, it is expected that an increasing number of DSSs related to new systems and operations will be developed, requiring the definition of new algorithms and mathematical models.

5.2.3. Assessment of necessary modifications

The modifications required to adopt DSSs in ordinary operations are not relevant. Current employees can be easily trained in using the new systems without requiring new figures.

Quite larger modifications of the labor market could arise to allow the development of DSSs. In fact, to develop a DSS, it is required a deep technical knowledge that cannot easily be found in a pure programmer. Therefore, the labor market could require new hybrid figures characterized by a strong technical background combined with good programming skills.

5.2.4. Assessment of potential risks

There are no risks connected to the reduction of the number of employees connected to the adoption of DSSs. The main risk is related to the possible loss of the knowledge required to operate without the aid of DSSs. The confidence in DSSs aided operations could lead to the progressive disappearance of competencies that are essential to maintain the operation of a ship, a fleet or a port facility after a critical failure of one or more DSSs. This problem has to be considered by companies and shall be mitigated by means of additional training and drills on present procedures which are not based on the outcomes of DSSs. Redundant systems and resilient development are recommended too.

Conclusion

D313 shows the need and importance of setting a good, standardized base for operations process automation (Document digitalization, PCS, WMS), which can in its parts trigger further innovations. The best example of utilization of better, innovative base data is utilization of this data for better operations and strategic decisions (DSS) and introductions of innovative technology (Mobile safety and security).