DigLogs

Analyses of the most attractive informatisation processes already on-going and directly transferable in the ITA-CRO area

Deliverable 3.1.2

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Introduction

The purpose of this deliverable is to select and extensively analyse the most promising innovations related to <u>informatisation trends</u> among the ones gathered in D3.1.1. The activity has been carried out by Elevante Srl and UniTS involving all the other PPs.

In this Deliverable the most attractive innovations already on-going and directly transferable in the Italy-Croatia area in the prospective three years are analyzed. To achieve overall goals, a straightforward methodological approach is developed, which is composed by two streams of activities.

First, a best practice analysis is conducted on a number of already-on-going innovations. The results are shown in the form of "cards", reporting an in-depth analysis of each selected innovation. All PPs have been asked to collaborate and carry out at least one analysis each, in order to define the state of the art and the most recent developments regarding the innovations that can be applied in the next three years in the project area.

Secondly, in order to get an effective assessment about the transferability of available innovations, PPs are involved to identify priorities. The overall idea is to move from the level of disruptive innovations to pilot actions in a smooth and coherent manner. In particular, an on-line questionnaire was developed in which each PP is asked to identify tech priorities by ranking the innovations identified in the previous Deliverabels on the basis of two criteria, e.g., their importance and easiness of implementation.

The questionnaire was jointly prepared by the WPL and the University of Trieste in coordination with the LP. It was submitted to PPs in July and results were collected and analysed at the end of August in order to map the importance of the innovations described in D3.1.1 and the easiness/difficulty expected in their deployment.

Overall results are presented for each trend both in aggregate – e.g., for all the ITA-CRO area – and with respect to each PP, reporting the final rank of priorities based on the above mentioned criteria, thus, the identification of directly transferable innovations. A both descriptive and graphical representation is produced.

The results from the questionnaire have been analysed by Elevante S.r.l. and UniTS providing a global analysis and a single partner analysis. The former offers some insights about informatisation processes in the Adriatic Region, while the latter provides results highlighting the priorities of each player involved in Diglogs project, some of which will be tested in subsequent pilot actions.

1. Informatisation processes:
Best Practice Analyses of already on-going innovations

In the present section best practices concerning some of most important innovations connected to the informatisation processes are discussed. The best practice analysis is essential to provide a starting point for innovation implementation within the Adriatic Region, i.e. the project area. All PPs have been asked to collaborate and carry out at least one analysis each, in order to define the state of the art and the most recent developments regarding the innovations that can be applied in the next three years in the project area. In addition to those provided by PPs – among all 3 innovation trends, namely: Informatisation, Big Data/Data Analysis and Automation systems – WPL (Elevante Srl, PP2) has carried out 5 analyses , PP4 (UniTS) has done 3, while the LP has provided a document that also included several analyses. Within the Informatisation processes innovation trends, a total of 8 already on-going innovations have been investigated and presented in the following paragraphs.

1.1. CWS Container Weighting System (PP2)

The incorrect declaration of weight is a significant issue that arises in many trade sectors and has led to a number of incidents. Proper container handling and safe vessel stowage planning requires the verification of accurate container weights before the vessel loading process occurs. Since July 2016, it has been a legal requirement to have a verified container weight as a condition for loading on a vessel. Under the SOLAS (Safety Of Lives At Sea) amendments, there are two permissible methods for weighing:

<u>Method 1</u> requires weighing the container after it has been packed;
<u>Method 2</u> requires weighing all contents of the container and adding those weights to the container's tare weight, as indicated on the rear-end of the container.

There are no exceptions to this requirement and estimating weight is not allowed. The shipper (or if assigned by the shipper, a third party) has the responsibility to weigh the packed container (or to weigh its contents). The weighing equipment used must meet national certification and calibration requirements. Finally, the agent packing the container is not allowed to use a weight that somebody else has provided. Carriers do not need to be a verifier of the shipper's weight verification, they can rely on a shipper's signed weight verification to be correct. However, it is important to note that, for the shipper's weight verification to be compliant with the SOLAS requirement, it must be *signed*, meaning a specific person representing the shipper is named and identified as having verified the weight.

Most recent applications (such as James Fisher & Sons and Strainstall's Container Weight Systems) are designed to be retrofitted to existing container handling equipment with no substantial modifications required, enabling easy installation and adaptable to suit all major crane and spreader manufacturers' equipment. The system can be retrofitted into the spreader headblock (or at the twistlock) making it a permanent feature of the container handling equipment.
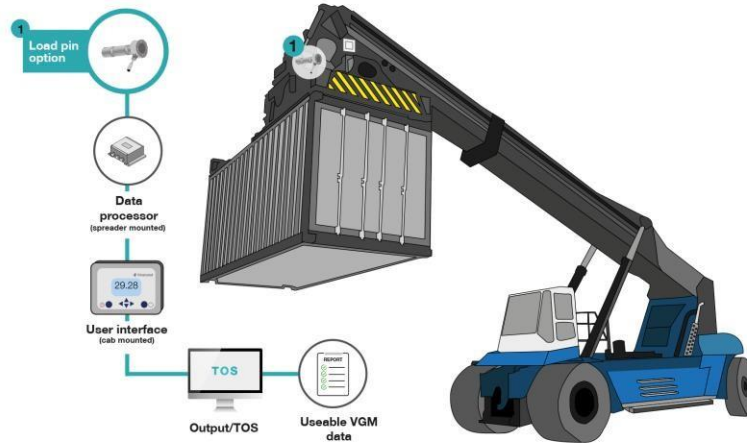
Figure 1 - A container handler equipped with CWS

Developed in response to industry needs to meet VGM-SOLAS requirements, the latest generations of Container Weigh Systems deliver highly accurate and repeatable results, with 100% of all data points falling within +/- 300kgs (for weights up to 20T) and 1,5% (for loads beyond 20T).

Spreader-based weighing systems are a solution that has no operational impact on existing terminal operations. There is no need to implement separate lift and drop for weighting.

This gives ports and terminals the opportunity to obtain a VGM (Verified Gross Mass) for each container without any additional operations and/or costs.

The above mentioned solutions have already been implemented in various locations around the globe, including DP World Southampton, Hong Kong and the Flavio terminal in Naples, Italy.

By installing a container weighing system into existing container handling equipment, there is no need to provide a dedicated weighing station, simplifying the logistical flow of terminals and increasing its operational safety.
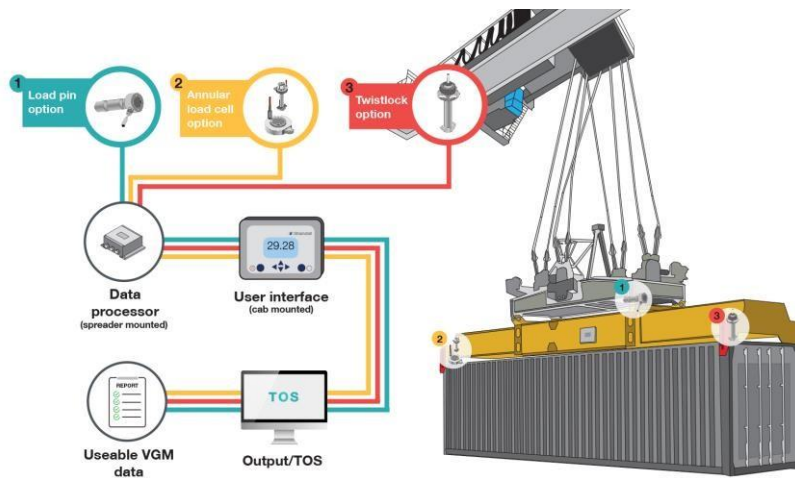
Figure 2 – Scheme of a CWS

The CWS detects when a container is lifted and automatically establishes its weight, which is then transmitted to the TOS, together with a "lift ID". The system provides a time stamp with each VGM to allow the TOS to automatically associate the VGM with a particular container. No driver or crane operator intervention is required, thus eliminating human errors.

1.2. Augmented Reality for Logistics (PP2 and LP)

Although AR is in relatively early stages of adoption in logistics, it could offer significant benefits. For example, AR can give logistics providers quick access to anticipatory information anytime and anywhere. This is vital for the prospective and exact planning and operation of tasks such as delivery and load optimization.

The availability of virtual reality and augmented reality applications will lead to possibilities for port operators and logistics service providers to fully exploit the advantages of simulation software. Port operations can be modelled in order to analyse operational flows, pinpoint possible barriers as well as define enhancements, and simulate and assess various scenarios of design and throughput. This can be done for existing or newly planned port layouts as well as for terminals. An additional benefit is that such simulation software can also be used to train staff. Already, current proprietary or service-based resilience predictive tools are becoming far more powerful and efficient, and such simulation tools are a valuable asset in emergency and mitigation planning. Considering the automation and robotization of various types of vehicles and equipment, simulation will be important in understanding the impact of these developments as well as how to adjust terminal processes in order to optimally integrate these developments into everyday operations.

Augmented reality, defined as the expansion of physical reality by adding layers of computer-generated information to the real environment, will further support such simulations. This is a technology in full development that will become part of everyday life. In a port related environment one can envisage enhanced feeds from infrastructure, port equipment, automated vehicles and various types of drones.

Figure 3 - Sample of augmented reality application

AR can have a wide field of applications ranging from operational support of how to execute certain processes to active safety or security interventions.

More applications regard extending AR to value added service offerings in logistics: Warehousing Operations (optimized picking, warehouse planning) Transportation Optimization (freight loading without printed lists and load instructions; completeness checks for loads and documentation; real-time traffic data to optimize routes or re-route shipments), Last-mile Delivery (driver could receive information about a specific parcel by looking at it with their AR device, AR can provide last meter navigation info).

1.3. Smart Contracts and blockchain (LP and PP2)

Smart Contract, in a lack of viable blockchain solutions and numerous and oft-competing platforms, can offer container shipping a way to streamline payments and tether those payments to physical movements. The tools are computer protocols that facilitate, verify, or enforce the negotiation or execution of a contract, sometimes allowing the partial or total exclusion of a contractual term.

This technology is designed to replace traditional contracts for a host of reasons:to reduce latency in payment, to eliminate discrepancies in the invoicing and payment process, and to link processes to real-world physical events. The goal of a Smart Contract is essentially to make contracts self-executing and enforceable, which is to say automated. Theoretically, if a Smart Contract is properly set up, processes are automatically initiated.

To enable them to work, Smart Contracts they use another technology: Blockchain.

This innovation is based on a method whereby previously unknown parties can generate and maintain virtually any database on a fully distributed basis where the correctness and completeness of transactions, if validated using the consent of independent verifiers.

The system shall operate in such a way that a copy of the database or its partial copy is distributed to each party, and that party may then make changes to the database subject to collectively accepted

standards. Changes made by different parts are collected and stored in the database at regular

intervals as grouped packages called "blocks".This is a sequence (or chain) of linked blocks, taking into account time transactions that are secured by public key encryption and verified by the network community. Once an item is added to the blockchain, it cannot be modified, turning a blockchain into an unchanging record of past activity.The blockchain technology, combined with Smart Contracts, solves the problem of double spending.
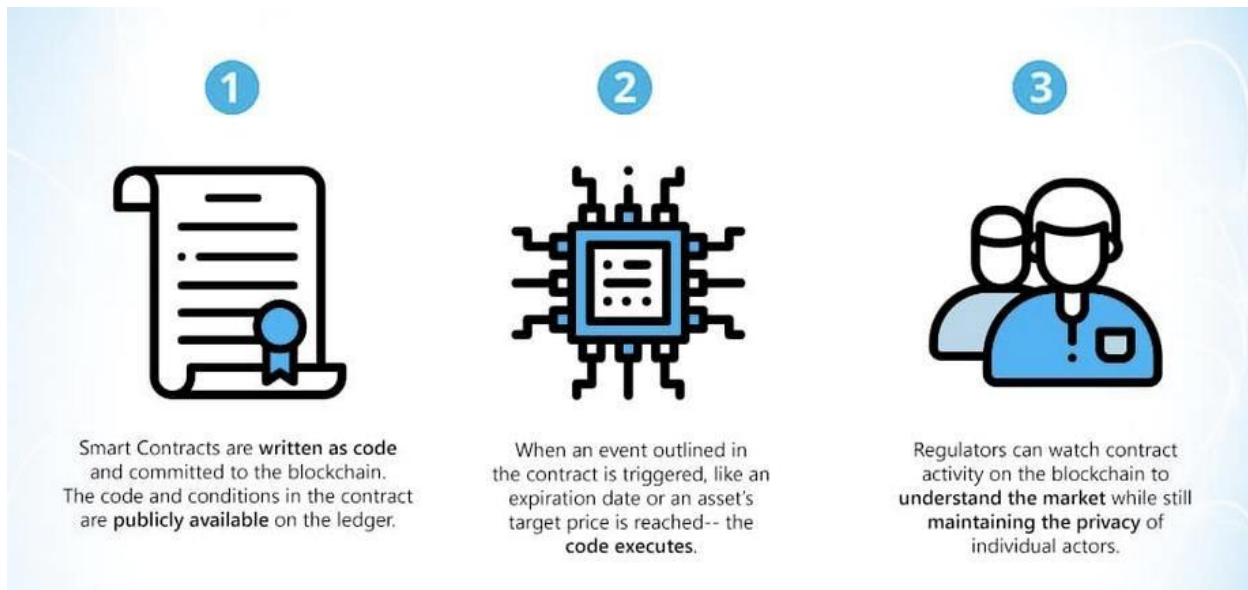
Figure 4 – Main steps in a smart contract workflow

Double spending is when same digital currency can be spent more than once: an instance in which a transaction uses the same input as another transaction that has already been made on the network.

This is a flaw that is unique to digital currencies because digital information is something that can be reproduced rather easily. This can be fixed with the help of public key encryption, in which each user is assigned a private key, and a public key is shared with all other users. The main idea of blockchain is a distributed database that includes records of transactions that are shared between the participating parties. Each transaction is verified by the consent of most system participants, making fraudulent transactions able to pass the collective verification. Once a record is created and accepted by the blockchain, it can never be changed.

All network members can verify the transactions in the block. If no consensus is reached on the

validity of the new block, the block is rejected. Similarly, if there is consensus on the validity of the operations in the block, the block is added to the chain.

Each block contains not only transaction records, but also the hash of the previous block. This creates a block of interdependence that connects up to a chain: the Blockchain.

Smart Contract technology addresses an elusive network problem by allowing transactions that are not based on centralised authority. Values, assets and rights may be exchanged without central institutions. These transactions are verified, monitored and enforced through blockchain technology. It offers confidence to all those involved in the process.

This type of technology changes the way transactions are conducted a decentralized system, without using the system.

On March, 2018 – 300cubits, a Hong Kong-based firm focusing on developing Ethereum blockchain for shipping, announced the successful completion of the first trial shipment in its Smart contract distributed on ethereum blockchain. The TEU tokens held as a booking deposit on blockchain were successfully returned to users upon receipt of the EDI port message on a textile shipment.

The shipment consists of two 40-foot high cube container boxes going from Malaysia to Brazil. A liner company, Malaysia's West Port and, LPR, a Brazilian textile importer that ships few thousand TEU a year have participated in the trial.

The shipment booking was confirmed on 8 March 2018, booking deposits in TEU tokens were placed by both the shipper and the liner on 9 March 2018 and returned on 15 March 2018 upon successful completion of shipment loading. The respective Blockchain Smart Contract transactions of this trial shipment can be viewed in Etherscan in conjunction with the source code published in GitHub.

1.4. The PCS objective: a best practice analysis (PP5)

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.

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 utilisation is gathering the data and making it visible to interested and entitled stakeholders, providing operational data for planning purposes. Both in the inner port community as well as brother local community, for example as way to mitigate environment impact and public transportation optimization.

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.

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.

Best practices of usage of PCS systems include the following functionalities: fast, easy and efficient EDI information exchange allowing for the centralisation 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, transhipment and transit cargo is handled electronically, substantially reducing the need for phone, fax, email, paper messages and personal visit transactions for the stakeholders.

PCS provides full transparency on the movement of 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.

1.5. Mobile Solutions for Safety/Security (PP4)

On a large passenger ship, safety & 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 have to be guided to the safe area and then to lifeboats and a mustering procedure is needed to ensure the complete evacuation of the vessel. Informatisation can aid to manage the evacuation procedure [1] on passenger ships as well as other safety & security issues. In detail, solutions based on biometrics (e.g. fingerprint/iris/facial recognition) or wearable devices [2,3,4] can be adopted to authorise access to cabins or to restricted areas or to count passengers during mustering operations. However, for this purpose, a very promising solution is the exploitation of mobile technology [5].

Nowadays the majority of people own devices supporting mobile applications. 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 [6], which helps passengers in finding attractions or other people onboard. Although their usage is presently limited to commercial purposes, the mobile applications can provide several benefits in safety and security field too. In detail, onboard passenger ships, mobile apps could be adopted to collect data in an active or passive way devoted to reducing reaction time during emergencies of both crew and passengers. In fact, mobile solutions can be developed to localise passengers onboard [7,8], allowing to easily identify unauthorised access to a restricted area. Moreover, passengers, using an app, 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 analysed respecting passengers' privacy, can allow a faster reaction of the crew facing safety issues and a reduction of security threats (e.g. sabotage, terrorism).
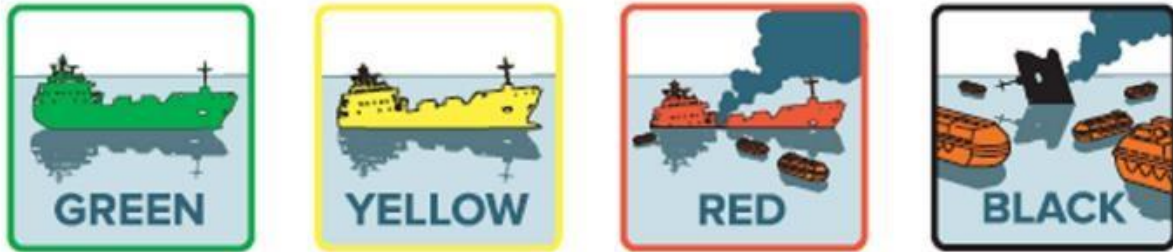
Moreover, provided an onboard localization system of mobile devices, an application could guide passengers during the evacuation procedures and allow automatic passenger recognition during mustering operations. Some examples of such systems have been studied for building evacuation [9,10] and could be easily adopted even in port terminals. Moreover, during the eVACUATE project founded by the European Union, a mobile application devoted to reducing evacuation

time has been developed [10] together with other systems to reduce the evacuation time. Among different scenarios tested during the project (a soccer stadium, an airport and a metro station), the test performed in March 2017 on MSC Meraviglia, while was in finalization at St. Nazaire shipyard, is particularly interesting. Although dynamic signs were adopted instead of the mobile application during the test, it shows clearly how additional guidance can reduce the evacuation time on a large cruise vessel in case of obstruction of some escape routes (an event that can easily occur in case of fire).

1.6. Decision Support System (PP4)

During maritime operations, especially on aged ships, it is common that masters and officers have to deal with incomplete information. In recent years several studies explored the enhancement of the amount and quality of information by means of monitoring systems. For example, proper monitoring systems can be adopted to improve intact and damaged stability [11,12], ship structural strength [13,14], the response to flooding emergency [15-19] or navigational issues [20-22]. However, even a too large set of heterogeneous information, provided by several different monitoring systems, can be a problem, increasing the probability to neglect some crucial information while assessing the ship safety status.

To solve this problem, decision-making techniques can be applied onboard, defining rational and objective synthesis procedures to assess ship safety. The information from all crucial systems can be collected in a Decision Support System (DSS), which analyses all the data and provides the results by means of user-friendly interfaces. Reacently this concept has been studied and some applications are already on the market: Perera et al. [23] developed a DSS to assess ship safety in rough weather based on multiple parameters (loads, motions and operational safety). Moreover, the safety state of a ship after an emergency was studied by Nordström et al. [24] defining an approach to assess and communicate ship safety status (Fig.6). The approach took into account several threats including flooding, fire, listing, and blackout, and was applied to survivability assessment after damage [25].

GREEN	YELLOW	RED	BLACK
Vessel is safe and can be assumed to remain so	Vessel is currently safe, but there is a risk that the situation will get worse	Level of safety has significantly worsened or will worsen and external actions are required to ensure the safety of the people aboard	Vessel is no longer safe and has been lost

Figure 5 - Vessel TRIAGE (Adapted from Nordström et al. 2017)

Finally, Trincas et al. [26] propose the application of Fuzzy Analytic Hierarchy Process (FAHP) to assess the safety state of the ship through a modular synthesis process based on a large set of criteria and sub-criteria [27]. This framework (Fig. 7), combining both operational and emergency-related aspects, will be capable to perform the quantitative assessment of ship safety in each possible scenario during ship operational life. Such quantification is the key for designing a new generation of Onboard DSS, fetching data from different ship's instruments and monitoring systems. Namely, the DSS will be able to compare simulated alternatives, in order to test actions/countermeasures or to carry out optimisation processes devoted to increasing ship safety.
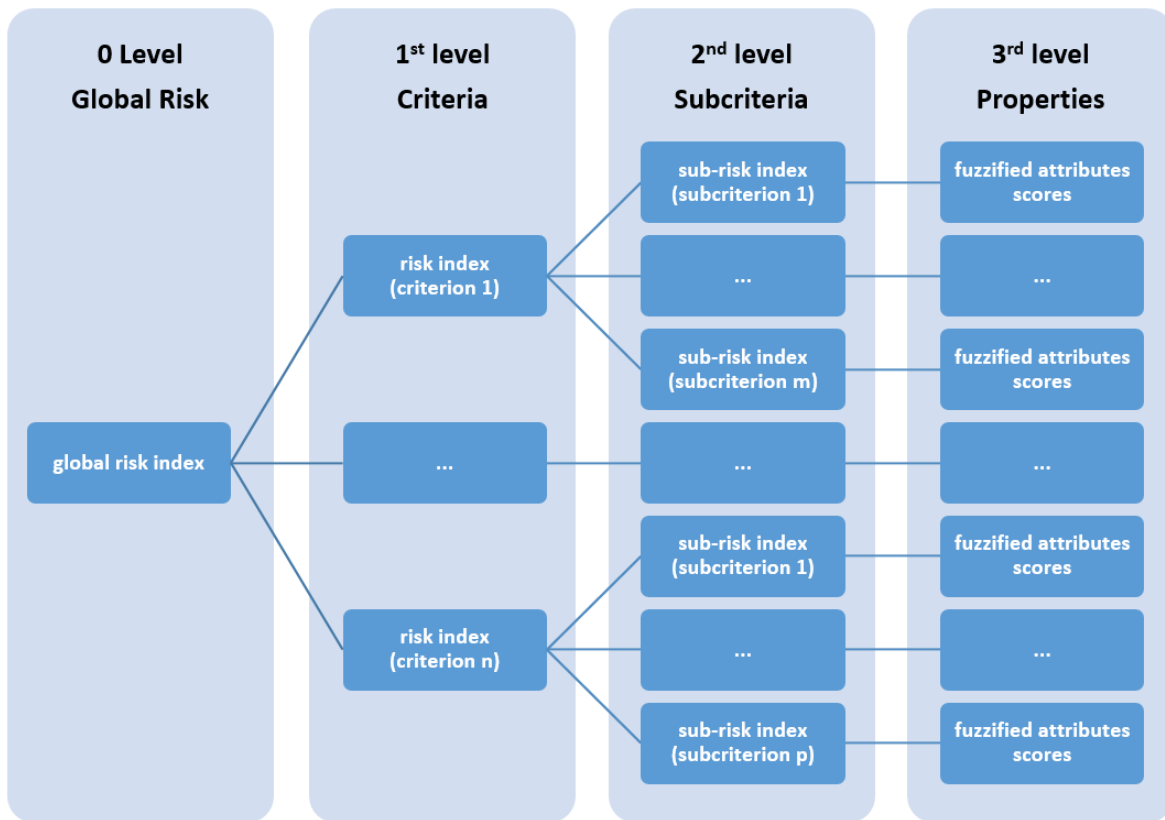
Figure 6 - Risk-Based Framework (from Trincas et al. 2017)

1.7. E-navigation (PP8)

Electronic navigation is defined as harmonised collection, integration, exchange, presentation and analysis of marine information on board and ashore by electronic means to improve mooring, navigation services and related services for safety at sea and protection the marine environment.

Electronic navigation is designed to meet the current and future needs of users by harmonising maritime navigation systems and supporting groundhandling services.

The work carried out by the IMO organisation in recent years has led to the identification of specific user needs and potential electronic navigation solutions.

The Electronic Navigation Strategy Implementation Plan (SIP) contains a list of tasks to be performed to address priority electronic navigation solutions, namely: improved bridge design, standardised and automated means of communication, greater reliability of bridge equipment and navigation information, integration and presentation of information available in graphical displays received via communication equipment and improved communication of VTS service portfolio (not limited to VTS stations).

It is expected that these tasks, once completed during the period 2015–2019, should provide industry with harmonised information in order to start designing products and services for meet the electronic navigation solutions.

On board the fishing vessel, navigation systems benefiting from the integration of their vessel sensors, supporting information, a standard user interface and a comprehensive system for the management of watch zones and warnings.

Fundamental elements of such a system will include, actively involving the seaman in navigation process to perform its/ its functions more efficiently, while preventing distraction and work overload.

Land-based management of ship traffic and related ground services through better delivery, coordination and exchange of comprehensive data formats that will be more easily understood and used by shore-based operators in support of ship and communication safety and efficiency.

An authorised infrastructure for seamless information transfer on board ship, between ships, between ship and shore and between coastal authorities and other parties with many related benefits.

In the Port of Singapore the number of major incidents has dropped over the last 10 years, with fewer than 0.12 major incidents per 100,000 vessel movements in 2018, down from 0.8 in 2009.

Marine Port Authority will also be pushing for digitalisation in two other areas: from first will embark on a "Digital OCEANS" strategy to encourage Open or Common Exchange And Network Standardisation. This strategy aims to allow digital platforms of port authorities e.g. maritime single windows of shipping lines and of logistics service providers to link up. This will allow business entities, government agencies, and vessels to connect seamlessly between different digital platforms and achieve end-to-end connectivity. For example, MPA is developing a Maritime Single Window (MSW) to provide a single portal access to submit documents for port clearance. The MSW will have the ability to exchange relevant data through standard Application Programming Interfaces (APIs).

The Marine Port Authority is also supporting the International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) in operationalising the International Maritime Organization's (IMO) concept of E-navigation for vessels which aims to make marine navigation safer and digitalise key maritime services. These initiatives will improve efficiency, reduce transaction costs and enhance maritime safety.

1.8. E-Tendering Platforms (PP6)

An E-tendering platform aims to make the transport sector more transparent, environmentally friendly, efficient and flexible by connecting the Supply and Demand side with a real-time price platform.

Through the comparison of real-time prices, shippers (both B2B and B2C) can make an offer for FTL and LTL shipping orders. The benefits will be multiple, allowing the Supply to achieve full fleet saturation and at the same time simplify the tendering process for demand. The main side effect will, of course, be a transparent market and a massive decrease in unladen journeys for the fleet with a decrease in carbon emissions.

The current trend of the freight transport sector towards a marginal reduction for major operators; at the same time, small operators, who do not have good market access are rapidly disappearing or becoming sub-contracting vectors of the main operators.

Platforms could enable small operators to obtain better placements on the market and at the same time increase the margins of the main operators who are constantly affected by an imbalance in fleet management, a point that could be directly addressed by this technology, allowing a better saturation of the fleet.

Several social factors are influencing the transport market. The first is definitely a call for transparency. In many European areas, price requests are still made by e-mail or, at most, by individual operators. The forms are to be filled in on company websites. This process is slow and time-consuming, not to mention the frustrating part of being forced to wait hours, days or even weeks for the responses of each individual operator, comparing the obtained prices even more difficult.

E-tendering will allow an immediate comparison between all the operators present on the market and give an immediate feedback to customers, allowing you to receive offers in the local language, ensuring that all contractual points are easy to be including, and with the prices set in the currency of choice, removing the issue of the currency comparison.

During the research we identified the main actors analyzed in two areas: those FTLs and LTLs.

As for FTL, possible examples can be Uber freight, convoy and transfix. They aim to create a platform dedicated to long-haul services by comparing the prices available on the market.

As for LTL, we have identified two companies: the first one is Eurosender, a Slovenian company operating throughout the EU, the second one is Macingo, which is an Italian company operating at different levels of price comparison between different LTL services and other freight transport services.
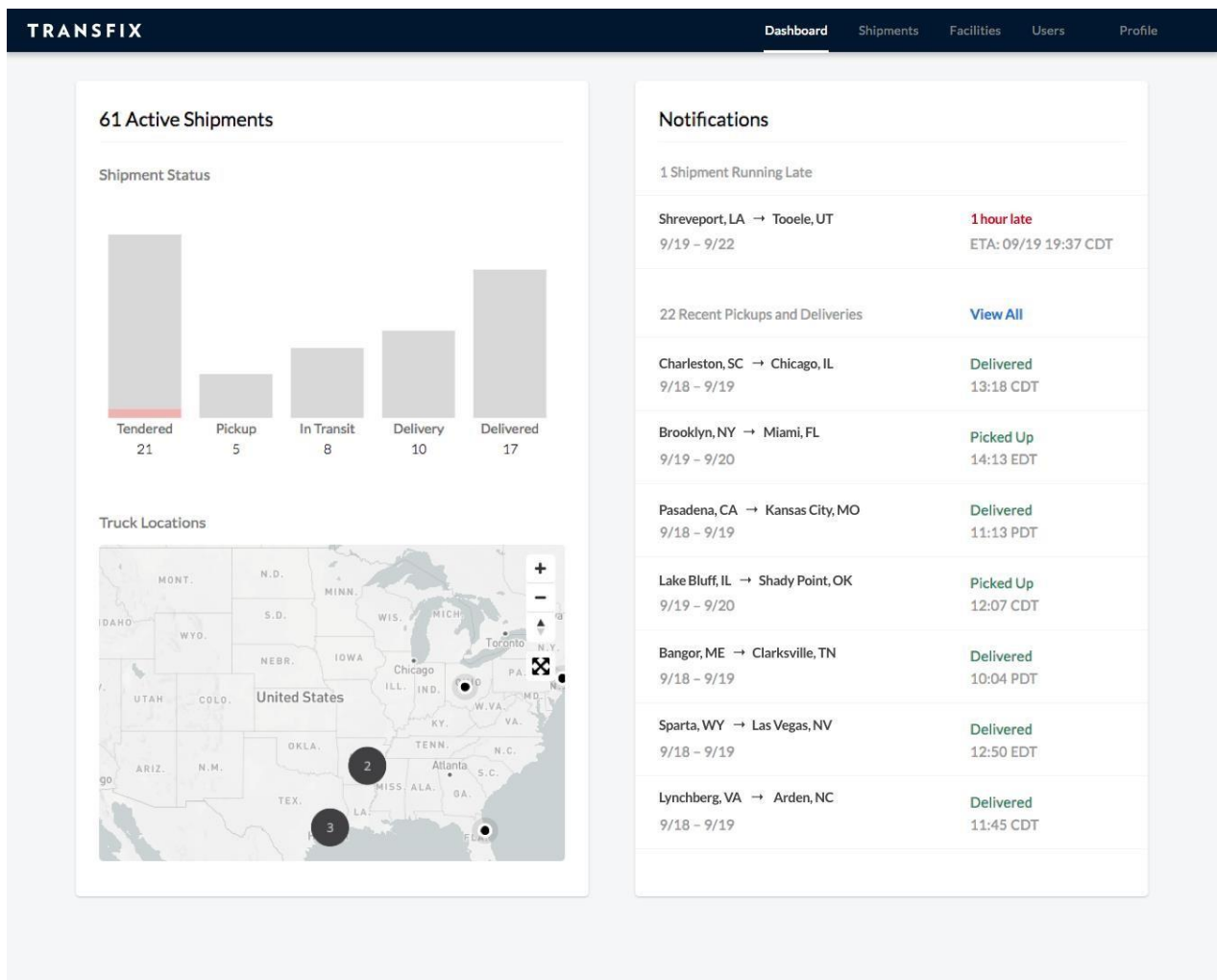

Figure 7: Transfix User Dashboard

Further strengthening its commitment to enhancing the quality of its services and deepening business relationship with key partners, Bahri has announced the launch of its 'iSupplier' portal.

The online platform will serve as a dedicated communication channel between Bahri's Corporate Procurement and suppliers and contractors. A fast and convenient platform, 'iSupplier' will enable Bahri to have easy access to a larger segment of suppliers and contractors in Saudi Arabia's private sector.

Companies in the Kingdom can easily register themselves as a Bahri-certified and approved supplier or contractor through the platform.

Upon registration, they may be contacted based on business needs and requirements at Bahri and will be able to conveniently access information related to invoices and orders, financial transactions, performance evaluation, and data management.

The launch of 'iSupplier' represents a commitment to service excellence, and this platform will play a crucial role in building and managing a strong supplier base. All partners will take an advantage of 'iSupplier' to benefit all players in the supply chain.

The tool will come in handy for the company in reducing the time and effort taken for new supplier registration, maintaining supplier records, and managing order changes. It will also help improve inventory availability, streamline payments with online invoicing, and better manage contracts.

2. Identifying most attractive directly transferable innovations: the Questionnaire

A questionnaire has been designed and implemented as an online tool by means of the Google Forms platform. It has been submitted to all the PPs in order to collect data devoted to rank the innovations defined in previous deliverables by importance and analyse the issues related to each innovation deployment in the project area. The questionnaire is composed of three sections:

- General information
- Informatisation processes
- Big-Data
- Automation

In the general section, some information is collected regarding the subject which is compiling the questionnaire. This information is useful to properly qualify the subject and his expertise. In detail, the following data have been collected:

- Name
- Surname
- Age
- Project Partner (the affiliation of the subject)
- Position (the position of the subject within the project partner)
- Seniority (years of service in the current position)

The other three sections deal with a specific innovation trend. Each subject was required to select the innovations they deem more relevant to them in terms of appeal and applicability to their local needs. In detail, each innovation was ranked per importance on a five steps scale:

1. not at all relevant;
2. not very relevant;
3. no opinion;
4. relevant;
5. extremely relevant.

Efforts required to implement the innovations in the current environment was also ranked according to the following scale:

1. very difficult to implement;
2. somehow difficult to implement;
3. no opinion;
4. somehow easy to implement;
5. very easy to implement.

PPs were required to briefly explain the reasons behind their choices.. They were also asked to suggest up to two additional innovations for each innovation trend. Finally, each subject was required to rate only innovations that apply to his context and field of expertise, in order to prevent the collection of inconsistent data.

2.1.   Results

In this section, the results related to the informatisation innovation trends are provided. First, a global analysis coming out from the outcomes of all the collected questionnaires is provided. Then, the outcomes and ranking of the innovations are provided for each partner.

2.1.1.   Global Analysis

Overall, 24 responses have been collected from partners (see Figure 8).

The distribution of age and seniority of the subjects involved in the completion of the questionnaire are provided in Figures 9 and 10 respectively. Since most of the partners are engaged in research activities, the concentration on 0-5 years seniority is not a surprise, given the dynamic labour market typical of such a sector. However, most of the low-seniority respondents are scholars or other specialists with strong experience. Moreover, all the other subjects involved in the questionnaire completion have a strong experience in their field since they cover the same position for a relevant time period (more than 5 years).
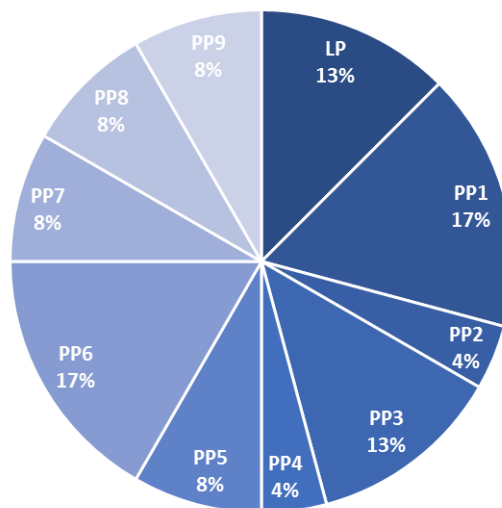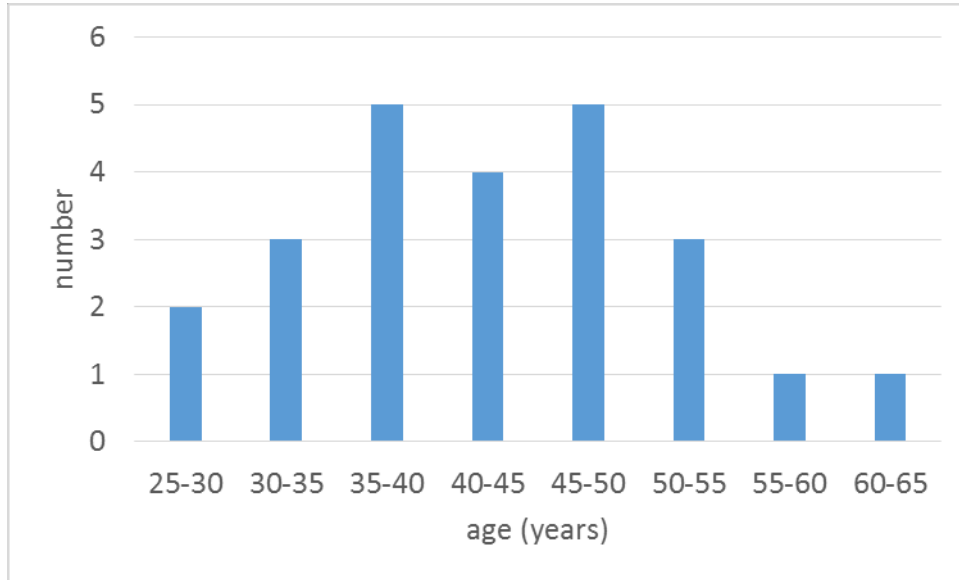

Figure 5 - Responses collected from PPs
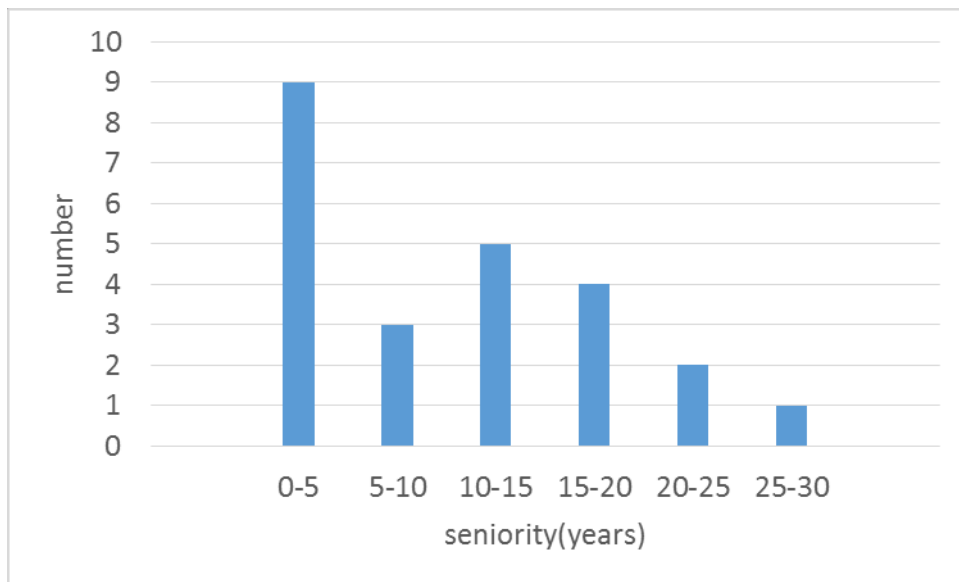
Figure 6 - Age of the subjects

Figure 7 - Seniority (in current position) of the subjects

The innovations ranked by importance I are shown in Table 1, together with their deployment difficulty/easiness D. Moreover, the standard deviation σ are provided for both quantities:

$$\sigma_x = \sqrt{\frac{\sum_{i=1}^{n}(x_i - \bar{x})^2}{n}}$$

Figure 11 provides a graphical representation of the results on a scatter diagram. It can be noticed that all the innovations are located in a restricted area located in the upper part of the diagram. Figure 12 provides a more detailed view of such an area of the scatter diagram. Numbers showed in Figure 12 refer to innovation ranking (Tab.1). In general, no correlation exists between importance and deployment's easiness/difficulty. Moreover, the concentration in the upper part of the scatter diagram highlights how all the partners assigned a medium/high importance to all the innovations defined in D3.1.1, thus, confirming that the selection process was very effective.

However, the quite high value of standard deviations related to innovations' importance reduces the significance of the ranking.

Table 1 - Global Rank of innovations

Rank	Innovation	I	σ_I	D	σ_D
1	Document digitalisation	4.54	0.58	3.42	0.95
2	PCS	4.48	0.59	2.86	0.94
3	Systems Integration and collaborative logistics	4.43	0.65	2.83	0.96
4	Passenger PCS	4.40	0.58	3.25	0.94
5	Mobile solutions for Safety/Security	4.30	0.56	3.55	1.02
6	DSS	4.23	0.67	2.95	0.93
7	Sensors/Monitoring Systems	4.19	0.79	3.00	0.87
8	WMS	4.18	0.78	3.32	0.76
9	Stowage planning	4.10	0.83	3.20	1.08
10	TOS	4.09	0.73	3.10	0.87
11	VBS	4.05	0.84	3.09	0.79
12	Ship to Ship/Shore Connectivity	4.05	0.93	3.25	0.99
13	IIoT platforms	4.00	0.90	3.05	0.82
14	Mobile solutions for Mobility	4.00	0.93	3.86	0.83
15	Digital cargo ID	4.00	0.86	2.95	1.05
16	E-Tendering platforms	4.00	0.77	3.10	0.94

| 17	GIS systems and digital cartographies	3.96	1.08	3.48	0.96
18	Onboard Emergency DSS	3.90	0.92	2.58	0.75
19	Smart contracts with blockchain	3.90	1.04	2.70	1.05
20	Weather routing systems	3.87	0.90	3.32	1.02
21	E-Navigation	3.82	0.83	2.50	1.03
22	GIS and drones	3.73	0.81	3.27	0.96
23	Cybersecurity	3.67	1.03	2.50	0.82
24	V2V and V2I connectivity	3.65	0.79	2.58	0.99
25	Wearable devices for Safety/Security	3.59	0.94	3.43	0.90
26	Augmented Reality	3.55	0.92	3.05	0.89
27	5G data flows	3.52	0.96	2.76	1.06
28	CWS	3.50	0.81	3.35	0.85
29	EnMS	3.44	1.07	2.72	1.10
30	Biometric devices for Safety/Security	3.43	0.90	2.76	1.27
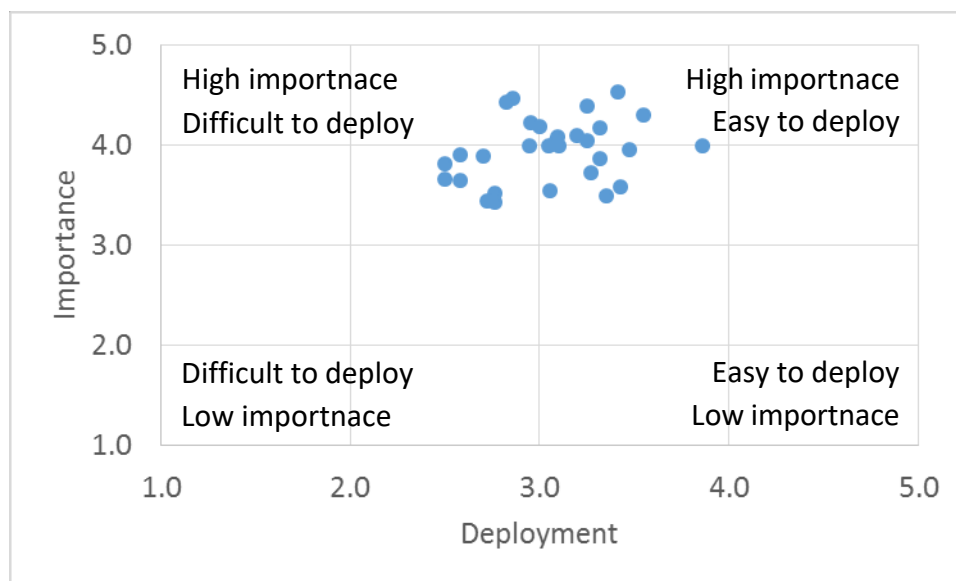
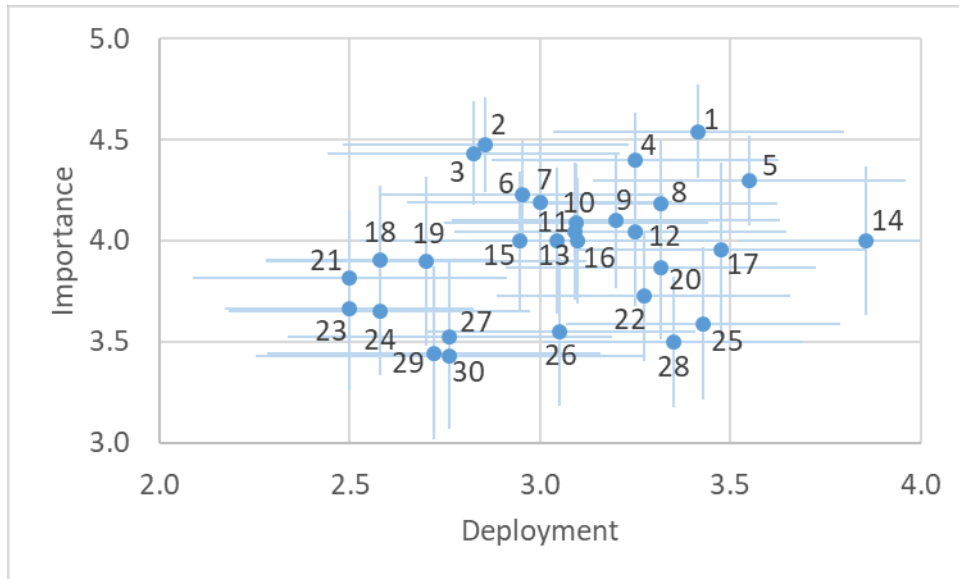*Figure 8 - Importance vs Deployment Easiness/Difficulty*

Figure 9 - Detail of Importance vs Deployment Easiness/Difficulty;
numbers refer to ranking (Tab. 1);
bars refer to 95% confidence interval

Nevertheless, a group of more interesting innovation can be defined including *Document digitalization*, *Freight PCS*, *Systems Integration and collaborative logistics*, *Passenger PCS* and *Mobile solutions for Safety/Security*. The choice of the first three 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 least innovations by importance are: *Wearable devices for Safety/Security*, *Augmented Reality*, *5G data flows*, *CWS*, *EnMS*, *Biometric devices for Safety/Security*. In particular, it is worth noticing that different solutions related to safety and security are considered less important (and less easy to deploy too) by the PPs with respect to mobile applications.

A wider spectrum of outcomes was obtained on the difficulty in innovations' implementation in the Adriatic Region. However, also larger standard deviations were spotted in this case, leading to greater uncertainty.The innovation of the easiest implementation is *mobile solutions for mobility*, which largely outdistances the second: *mobile solutions for safety and security*. It can be concluded that solutions based on mobile technologies are considered an easy way to manage passenger's flows in both normal and emergency situations. On the other hand, the most difficult

to deploy innovations are *e-navigation* and *Cybersecurity*. According to PPs, the main problems are in both cases the high expertise (often hard to find on the labour market), the substantial investments and the necessary agreement of a large number of stakeholders required for innovations' effective implementation.

2.1.2. Individual partner results

The following charts show the ranking of innovations deemed by each partner as the most interesting.

 In the first chart the length of the horizontal bar represents the easiness of implementation for each innovation: the longer the bar, the easiest the implementation.

In the second chart, the lower part (in *blue*) of the istogram represents the importance of each innovation, while the upper part (in *orange*) shows the feasibility (easiness) of its implementation.

In our methodology, the importance and easiness ranking are not meant to be summed to obtain a total value: therefore this is simply a graphical representation to help us understand how those values "move" for each innovation and for each surveyed partner.
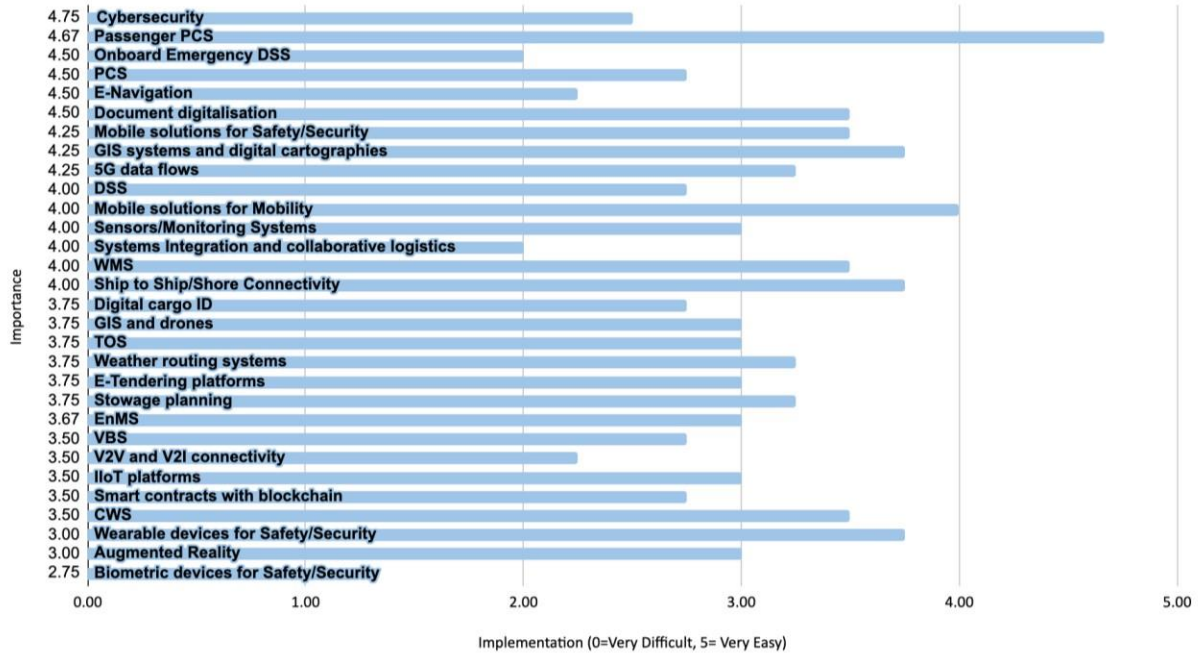
PPs interested in adopting an innovation were expected to be already somehow knowledgeble about the innovation itself and about what its implementation entails.

Please also note the these judgements, are as perceived by partner participants – and they do not refer to an objective evaluation/scoring.
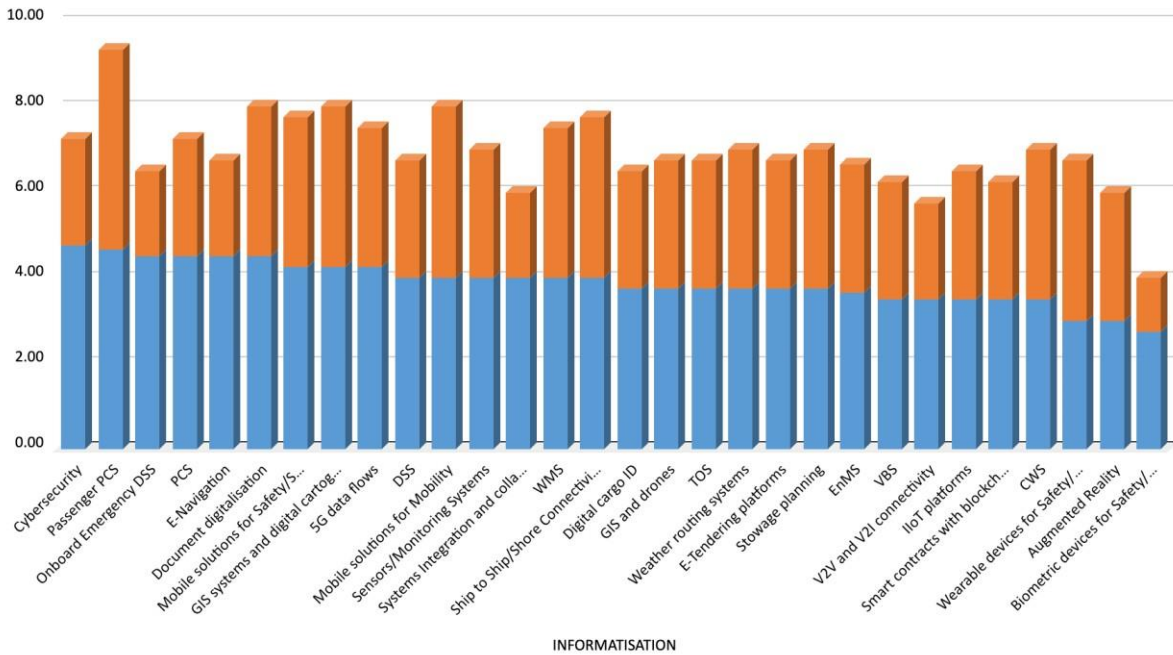
From those innovations considered important by the partner, we can see that a few were also seen as the directly transferable (as perceived to be somewhat easy to implement). However, from the chart it is clear that many innovations we ranked as having mid to high importance and they could be feasibile for implementation.

Please not that results for LP and PP3 are not presented here, since those two partners will not be involved in pilot actions and therefore do not need to identify specific innovations within the context of the Diglogs project.
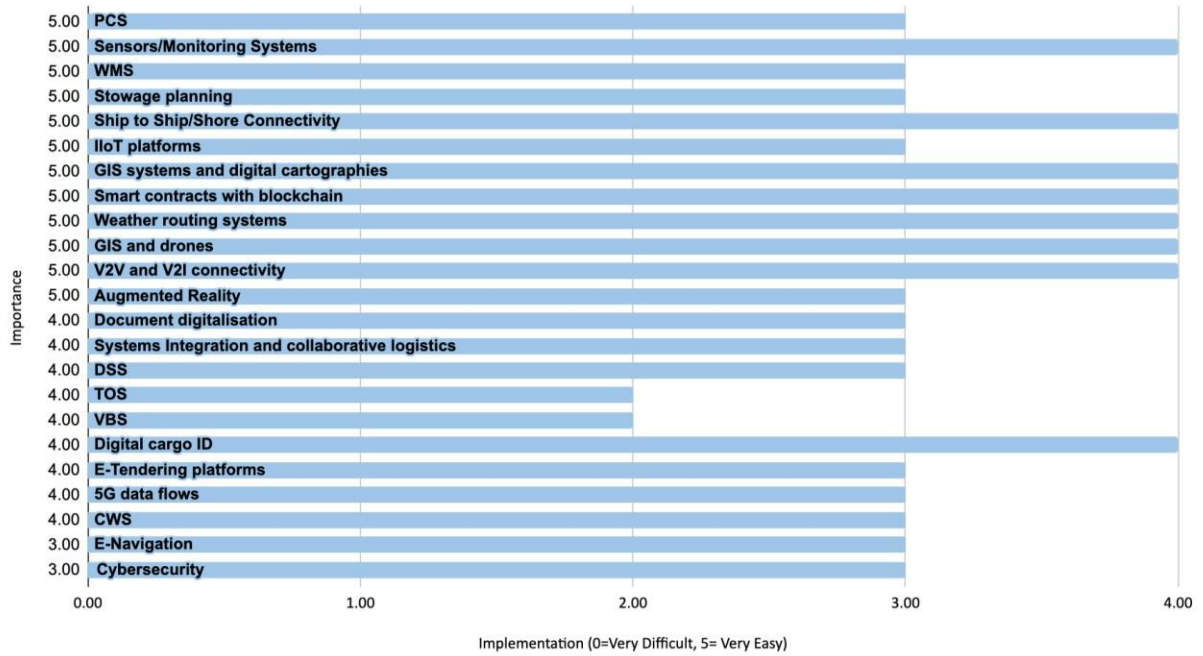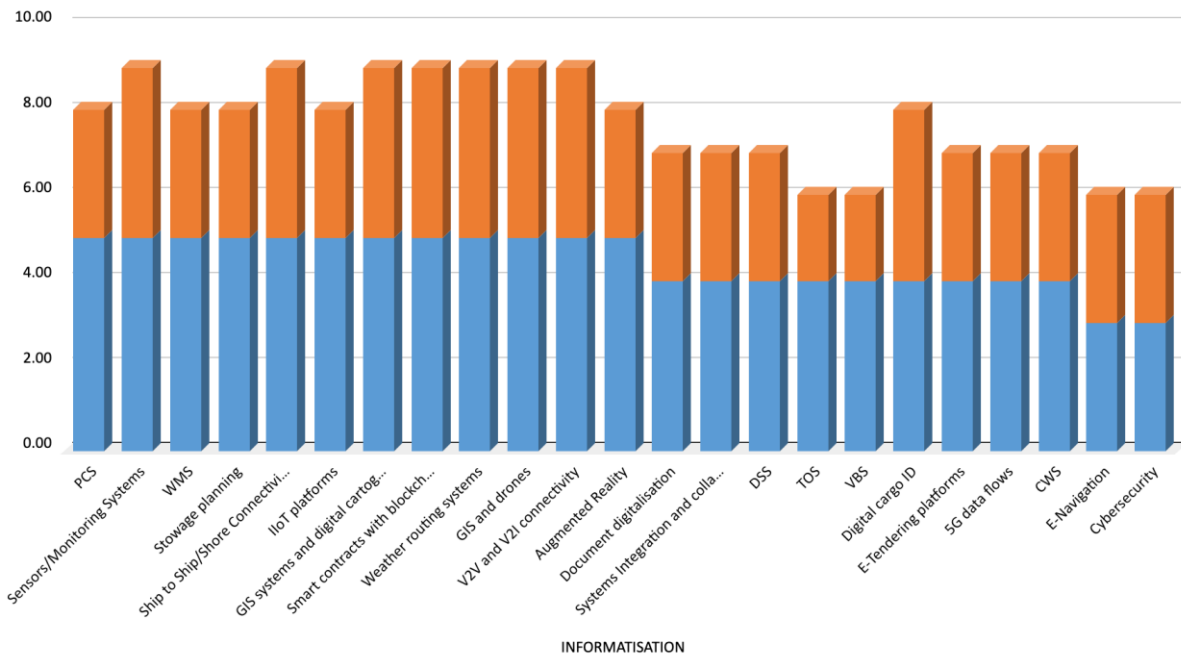
PP1 - Innovations in Informatisation

Importance	Innovation
4.75	Cybersecurity
4.67	Passenger PCS
4.50	Onboard Emergency DSS
4.50	PCS
4.50	E-Navigation
4.50	Document digitalisation
4.25	Mobile solutions for Safety/Security
4.25	GIS systems and digital cartographies
4.25	5G data flows
4.00	DSS
4.00	Mobile solutions for Mobility
4.00	Sensors/Monitoring Systems
4.00	Systems Integration and collaborative logistics
4.00	WMS
4.00	Ship to Ship/Shore Connectivity
3.75	Digital cargo ID
3.75	GIS and drones
3.75	TOS
3.75	Weather routing systems
3.75	E-Tendering platforms
3.75	Stowage planning
3.67	EnMS
3.50	VBS
3.50	V2V and V2I connectivity
3.50	IIoT platforms
3.50	Smart contracts with blockchain
3.50	CWS
3.00	Wearable devices for Safety/Security
3.00	Augmented Reality
2.75	Biometric devices for Safety/Security

Implementation (0=Very Difficult, 5= Very Easy)

PP1 – combination of perceived Importance [blue] and implementation easiness/difficulty [orange]

INFORMATISATION

PP2 - Innovations in Informatisation

Importance		Implementation (0=Very Difficult, 5= Very Easy)

PP2 – combination of perceived Importance [blue] and implementation easiness/difficulty [orange]

INFORMATISATION

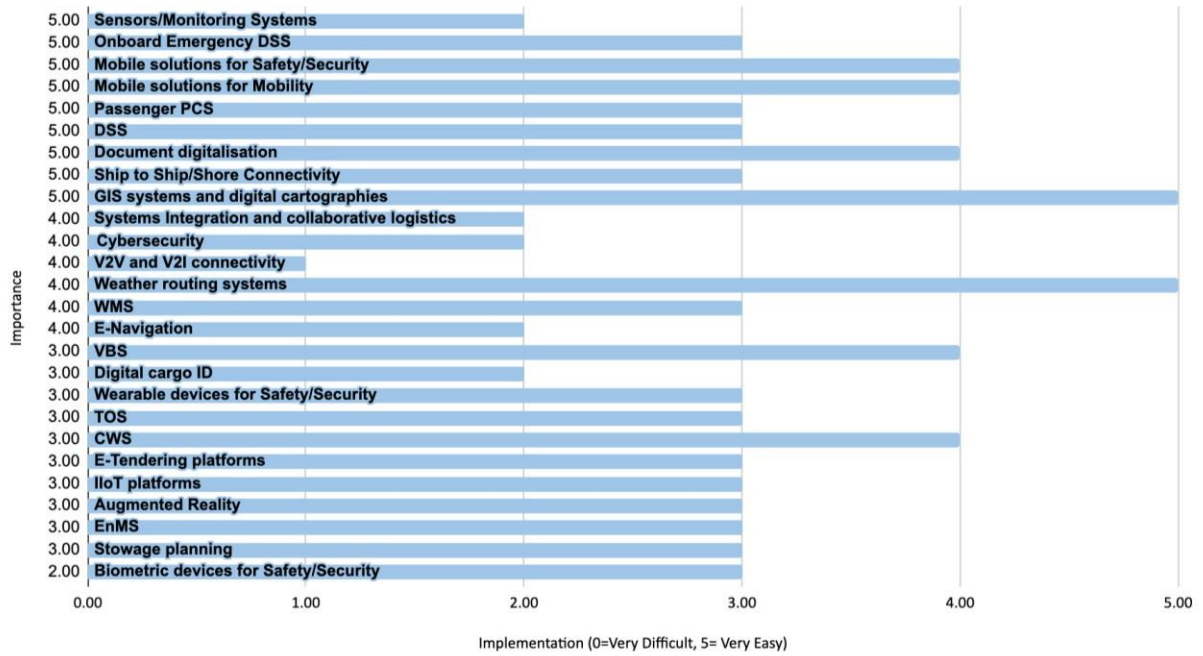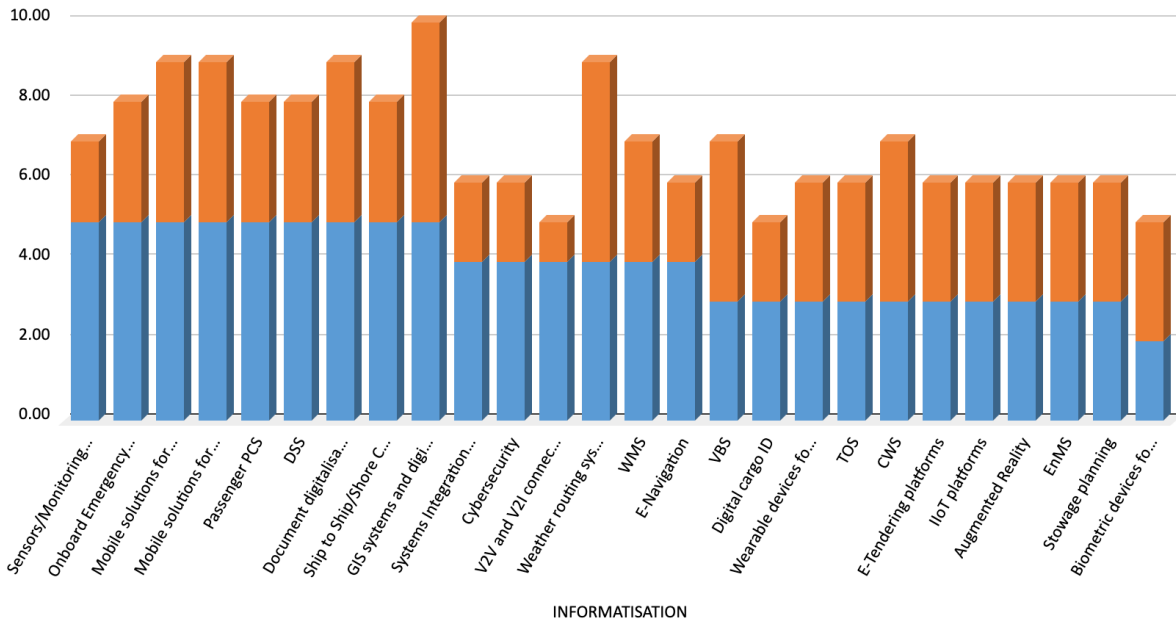## PP4 - Innovations in Informatisation

PP4 – combination of perceived Importance [blue] and implementation easiness/difficulty [orange]

INFORMATISATION

PP5 - Innovations in Informatisation

PP5 – combination of perceived Importance [blue] and implementation easiness/difficulty [orange]

PP6 - Innovations in Informatisation

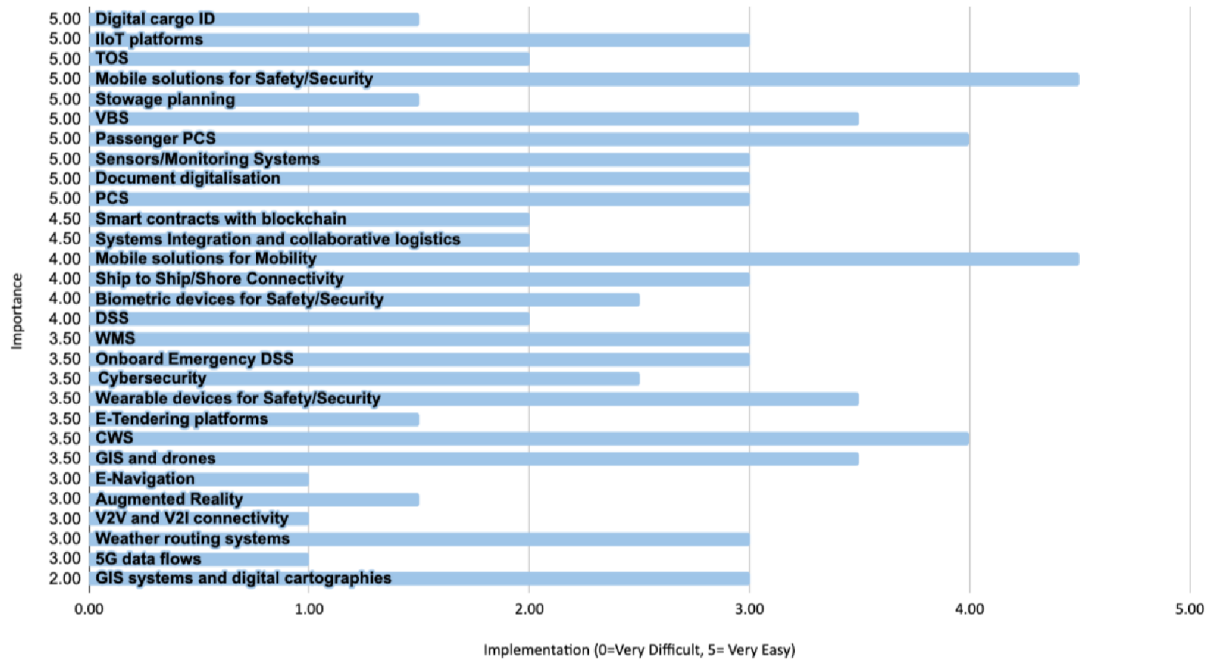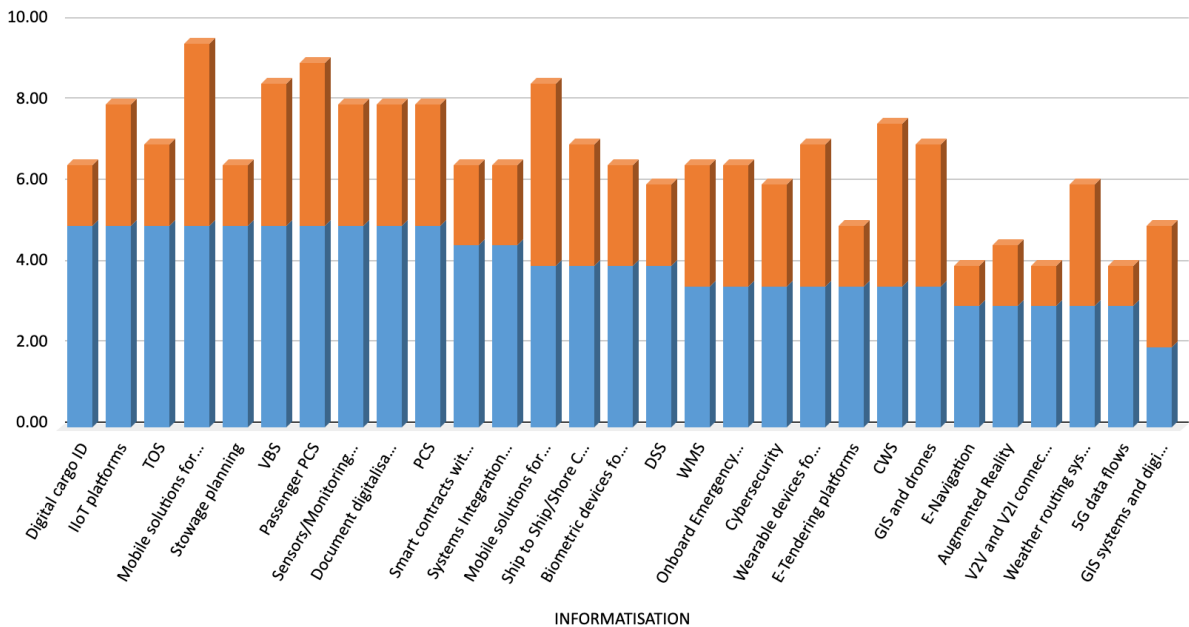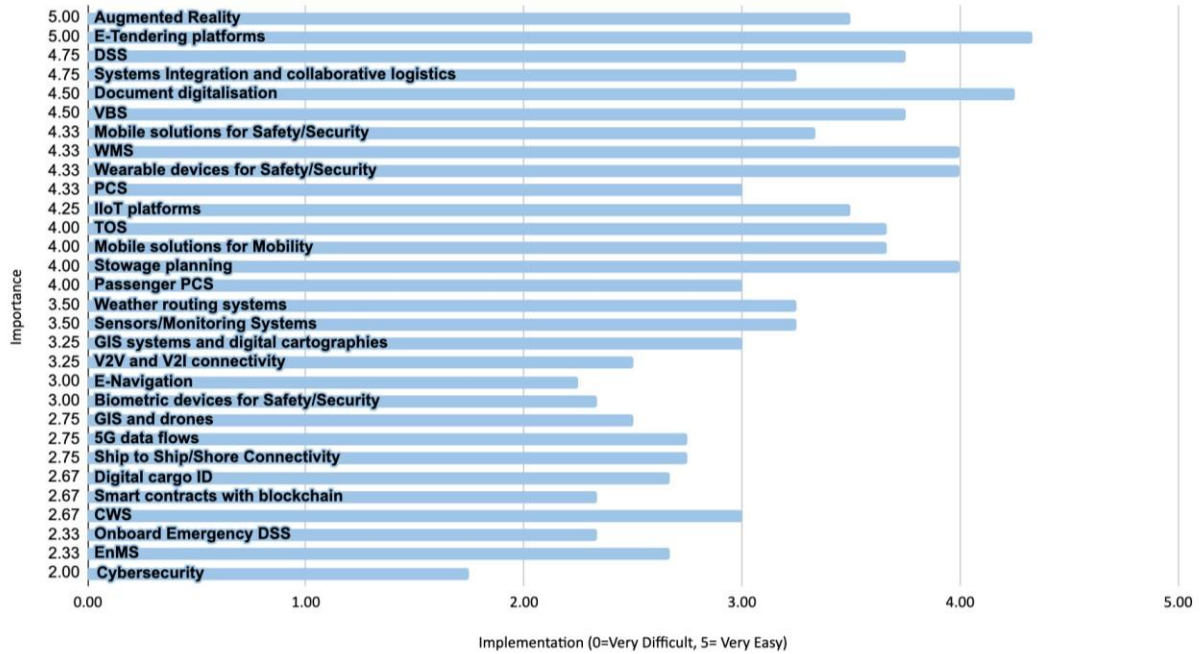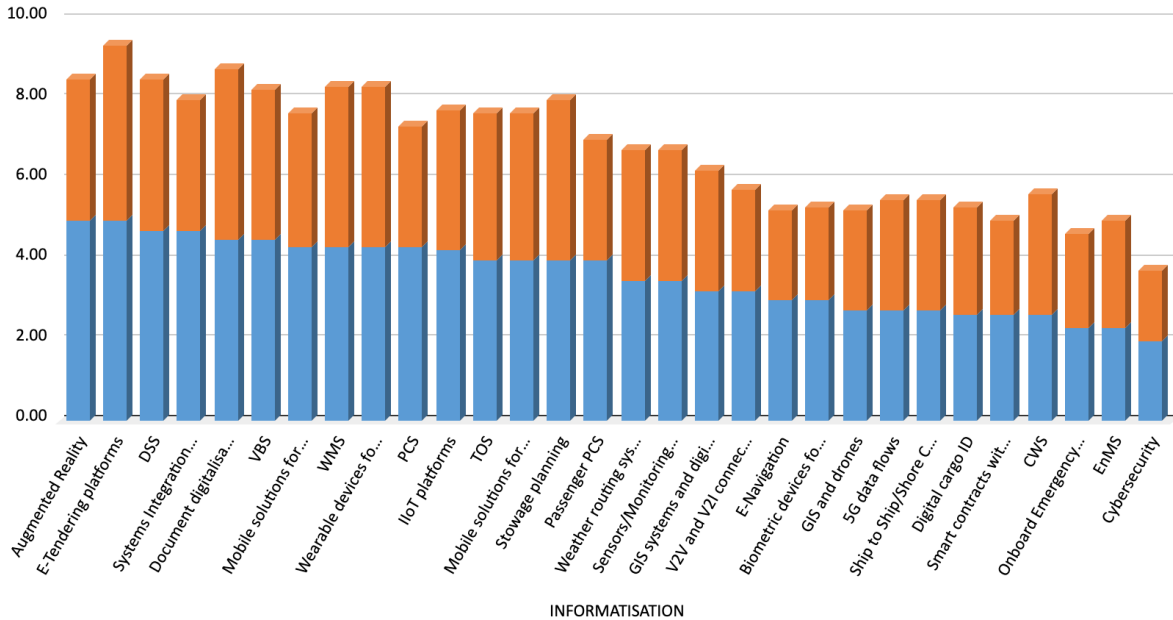PP6 – combination of perceived Importance [blue] and implementation easiness/difficulty [orange]
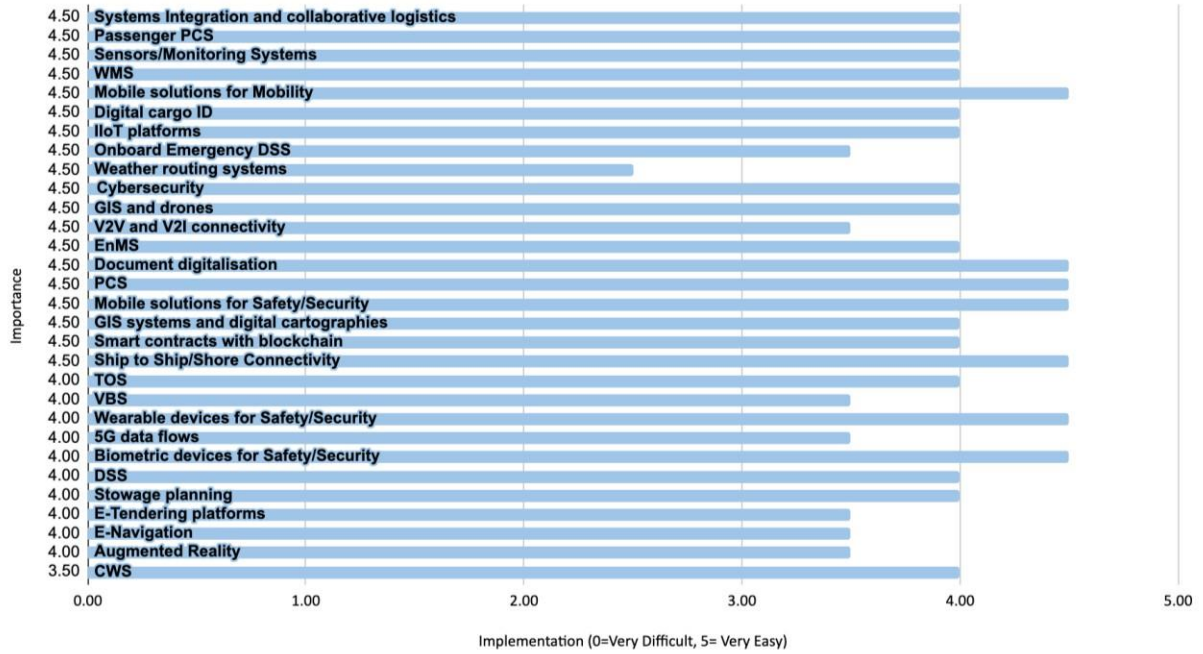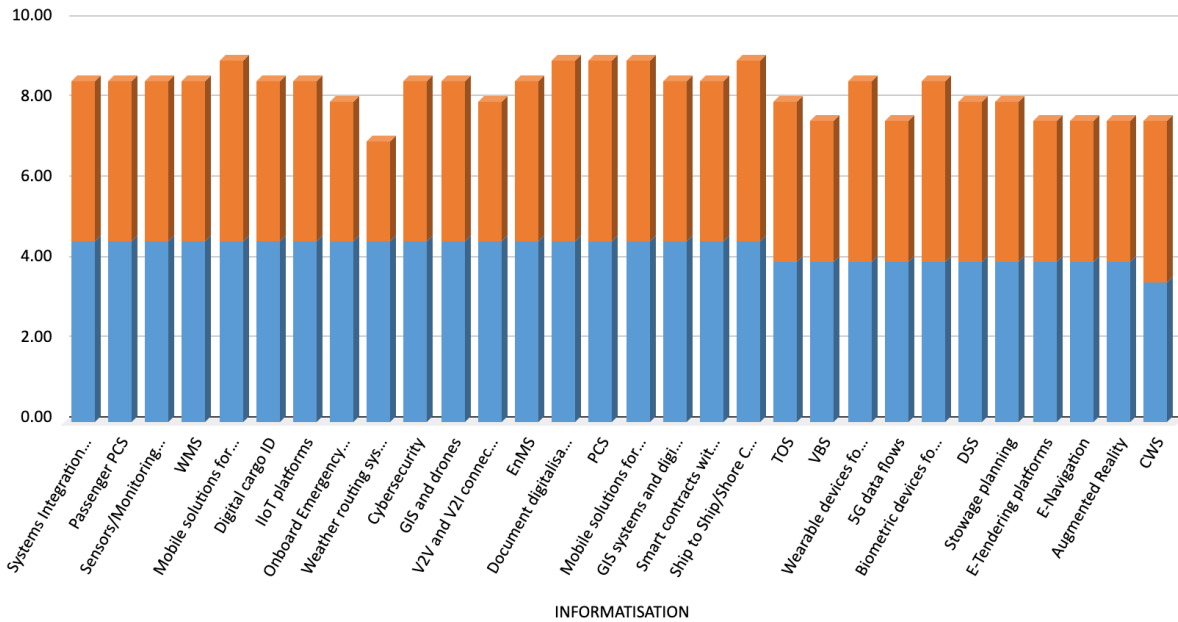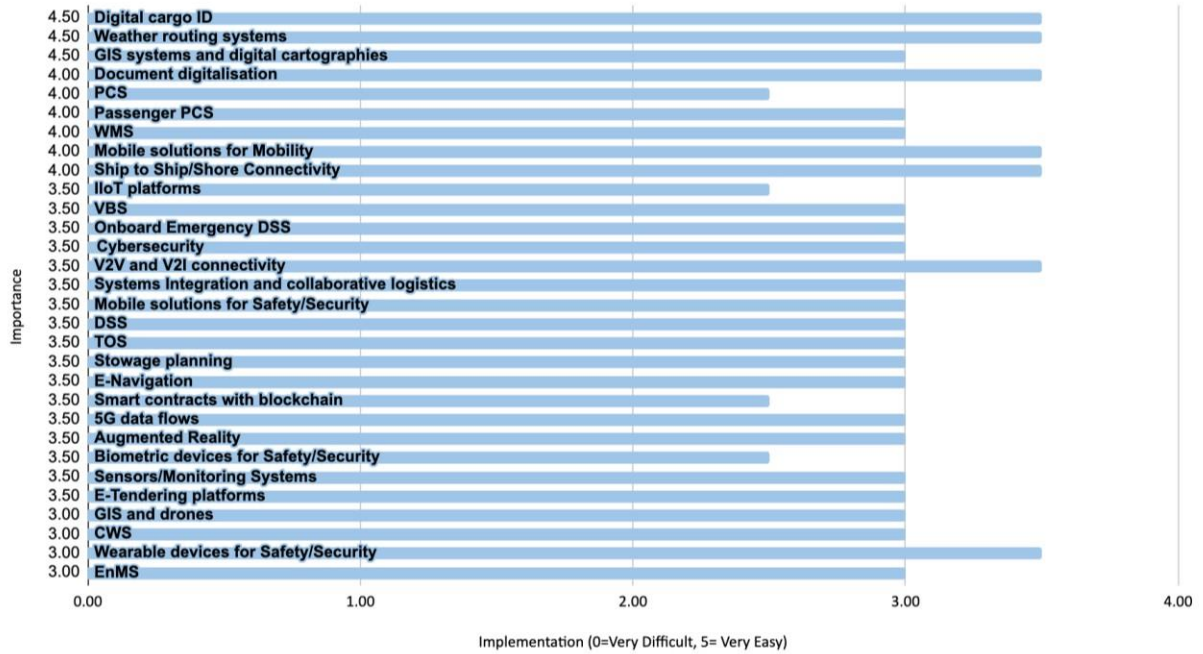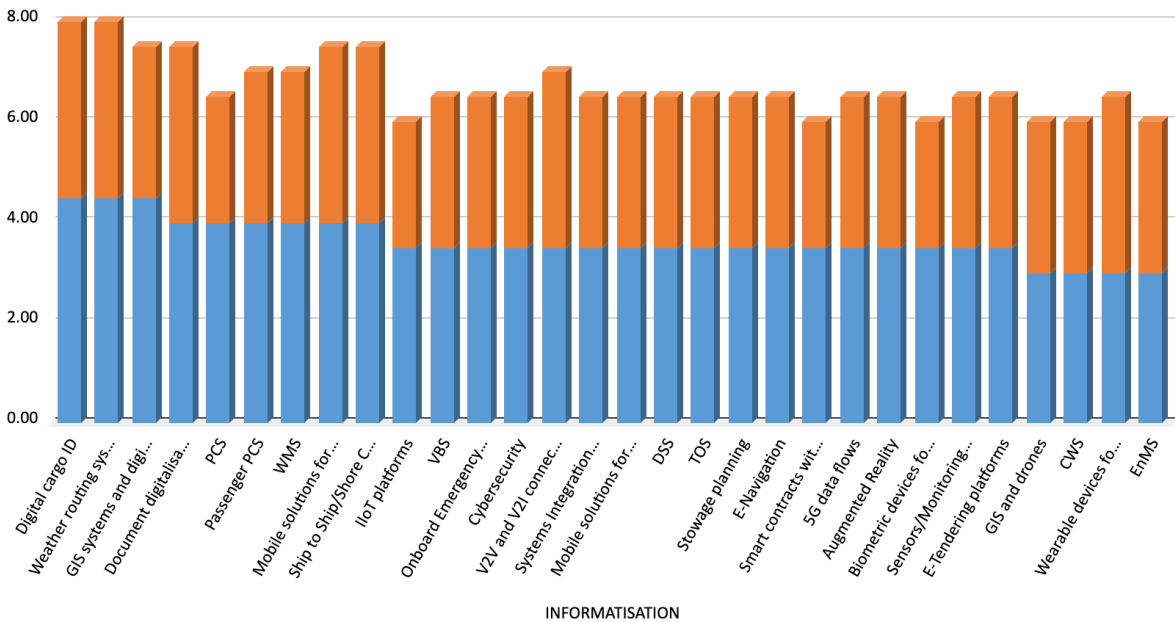
PP7 - Innovations in Informatisation

Horizontal bar chart titled by Importance (y-axis) vs Implementation (0=Very Difficult, 5= Very Easy) (x-axis)

Importance	Innovation
4.50	Systems Integration and collaborative logistics
4.50	Passenger PCS
4.50	Sensors/Monitoring Systems
4.50	WMS
4.50	Mobile solutions for Mobility
4.50	Digital cargo ID
4.50	IIoT platforms
4.50	Onboard Emergency DSS
4.50	Weather routing systems
4.50	Cybersecurity
4.50	GIS and drones
4.50	V2V and V2I connectivity
4.50	EnMS
4.50	Document digitalisation
4.50	PCS
4.50	Mobile solutions for Safety/Security
4.50	GIS systems and digital cartographies
4.50	Smart contracts with blockchain
4.50	Ship to Ship/Shore Connectivity
4.00	TOS
4.00	VBS
4.00	Wearable devices for Safety/Security
4.00	5G data flows
4.00	Biometric devices for Safety/Security
4.00	DSS
4.00	Stowage planning
4.00	E-Tendering platforms
4.00	E-Navigation
4.00	Augmented Reality
3.50	CWS

PP7 – combination of perceived Importance [blue] and implementation easiness/difficulty [orange]

INFORMATISATION

PP8- Innovations in Informatisation

PP8 – combination of perceived Importance [blue] and implementation easiness/difficulty [orange]

INFORMATISATION

PP9 - Innovations in Informatisation

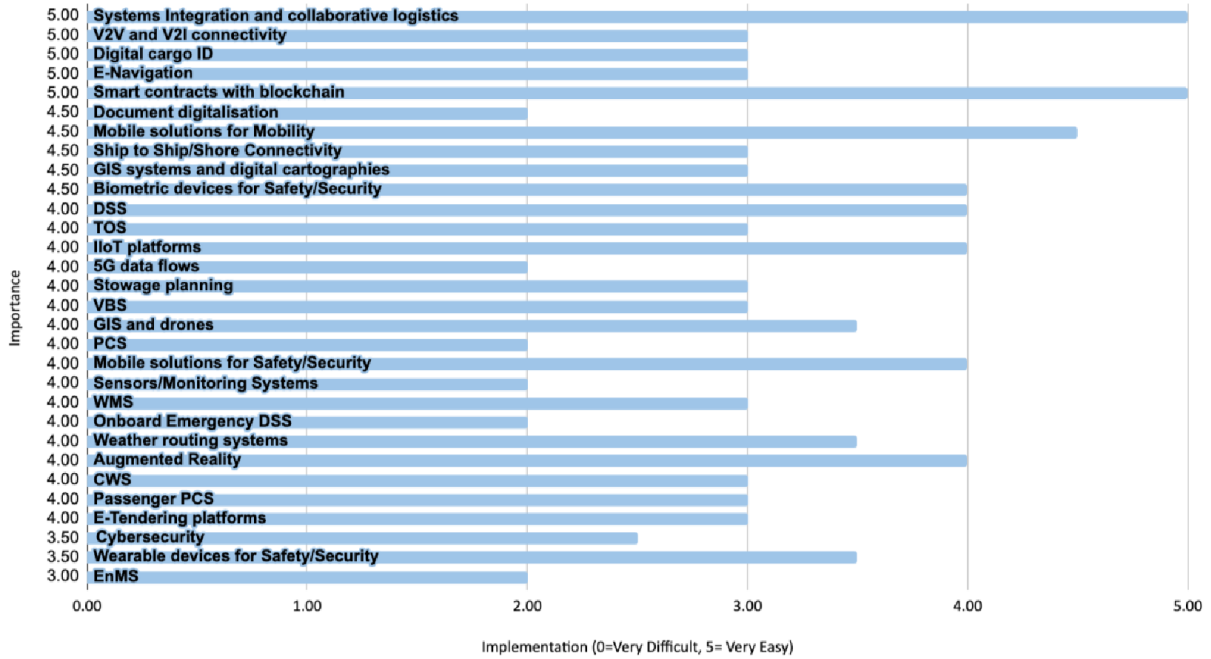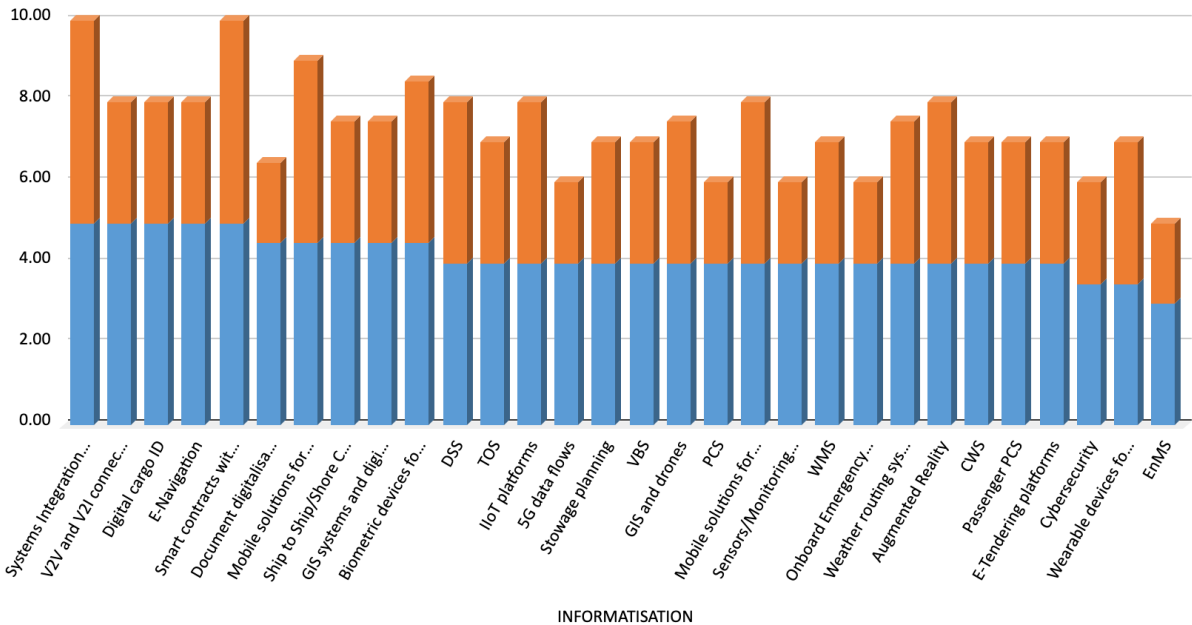PP9 – combination of perceived Importance [blue] and implementation easiness/difficulty [orange]

Conclusions

From the graphical representations of data, It can be noticed that all the innovations are located in a restricted area in the upper part of the scatter diagrams. In general, it can be concluded that no clear correlation exists between importance and deployment's easiness/difficulty. It also appears that all the partners assigned a medium/high importance to all the innovations defined in D3.1.1, thus, confirming that the selection process carried out by WPL and PP4 in the previously deliverable was indeed effective.

It can be concluded that no correlation exists between importance and deployment's easiness/difficulty. Moreover, the concentration in the upper part of the scatter diagram highlights how all the partners assigned a medium/high importance to all the innovations defined in D3.1.1, confirming that the previously carried-out selection process for innovations was indeed very effective.

However, the quite high value of standard deviations related to innovations' importance reduces the significance of the ranking.

The group of more interesting innovations includes *Document digitalization*, *Freight PCS*, *Systems Integration and collaborative logistics*, *Passenger PCS* and *Mobile solutions for Safety/Security*. The choice of the first three is due their strong contribution in the speeding-up/simplification/automation of logistic processes, while the latter was considered a very effective method to increase safety and security onboard and in port areas. Innovations deemed by PPs as having a low importance were: *Wearable devices for Safety/Security*, *Augmented Reality*, *5G data flows*, *CWS*, *EnMS*, *Biometric devices for Safety/Security*. In particular, it is worth noticing that – with respect to mobile applications – most of the solutions related to *safety and security* are considered less important and also somewhat less easy to implement.

The innovations deemed the easiest for a direct transfer were *mobile solutions for mobility*, which largely outdistances the second ranking one: *mobile solutions for safety and security*. It can be concluded that solutions based on mobile technologies are considered an easy way to manage passenger's flows.

The most difficult to deploy innovation were *e-navigation* and *Cybersecurity*. According to PPs, the main problems are in both cases the high expertise (often hard to find on the labour market), the large investments and the necessary agreement of a large number of stakeholders required for their effective implementation.

To sum it up, in the field of informatisation processes, it seems that the most relevant technological issues in the area consist of the digitalization and overall integration of logistics processes across different actors, with a specific focus on PCS. Other technological priorities include those concerning the safety & security sector and various mobile solutions. Strangely enough, some more advanced – although mostly on-going – innovations - including e-tendering, IoT, G5 and overall connectivity developments, blockchain, drones, AR - seemed to represent less relevant priorities in the Italy-Croatia program area.

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