DigLogs

4.1.3 - SWOT on selected traffic automation systems in multimodal transport flows

CFLI

Responsible partner: CFLI Involved partners: All			
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0.1	Draft	01/02/2020	CFLI
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0.5	Final		CFLI
Notes:			

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Introduction

The main purpose of work package 4 is the definition of a roadmap to be used by public and private actors on the implementation of smart solutions based on the innovation selected in the framework of WP3 activities. In this stage, public and private transport stakeholders will be involved in the common processes for roadmap definition and innovation deployment.

Action 4.1 regards the delivery of specific SWOT analysis based on impact analysis drafted by PP5 – Actual during WP3; SWOT will be used as base for discussion with identified stakeholders about the detailed definition of roadmaps towards innovative solutions deployment.

During WP4, project partners will enlarge the partnership to collect inputs and contributions from stakeholders, revise and integrate roadmap in order to obtain an effective and applicable implementation plan in different contexts and for different operators.

1 About WP4 – Action 1

Action 1 is based on WP3 results and is specifically related to SWOT analyses provided with deliverables 4.1.x.

WP3 has delivered specific impact analyses about changes resulting from innovation deployment evaluating how the status quo can be affected. SWOT analyses reported in 4.1.x. deliverables take in consideration the impact analyses to give details about strengths and weaknesses of each innovation, which are more related to organizations' internal constraints, and values as well as opportunities and threats concerning external and less controllable factors.

SWOT analysis aims at improving actors awareness about smart solution implementation repercussions on logistic processes from both strategic planning and decision-making standpoint.

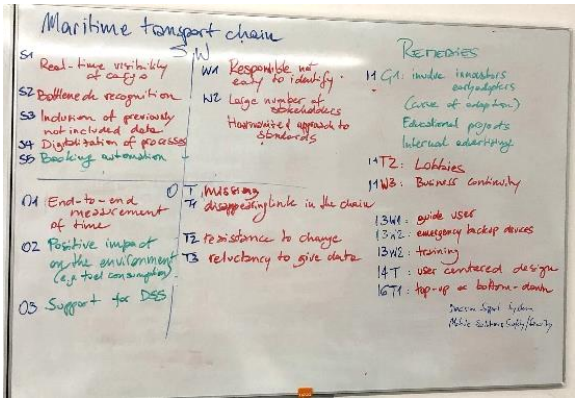
In addition to weaknesses and threats, 4.1.x deliverables report suggestions and possible remedies to avoid critical situations or mitigate negative impacts of solutions' deployment, helping to assess whether they are truly applicable in each context of programme area.

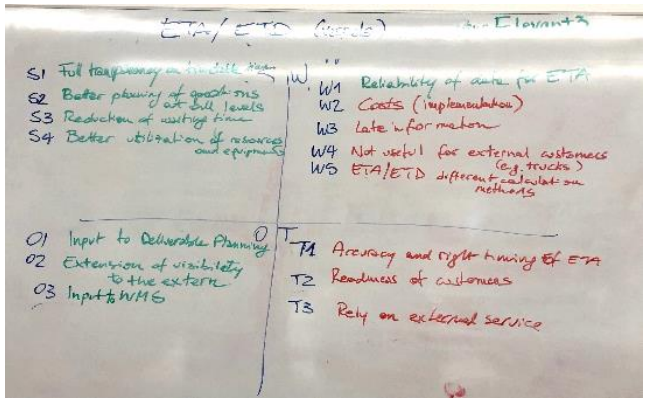
Actions 2 and 3 will go further, discussing and fine-tuning deployment roadmaps on the basis of action 1 results, considering that an innovative solution can include one or more selected innovations.

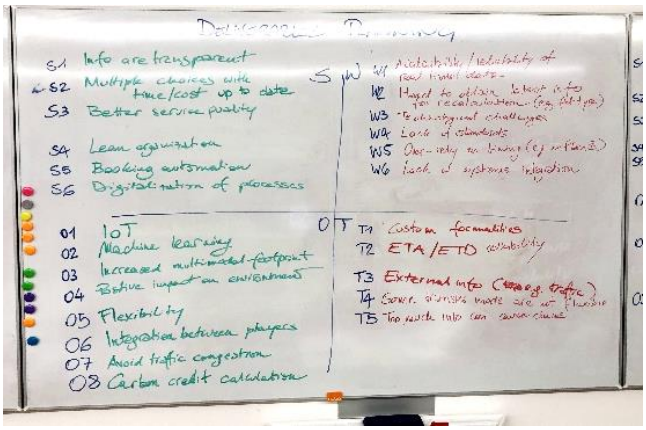
2 About information collection

4.1.x deliverables content is the processed result of partners contributions that have been collected during the brainstorming session carried out in Trieste on November 22nd, 2019 and managed by PP2, LP and PP5.

All suggestions coming from partners have been drafted on a whiteboard and collected by PP1 – CFLI.







4.1.x deliverables also take into account the LP contribution provided on February 7th, 2020 by the report "DIGITALIZING LOGISTICS PROCESSES (DIGLOGS) SWOT analyses of selected 11 innovations" drafted by Aksentijevic Forensics and Consulting, Ltd. for University of Rijeka and revisions by PP4 University of Trieste provided on February 10th, 2020.

3 Objectives of this document

This deliverable is about SWOT analysis of the third category of innovations: traffic automation systems in multimodal transport flows.

Chapter **Errore. L'origine riferimento non è stata trovata.** contains the core analysis and includes f ive paragraphs, one for each selected innovation; each paragraph, related to innovation, is further structured as follows:

- **Innovation summary**: a brief description of the innovative solution
- **Needs, challenges, and opportunities**: a descriptive preview of goals, pluses, risks, and issues related to the innovation
- **SWOT matrix**: synthetic matrix diagram of SWOT analysis
- **Strengths**: a detailed description of strengths
- **Weaknesses**: a detailed description of weaknesses
- **Opportunities**: a detailed description of opportunities
- **Threats**: a detailed description of threats
- **Weakness and threats mitigation approaches**: suggested remedies and strategies to address weaknesses and threats

The last chapter of this document includes overall final considerations about innovation relationships and recurring features and issues.

4 Innovations SWOT Analysis

4.1 Maritime transport chain

4.1.1 Innovation summary

Maritime transport chain innovation is not a single solution or a technology but rather a combination of smart applications and services aimed at improving the operation in the Maritime transportation chain.

Basically, this approach is intended to exploit the synergy of different combination of well-known technology-based innovations such as document digitalization, data exchange systems, smart sensors, data standardization, traceability systems, real-time monitoring but even those emerging like Blockchain, Machine Learning, Artificial Intelligence, and Internet of Things, to gain advantages and improvement in maritime transport chain effectiveness.

4.1.2 Needs, challenges and opportunities

Basically, maritime transport chain innovation comes from the need for increased efficiency of the transport operation understood as a whole interconnected system in which any link in the chain must have the maximum performance. Having said that, major challenges are related to the harmonization of a different part of the chain which can have a high degree of inhomogeneity in their own processes and tools. Being a wide-scale innovation, implementation benefits can easily spread to many actors in the port community.

4.1.3 SWOT matrix

STRENGTHS	WEAKNESSES
1. Data access and exchange improvement 2. New data sources useful in decision making 3. Increased efficiency 4. Better planning 5. More transparency, bigger security	1. Difficulty in harmonizing technology approaches 2. Low performance due to Big-scale changes 3. Need for specialized labour force

OPPORTUNITIES	THREATS
1. Better resource utilisation 2. Sustainable growth approaches 3. Wider optimisation 4. Fostering of further innovations	1. Resistance to change 2. Harmonized digitalization issues 3. Difficulty progressing beyond pilot initiatives 4. Risk of not reaching a critical mass

4.1.4 Strengths

S.1. Data access and exchange improvement

A maritime transport chain Information System will give better visibility and easy access to existing standardized digital data and improvement in communication and information exchange between parties and systems.

S.2. New data sources useful in decision making

A maritime transport chain Information System can act as an integrated platform and foster inclusion of data sources that were not previously integrated into the decision-making process.

S.3. Increased efficiency

A dedicated integrated platform for data access and exchange increases maritime transport overall efficiency basically resulting in decreased information processing time more speed in operation and cost savings in the long-term.

Also, data re-use and reduction or elimination of paper documents fosters efficiency in global logistics operation since it actually largely relies on paper documents, consequently reducing the execution speed and negatively affecting the planning of operations in the transport chain.

As a further effect, this innovation leads to efficient use of human resources decreasing the need for working man-hours and improving employee productivity.

S.4. Better planning

Maritime Transport Chain Information System has special tools to support operational planning and management based on data-driven indicators, quantitative estimation algorithms and multi-criteria scenario assessment functions.

S.5. More transparency, improved security

More standardized and interconnected data sources can foster the integration of technological solutions aimed at increasing transparency and security such as those based on blockchain that allows the maintenance of a distributed electronic ledger system for the transport chain with which to perform the automatic and authority-less validation of transactions in the cargo transportation.

4.1.5 Weaknesses

W.1. Difficulty in harmonizing technology approaches

There may be some difficulty to implement a harmonized approach of standards and technology adoptions over a large spectrum of organisations and environments. Indeed, the necessary modifications (regarding the implementation of innovations and new technologies) depend on numerous factors (for example, maturity and structure of the existing technical solution and its flexibility to manage new data, etc.) also considering that stakeholders may implement different technology solutions, platforms, and networks

W.2. Low performance due to Big-scale changes

Innovation does not include just one/single technology, but rather the combination of new services that complement and, in some situations, supplement existing systems and services. These changes do not necessarily require large modification of existing information systems rather than a system integration made by several connections protocols and services; in such a scenario, some big-scale changes could introduce propagation of errors, temporary disruptions, or gaps in processes with consequent low performance of the entire system.

W.3. Need for specialized labour force

To ensure platform effectiveness, special skills and a qualified labour force may be needed.

4.1.6 Opportunities

O.1. Better resource utilization

Future prospects anticipated by more efficient use of collected data is a higher level of cooperation between actors in transport operation or supply-chain, which enables real-time information exchange, consequently providing better resource utilization, increased productivity and costs reduction.

O.2. Sustainable growth approaches

Maritime Transport Chain effectiveness may foster new sustainable growth approaches based on positive environmental impact (CO2 and pollutants reduction), creation of new job positions with different skill sets (advanced resource and process planning, etc.) and logistics management in which the evolution of IoT and the use of Big Data creates the prospect of a new data-centric industry in which information takes precedence in logistics services' value propositions over the actual ability to move cargo.

In the long-term, this innovation will also help, on one hand, in a reduction or elimination of paper documents, on the other hand, in obtaining a generally more efficient use of natural resources.

O.3. Wider optimization

A maritime transport integrated platform will ensure better optimisation of processes and resources across the whole supply chain, not just within one stakeholder.

O.4. Fostering of further innovations

New opportunities may arise for new innovations triggered by new technologies integration and better data visibility and exchange. Internet of Things can enable revolution, and it is increasingly present in the transportation chain, either as smart sensors, controllers, embedded devices in cargo manipulation machines and even ship themselves. IoT devices facilitate process management and enable risk mitigation.

Further, document digitalization, electronic data exchange, integration of smart sensors, data standardization, visibility and traceability of cargo through real-time services (such as blockchain and other smart technologies) can vastly improve overall Maritime transportation chain services.

All these technologies provide numerous benefits, but these benefits can even multiply if they are combined in innovative ways, for example with machine learning algorithms and artificial intelligence based on data from IoT devices and shared with others through blockchain.

4.1.7 Threats

T.1. Resistance to change

Some resistance to change, particularly regarding established processes, may occur, depending on the spread of relatively fixed scope systems with an inability to support processes adaptation.

Also, certain stakeholders may refuse to cooperate due to lack of motivation, adequate skills or cultural approaches, employee resistance, lack of organizational agility.

System integration gains more benefits from “permission-less” chains and open data availability, however, the maritime industry still manages lots of confidential data which is hard to be shared.

T.2. Harmonized digitalization process issues

This threat is strongly related to W.1. The harmonisation of digitalisation process across a large number of stakeholders may be a severe issue, hard to estimate and may have high or unexpected investment costs. The variety of different languages, laws, and organizations involved in cargo movement may also increase harmonization complexity.

T.3. Difficulty in progressing beyond pilot initiatives

Integrated platforms must be tested and tried with pilot projects, prototypal application, and experimentation. These initiatives, particularly if they are small projects, may be hard to go beyond and scaled up becoming a widespread solution without special motivation for involved stakeholders.

T.4. Risk of not reaching a critical mass

In some cases, not reaching a critical mass means a quick death of the initiative even for supporters. For example, for blockchain application, a low number of transaction validation nodes may not allow the minimum performance of the distributed electronic ledger leading to a procedure failure.

4.1.8 Weakness and threats mitigation approaches

WR.1. Difficulty in harmonizing technology approaches

Maritime Transport chain implementation is a typical multi-actor scenario in which the design stage of the solution must include a highly accurate assessment of the state of the art of each involved player. The assessment might be related to both organizational and technological aspects in order to design a base framework for the detailed implementation plan that can support the draft of a special roadmap for complete harmonization.

WR.2. Low performance due to Big scale changes

This type of innovative solution is highly exposed to potential issues related to Big-scale changes. To mitigate this risk, a special assessment of possible performance issues or system failures is recommended. This assessment must define at least two aspects: the best system performance monitoring techniques and the action plan to be performed in case of system defects or incorrect results.

WR.3. Need for specialized labour force

An adequate level of specialized skills can be obtained carrying out a dedicate training program for internal employees as well as developing special education plans for new professionals in cooperation with available public and private education systems.

TR.1. Resistance to change

As already mentioned for other similar threats, resistance to change can be overcome by well-communicating goals and benefits to all actors, for example by holding events to involve parties and exchange experiences. Stakeholders should be preventively inquired, and their contributions included in the early stage of project design using tools and techniques like surveys, workshops, focus groups, training programs, etc.

TR.2. Harmonized digitalization process issues

This threat is strongly related to W.1 (see also WR.1) though it is more related to digitalization process across a large number of actors so it may be a more external factor to be faced.

Anyway, the best way to approach harmonization in processes in a multi-actor scenario is probably a well-carried assessment stage aimed at preventing unexpected situations and preparing an optimized background for following design and implementation stages.

TR.3. Difficulty in progressing beyond pilot initiatives

To avoid failures in pilot initiatives, it is recommended to develop a long-term strategic plan which defines the pilot's expected results and what future developments and scenarios could be. The strategic plan must also estimate investments costs and how the necessary resources will be collected to carry out the proposed activities.

TR.4. Risk of not reaching a critical mass

To mitigate the risk of not reaching a critical mass, a specific strategy aimed at involving the largest number of users and players must be defined as a basic part of the implementation plan. Indeed, it has the same importance as technical and technological aspects since they are closely related, and general performance heavily depends on it.

4.2 ETA, ETD

4.2.1 Innovation summary

ETA/ETD is a software-based innovation aimed at predicting with high precision the arrival and departure time of a ship increasing the efficiency of port operations.

The solution is based on the integration of data sources and Machine Learning algorithms capable of precisely estimate ships arrival and departure time by comparing the current and past metering of the progress of the transport and cargo loading/unloading.

The goal of using this ETA is to achieve "right on time" management regarding the planning of arrivals, departures, and connected services.

4.2.2 Needs, challenges and opportunities

Accurate ETA/ETD is a highly requested feature and a key value in port operation effectiveness. Many activities are related to arrival/departure and load/unload time so the availability of precise

information about it affects several processes. Furthermore, some opportunities may arise by giving interoperability to ETA/ETD information within the port community.

Main challenges basically regard incorrect estimates due to data inaccuracy that can occur for algorithm tuning issues or temporary data unavailability.

4.2.3 SWOT matrix

STRENGTHS	WEAKNESSES
1. Improved information transparency 2. Better planning and resource utilisation 3. Operational efficiency 4. Cost-effective implementation	1. Difficulties in modifying existing processes 2. Wrong planning due to bad estimates
OPPORTUNITIES	**THREATS**
1. New info services based on departure times 2. Improved data visibility	1. Bad management due to data inaccuracy 2. Risk of non-reliable estimates 3. Hard-to-reach standardized calculation methods 4. Lack of skilled workforce

4.2.4 Strengths

S.1. Improved information transparency

ETA/ETD innovation increases the transparency of information for all stakeholders. Shipping companies can take advantage of increased planning efficiency and lowering bunker and charter costs, agencies can benefit from clearer and streamlined communication while logistical and maritime service providers can provide better service thanks to a quicker grasp of the current situation.

S.2. Better planning and resource utilisation

Real-time updates can improve events predictability improving operations planning capabilities all levels and departments also obtaining environmental benefits such as lower CO2 emissions during each port call.

This means obtaining an optimization of business processes, reduction of delays, better estimations of delivery time and better planning of operations at all levels and departments.

S.3. Operational efficiency

From the operational standpoint, a better time estimation capability will result also in better usage of storage spaces, berth positions, loading/unloading activities, and waiting times reduction. ETA/ETD enables real-time shipment tracking, alerts messaging as well as the optimization of global multi-modal supply chain performance.

Idle times reduction will provide benefits to shipping companies in terms of shorter port call turnaround times and lower bunker/charter costs, to terminals in terms of better capacity utilization, to agencies that can offer better communication and services to customers and to logistics and marine service providers who may perform better predictability and faster assessment of the situation.

Port Authorities will get more accuracy in volumes calculation and cargo management while shipping companies can have shorter port call turnaround times and cost savings, agencies may reduce the number of needed calls, messages, and service providers in order to improve their overall quality level.

S.4. Cost-effective implementation

ETA/ETD is a cost-effective solution that can be easily implemented, unlike other Big Data analytics solutions.

4.2.5 Weaknesses

W.1. Difficulties in modifying existing processes

Given the general difficulty to modify existing processes, in this case, the issues can be related to introducing up-to-date arrival/departure information inside existing algorithms and procedures in order to obtain more accurate outputs from already operating processes and applications.

W.2. Wrong planning due to bad estimates

The quality of forecast data depends on the quality of input data. Vessel ETA is often unreliable since it is manually input; wrong estimates cause wrong planning and cause damage instead of benefit.

4.2.6 Opportunities

O.1. New info services based on departure times

Accurate ETA/ETD provides possibilities to build innovative service and communication based on the current state of logistics operations related to vessels. For example, ETA can be based on measuring and processing with Machine Learning data about transport progress (arrival), cargo loading/unloading (departure) and other related operations; final estimates, but also intermediate calculated values can be sent to stakeholders through mobile apps or even standard messaging system.

O.2. Improved data visibility

All generated data can be considered as added useful information that can be highly helpful for different actors, even those beyond the local community and the rest of the supply chain. This is truer if we consider that needed System Integration must be done developing special web services and interoperability protocols that facilitate the implementation of smart digital applications.

ETA/ETD solution can store historical and real-time data from several systems such as transportation management systems, ERP, EDI messages, sensors, etc. and provide in-transit visibility. More visibility during transportation can help stakeholders in many operations, for example in predicting the arrival of goods or in solving inventory management, cross-docking, and on-time delivery challenges.

4.2.7 Threats

T.1. Bad management due to data inaccuracy

Accuracy and the right timing of ETA information will affect the efficiency of the management of processes. Thus, the main risk stems from the inaccuracy and lateness of the data on which the estimates are based causing useless or unavailable estimates.

If the accuracy of data used as a base for estimates is not correct, the mislead estimates could cause waiting time and lower employee utilization.

T.2. Risk of non-reliable estimates

Although real-time monitoring is currently at a very good level, further improvements are needed in the area of monitoring the entire journey of goods and in the area of forecasting further movement, especially in case of large disturbances. For different reasons and system weaknesses, late information receiving can occur causing non-reliable estimates.

T.3. Hard-to-reach standardized calculation methods

Discrepancies in methods and standards for calculation estimates from solution to solution or port to port can lead to significantly different estimates and non-reliable results. Methods and standards for calculating estimates can be hard to reach and involve unexpected investment costs.

T.4. Lack of skilled workforce

To ensure solution effectiveness, special skills and a qualified labour force may be needed.

4.2.8 Weakness and threats mitigation approaches

WR.1. Difficulties in modifying existing processes

Modifying existing IT applications may involve high time and costs so it is recommended to carry on a detailed assessment of needed interventions in order to estimate the time and costs of each operation but also to define priorities according to system architecture. In many cases, it may be possible to divide the implementation plans into sub-modules and proceed to implement them in different stages.

WR.2. Wrong planning due to bad estimates

This issue is strongly related to previous T.2 (TR.2) so a mitigation strategy to avoid wrong planning must be designed as a whole, including the entire data processing chain.

TR.1. Bad management due to data inaccuracy

This mitigation strategy is also related to previously mentioned risks (see TR.2, WR.2). The entire solution has to be calibrated and monitored in order to gain adequate accuracy; as already mentioned, in case the estimates for some reasons cannot be available or are missing, there must be “alternative sources of estimates”.

TR.2. Risk of non-reliable estimates

Wrong estimates are very likely to happen so a strategy to correct calculations must be provided. On the one hand, it is important to define some target indicators that can highlight that some wrong estimation is occurring, secondly, the re-tuning strategy must provide alternative techniques to obtain needed calculation and ensure the main process best results.

TR.3. Hard-to-reach standardized calculation methods

As mentioned in par. 4.1.8 point WR.1, to achieve a good level of harmonization it is recommended to make a detailed assessment of organizational and technological aspects and design a base framework to support the definition of implementation roadmaps.

TR.4. Lack of skilled workforce

As already mentioned, an adequate level of specialized skills can be obtained by developing special training programs in cooperation with available public and private education system and carrying out dedicated training courses for employees

4.3 Deliveries Planning

4.3.1 Innovation summary

Deliveries Planning innovation is a specific IT tool based on Big Data and PCS automation and it is aimed at better planning of deliveries based on real-time and predicted traffic conditions automatically suggesting or enabling selection of best travel routes before or during the trip.

This IT tool involves a special decision support system that calculates routes by processing normalized real-time data coming from external sources and systems used by the port community.

This solution can be easily connected to the existing Port and Maritime information systems both as sources and as targets of the Delivery Planning solution.

4.3.2 Needs, challenges and opportunities

Deliveries Planning tool can be a good choice when other underlying technologies are available and effectively tuned; indeed, in such a situation, the development of this additional support tool might be quite simple and easy and it will bring more benefits to the overall operation of the port such as waiting time reduction, environmental impact reduction, improved multimodality and routes optimization.

Also for this innovation, the main challenges may come from data availability/time issues, and system integration complexity.

4.3.3 SWOT matrix

STRENGTHS	WEAKNESSES
1. Better resources utilisation 2. Waiting time reduction 3. Early planning based on real-time information	1. Poor data quality or unavailability 2. Processing time too long to support processes 3. Processes and technological integration issues 4. Implementation and maintenance costs 5. Lack of employees' adequate skill
OPPORTUNITIES	**THREATS**
1. Environmental impact reduction 2. Improved multimodality 3. Improved efficiency along the supply chain 4. Technologies integration	1. Planning inability due to late or missing data 2. Process disruption due to system modifications 3. Distrust and non-readiness to provide data 4. Risk of distorted use of innovation

4.3.4 Strengths

S.1. Better resources utilisation

Deliveries planning basically allows better utilisation of available resources. For example, in terms of workforce, automated delivery processing will allow a single operator to manage more orders

per minute since information exchanged with traditional communication methods will be greatly reduced. In the long-term, there will be cost savings and a general higher reliability.

S.2. Waiting time reduction

Transport and waiting time caused by external factors like traffic congestion, weather conditions, etc. will be reduced.

S.3. Early planning based on real-time information

Constant monitoring of conditions and real-time information allows events prediction and early/advanced planning of delivery changes. The system can provide automatic suggestions or selection of travel routes before the trip and even during the trip, considering a multi-factor scenario.

System Controller can also directly provide instructions and useful information to the operational base of organizations (e.g. drivers, warehouse staff, terminal staff, etc.) in real-time.

4.3.5 Weaknesses

W.1. Poor data quality or unavailability

Data not available or not readily provided can reduce transportation performances; this can be a threat or a weakness, depending on the involved data sources. Data quality depends on the frequency of data collection and quality of sources; this includes publicly available data, such as traffic conditions, weather data, availability of transport capacity, as well as data available in the transportation management solution, such as estimated times of arrivals, number and types of cargo, transportation vehicles.

Deliveries Planning solution requires good quality data sources in order to obtain useful data for more efficient planning processes. This includes creating an interface for the acquisition of the data from existing sources (such as Estimated Time of Departure and Arrival from PCS systems, cargo manifests, etc.) as well as new sources and sensors (location data, transport/stowage capacity monitoring, etc.).

W.2. Processing time too long to support processes

The timing of availability and analysis of data can affect the capability to effectively make smart changes to delivery plans. It can be difficult to define the required time needed for a change of deliveries and still make it actionable.

W.3. Processes and technology integration issues

Deliveries Planning IT tool is based on the integration of several data sources coming from different systems. Some modifications of existing solutions, systems and processes aimed to integrate them with the new tool may be necessary; this is normally time-consuming and requires careful and detailed planning.

W.4. Implementation and maintenance costs

Some modifications regarding an organization's structures will be necessary, including a fully integrated vertical system; unexpected high investment costs may come from the organization's structures improvement and adaptation. Several organizations may not need to increase the number of employees rather than to have more skilled and trained employees.

Furthermore, a large part of useful data for Delivery Planning may come from commercial and closed (not-public) systems and it may be necessary to pay for them.

W.5. Lack of employees' adequate skill

The real challenge will be a modification of decision-making processes, based on the prediction and suggestions of deliveries planning solution. These suggestions are likely to change very often and will be based on newly acquired traffic and other conditions. If operators do not manage "estimates" properly, it can affect operations in a negative way.

4.3.6 Opportunities

O.1. Environmental impact reduction

Effective deliveries planning means also lower resource waste and less impact on people and the environment. Reduction on Co2 emission may also be easily calculated by the system and obtained information can be used for marketing purposes.

O.2. Improved multimodality

Tighter connectivity of the supply chain and the availability of a new smart solution may help in integration and synergy planning of transportation systems resulting in improved multimodality.

O.3. Improved efficiency along the supply chain

Deliveries Planning solutions can improve efficiency along the entire supply chain, bringing benefits to a wide range of stakeholders and many aspects.

Traffic congestion can be reduced or avoided, integration and coordination among players may be simplified as the system may provide the right set of information at the right time, so the decision-making process will be more “data-based” and less “opinion-based”.

Communication will be less dependent on phone calls and email, making operational jobs more efficient, meaningful and less repetitive in some areas.

The technological solution will give more capability to tackle potential anomalies and to check the daily progress of the operations thanks to the integrated processing of a rich set of key monitoring variables useful in order to tackle issues and to check daily progress of the operation.

O.4. Technologies integration

Emerging technologies such as IoT and Machine learning can be easily and effectively integrated to a deliveries planning platform and to the existing Port and Maritime information systems providing more suitable interfaces and functions to support routing and other special needs.

Some technology integrations can include mobile devices with the aim to provide services in a more pervasive way. Smartphone logistics apps can be developed for stakeholders working “on the move” in the area and provide instant goods tracking, alerts on unexpected events, transportation delays information and re-routing functions.

4.3.7 Threats

T.1. Planning inability due to late or missing data

It may be difficult to secure the right and constant sources of data on which to base the model for Deliveries Planning, so late or missing data can result in the inability to modify delivery plans in the available time. For example, some areas can have limited infrastructure; when assets travel through those areas, tracking becomes very difficult.

Late or missing data can occur due to the use of an RFID-based tracking system, which cannot provide information about traveling assets when they are in between departure and destination.

Planning inability due to late or missing data may be both a weakness (see. W.1) or a threat depending on the origin of the main issues.

T.2. Process disruption due to system modifications

As what happens in many interoperable or multi-part technological solutions, there are risks of failure propagation that must be properly managed; in this case, changes or issues in one of the sub-systems that are part of the planning support platform can disrupt an entire delivery planning process.

Another possible issue may occur since data may not be available on all routes, limiting the usefulness of the whole planning process; in these cases, data will not be timely available or totally support all decision-making processes in delivery planning.

T.3. Distrust and non-readiness to provide data

There may be some inability/inflexibility of transportation providers to adapt to changes, especially as we move further up in the supply chain. Some players may not be ready to provide data because of their system or organizational model unsuitability.

T.4. Risk of distorted use of innovation

The main risk for the labour market would be a distorted use of the Deliveries Planning Systems by organizations. In particular, these platforms aim to help operational staff to take decisions on a day-to-day planning and re-routing activity while some organizations may take advantage of the automatization process in order to reduce staff and/or to cut internal costs.

4.3.8 Weakness and threats mitigation approaches

WR.1. Poor data quality or unavailability

Poor data quality or unavailability is a relevant risk since this innovation refers to a typical multi-actor scenario. The scenario is also particularly complex regarding technological aspects, so a prior detailed assessment of data sources and exchange systems and protocols is highly recommended. This will help in designing a "special toolset" to use in monitoring performances, detect weaknesses and failures and fixing malfunctions, low performances, and wrong planning.

WR.2. Processing time too long to support processes

Since it can be difficult at the beginning to exactly define exact time indicators, to avoid time issues in process support it may be useful to define a sort of ongoing adaptive strategy capable to allow system re-tuning according to significative monitored events.

WR.3. Processes and technologies integration issues

In this kind of innovation system integration must be properly and detailed design in order to mitigate the risk that small issues because of large-scale processes failure. Careful and detailed planning must start from an assessment of existing IT systems and data sources and should include rapid prototyping stages aimed at testing results quality and reliability.

WR.4. Implementation and maintenance costs

To develop system integration, the initial assessment of existing resources is crucial to prevent wrong investment cost estimation.

Furthermore, in investment costs assessment it is important not to forget to consider adequate training for the internal workforce and the possible need for new specialized professionals.

Regarding the data, since a large part of useful data for delivery planning is coming from commercial and closed (not-public) systems, a contractual base can assure a constant availability and quality of data.

WR.5. Lack of employees' adequate skill

As needed for other selected innovations, a lack of adequate skills must be addressed with a special training program, also developed in collaboration with educational institutions and organizations.

TR.1. Planning inability due to late or missing data

Possible missing or low-quality data is a rather widespread risk (see also WR.1, WR.2, and TR.2, TR.1 at par. 4.2.8) to be addressed by adequate assessment, performance monitoring techniques and specific intervention plans.

TR.2. Process disruption due to system modifications

In case of process disruption caused by missing or late data the issue is basically the one described in TR.1.

For what concerns possible data unavailability for some routes, it is a typical case of data inhomogeneity and it can be addressed by defining a special strategy that can allow a replacement of some datasets with alternative datasets. Alternative datasets may have less detail and accuracy but good enough to assure process execution. It is recommended to define this strategy as one of the first stages of the solution design.

TR.3. Distrust and non-readiness to provide data

This is a threat for some aspects similar to those already mentioned about resistance to change (see for example TR.1 in par. 4.1.8), so the same involving strategies can be adopted to face it.

If non-readiness is caused by IT infrastructure inadequacy, a special assessment and action plan aimed at leading to a "more aligned situation" may be helpful.

TR.4. Risk of distorted use of innovation

Distorted use of a Deliveries Planning Information System may be a real risk. It may be mitigated both by a proper communication plan aimed at raising the awareness of the actors on the optimal operating scenario and by the creation of a solid cooperation environment between stakeholders that can help to share experience and deal with the issues more effectively.

5 Final considerations

5.1 Mutual synergies between innovations

The first aspect that emerges from the first series of SWOT analysis is that almost all innovations can be considered "in synergy" with all others for at least two reasons: 1) each of them can be implemented together more effectively thanks to the existence of many common parts; 2) one of them is a prerequisite that must be implemented before the other. In many cases, it is not easy to understand if the relationship between two innovation is of type 1 or 2, even if it's not really crucial.

An example of this refers to deliverable 4.1.1 and it concerns the relationship between Document Digitalization and PCS, but also DSS, WMS, and Mobile Solutions. As for Traffic Automation systems, a further example is the strong relationship between ETA/ETD and Deliveries Planning or the one between ETA/ETD innovation and Port/Vessel Traffic Management reported in deliverable 4.1.2, as these innovations are both related to a more accurate estimate of travel times. Also, the Maritime Transport Chain is linked to many other innovations since it comes as an IT solution that aims to gain benefits from an integration of existing smart solutions and systems.

Also, in this case, this highlights that implementing one of these innovations, much useful information for the decision-making strategy can be obtained carrying out a cost-benefit assessment of some different integrated development scenarios in which more than one innovation is developed.

As already mentioned, this put in evidence that many innovative pilot solutions of WP5 have to be implemented combining more than one specific innovation.

5.2 Recurring features and issues

Some recurring benefits and positive repercussions come from this first series of SWOT analysis. As already done in deliverable 4.1.1 and 4.1.2, we can summarize/categorize strengths and

opportunities of selected informatization processes; also, in this case, the five hot topics (on average relating to three or four innovations) can be confirmed as:

1. **Processes improvement**: processes speed-up, automation, implementation of new features, safety and productivity increase
2. **Planning capability improvement**: better programming, forecast, assessment, analysis tool, and technique improvement
3. **Communication**: improved information exchange, data sharing, and actor interaction
4. **Services overall effectiveness and quality**: error reduction, more objectivity in decision-making, increased transparency and improved information availability for passengers and operators
5. **Environmental impact reduction**

As for critical factors and issues highlighted in weaknesses and threats, we can confirm the other five hot topics summarizing them:

1. **Infrastructure modification**: tools replacement and upgrade, system integration, increased costs in infrastructure and related work costs
2. **System complexity related risks**: process disruption, bad results, data unavailability, hardware failure, local inapplicability, design, and testing related costs
3. **Lack of skills**: the need for qualified/trained staff, internal organizational issues, internal and external acceptance issues
4. **Approach limitations**: technological intrinsic limitations, physical and local constraints, untested techniques
5. **Digital security**

As already mentioned in deliverable 4.1.1 and 4.1.2, some final general considerations can be made, especially for what concerns critical factors.

For what is about addressing infrastructure modification and system complexity it is very important to adopt a multi-stage design approach that includes at least a stakeholders consultation stage, concept definition stage, prototyping and testing, final detailed design stage.

The best way to face a lack of skills issues, both at the operational and decision-making level, is to design and carry out special education and training programs, which would be better if held in blended formats such as a laboratory, training on the job, e-learning, self-training.

The physical, technological and methodological limitations must be addressed by creating prototypes and tests to simulate working conditions, while digital security aspects must be treated with the contribution of qualified experts in both technological and regulatory aspects.

Finally, for what specifically concerns Maritime Transport Chain, ETA/ETD, and Deliveries Planning, higher importance must be given to aspects related to real-time tracking solutions, time estimation algorithms and techniques and mobile devices smart applications, but also to geospatial data processing for what concerns tracking visualization, multimodality and routing functions.

As for issues and criticalities, again, aspects related to technical implementation and system complexity are of particular importance, as well as some particular issues related to local constraints and limitations, such as those about connectivity and low-infrastructured contexts.