

## WP 5 – Activity 5.1

# Framework conditions and parameters for tool application in Ports and Terminals





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#### Creators

**INWL Institute for Sustainable Economy and Logistics**

Nils Heine

Phone +49 381 252952-20

Email [heine@inwl.de](mailto:heine@inwl.de)

Henning Wegner

Phone +49 451 69333-13

Email [wegner@inwl.de](mailto:wegner@inwl.de)

Georg-Büchner-Str. 17  
18055 Rostock  
Germany

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## Objectives of the Work Package

What is the main objective of the work package?

The purpose of Work Package 5 (WP5) is the following:

- 1) To identify, evaluate and test IoT – Internet of Things technologies suitable for SB small ports and effects on Blockchain Strategies, based from work in WP3 and WP4.
- 2) To assist the shipping, ports and terminals sectors by testing and evaluating various scenarios. Here, the combination of joint efforts will be done.
- 3) To model, simulate, emulate and prototype in order to evaluate partners that are ports. In WP5 will consider following technologies, such as Agent Technology, Data Science. i.e., Machine Learning and the integration of digital technologies (on cloud computing).
- 4) To help the shipping, ports and terminals sectors to be safer, more sustainable and competitive. The objectives achieved from available automation technologies and Blockchain strategies will yield unified/ integrated vision of digitalisation of port components combined with smart data management.



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## Deliverables

Deliverable 5.1
<b>Blockchain and IoT Modelling and Scenario Analysis Tool for Small Ports and Terminals</b>
Modelling of min. 5 transport business strategies using Blockchain strategy from WP4. Scenarios will be developed from input of PP6, PP8, PP9 and Associated Partners - ports. External evaluators ensure that factors and technologies are considered and evaluated. Deliverable is not subject to state aid - will be accessible via the project website.
Deliverable 5.2
<b>Implemented Simulation and Emulation for Small Ports for Digital Transformation</b>
This will be done for 5 small ports in the SB region - DK, DE, LT, PL and SE. DK is assured due to participation of Danske Havn. The modelled and developed scenarios for small ports in digital technologies use and value-added creation for transport services will be simulated under the "real-life" conditions. Implemented in 3-5 days workshops.
Deliverable 5.3
<b>Prototypes of Small Ports Digital Roadmap</b>
After modelling, scenarios and tested simulation, real-life prototypes are applied for the small ports. This will result in specific service prototypes that can be further developed beyond the project life by the small ports with investments from the CEF or other structural funds. The ownership within the project belongs to the consortium.

## Activities

Activity 5.1
<b>Framework Conditions and Parameters for Digital Modelling and Scenario Tool for Ports and Terminals</b>
The conditions cover the requirements and preparatory measures that are needed in order to implement digital port modelling, scenario developing and real-life prototyping in pilot small ports.
Activity 5.2
<b>Development of Blockchain and IoT Modelling and Scenario Analysis Tool for Ports and Terminals</b>
Development of models and specific scenarios for participating min. 5 ports. The results of 5 workshops will be published. The sensitive data of the participating ports will be anonymised for publishing purposes as well as workshops when other ports and stakeholders take part.
Activity 5.3
<b>Testing Blockchain and IoT Transport Business Strategies in Small Ports and Terminals</b>
The developed model and scenario analysis tool - process-based approach - is tested in ports in order to ensure its feasibility. This is done in the form of 5 workshops in each SB region. Participation of other ports will be ensured for free and equal access to information.
Activity 5.4
<b>Implementation of Simulation and Emulation for Small Ports for Digital Transformation</b>
The tested tool will be applied to simulate and emulate small ports digital transformation, i.e. what needs to be done in the next future in terms of equipment upgrade, strategy change, change of networks or new market entries, etc. Form: 5 workshops in each SB region.
Activity 5.5
<b>Application of Tool for Prototyping of Small Ports for Digital Transformation</b>
Developed for each of the participating small port. Min. 5 prototypes. Call for participation will be launched too - equal access. They are pre-ready market service that are subject to further development by the ports with other substantial funding after the project life.
Activity 5.6
<b>Validation and Verification of Tool by External Evaluators</b>
Experts from port management systems, the EC, ESPO, etc. will be involved in order to ensure feasibility and transferability of the Blockchain and IoT implementation tool to other ports. Form: medium-term and final report. Due: M30 and M34. Results will be presented in final conference.

## Introduction

The future of planning, building and operating ports will significantly change due to digital transformation. Creating digital models is already a reality. Nearly all operational processes can virtually be displayed and controlled. More and more ships and planes are synced to a virtual twin, which shows the operational data or malfunctioning parts in real time. Real-time maintenance or predictive maintenance becomes possible. Using blockchain systems in the future will bring more transparency and create better accountability between parties can be used for all business transactions.

This report among other things will look at the conditions that cover the requirements and preparatory measures that are needed in order to implement digital port modelling.

And it will develop possible scenarios and real-life prototyping in pilot small ports.



Figure 1- Introductory picture (Seaport of Wismar)

## Framework Conditions and Parameters for Digital Modelling

The future belongs to digital model-based, cooperation and efficiency in all phases of work. Planning errors, risks, unexpected cost increases, disturbed construction processes and unnecessary high operating costs - all this becomes less significant with the digitalisation of models and processes.

The work with digital models requires clear contractual regulations, close-cooperation and team-oriented long-term planning. Every aspect and every department of the port must be taken into consideration. The roles of all the involved employees and external partners must be clearly defined from the start.

The data must be exchangeable between the different parties. Any software between different ports or port departments must be standardized or the data format must be readable by the different software.

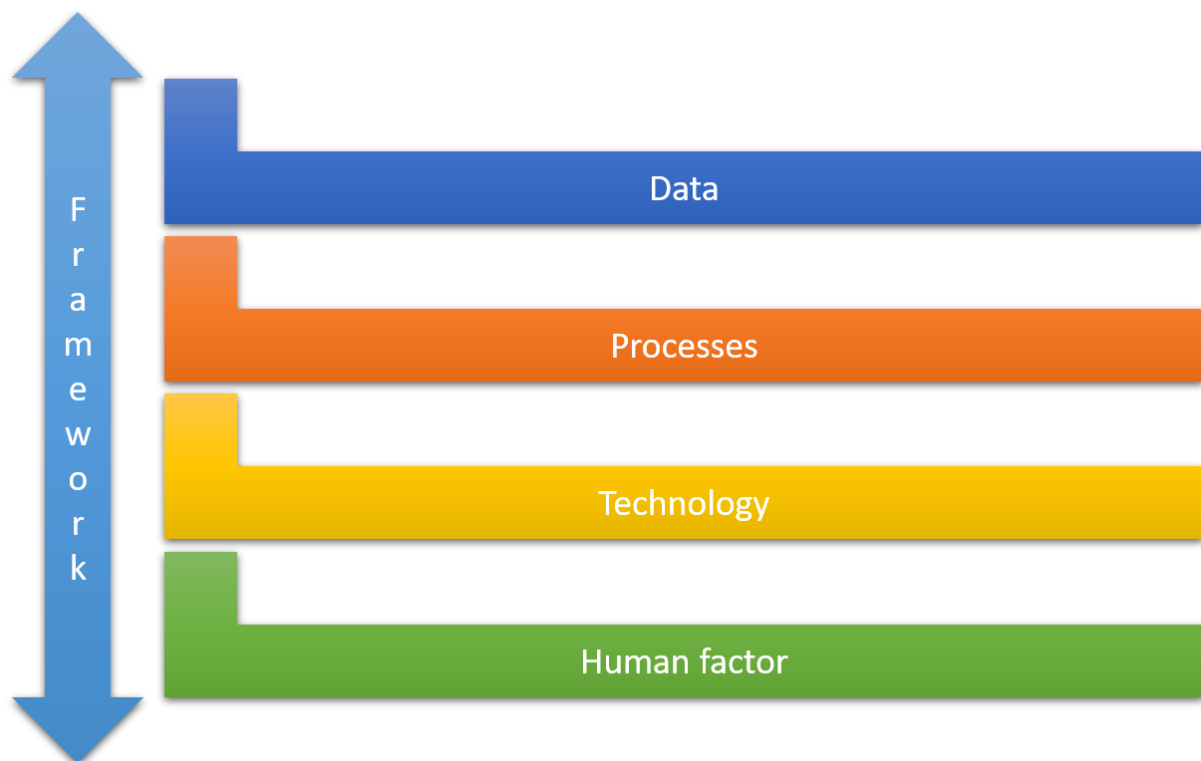


Figure 2- Key framework aspects

The main aspects within the digitalisation of process and the creation of digital models are the four points shown in the picture above. The data is the major point and the basis for all further development in the digitalisation processes. The actual processes will be digitalised, and the technology will assist in that. The last point is the human factor, the people, something that is often forgotten, but has a very big impact, especially since nowadays a lot of companies and that is including ports, face the trend of demographic change.





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## Data

Data takes a central role in the digital modelling process. The following points are essential for the development and implementation of digital models:

- Creation, coordination and implementation of manufacturer-neutral data exchange formats.
- Knowing the Standards and other applicable documents as well as active standardization bodies (E.g.: International Harbour Masters Association [IHMA])
- Coordination of interest groups, like science (universities), client / Operator (shipping companies etc.)
- Creating appropriate structures and coordination mechanisms for efficient work and to avoid duplication of work

Following these steps will ensure that partners can work together with the same set of data.

## Processes

The processes are in most cases what will eventually be digitalised, either fully e.g. letter to e-mail or as part of a different change where a digital model is created for the use of malfunction identification or real time information (e.g. digital twin). Digitalising models means the interaction of different areas: work processes, organizational structures, employees, business relationships and the correct use of technology are needed to achieve this step.

It is important to have standardized processes and responsibilities established at the beginning of the project - who does what, when and how. This will be a major step towards the development of a plan that creates the workflows. Which additionally need a precise definition of the interfaces, the different actors, their roles and interactions.

## Technology

The digital technology for the creation, management and use of information for a digital model is very diverse. It ranges from software to modelling and analysis to communication media to connect to the appropriate hardware and mobile devices. Comprehensive knowledge and understanding of the technology is required for different sized and complex projects. This knowledge is not always present to all parties.

## People

A consistently value-adding implementation of a project depends to a large extent on the human factor which have to be ready and able to make new steps. If appropriate skills and resources are missing, people often feel overwhelmed and frustrated - a circumstance that hinders change. Recognizing one's own benefits is motivating. The decisive factor is therefore that on the management level the respective institutions, associations, departments or companies have to set the appropriate impulse.

## Scenario development

After the important framework aspects for the digital modelling and the scenario development have been covered the next step is the creation of possible scenarios. This step is based on the expected outcome of the Deliverable 5.1:

*“Modelling of min. 5 transport business strategies using Blockchain strategy from WP4.”*

The first thing that has to be understood is that:

“Blockchain and its opportunities in being used in sea freight logistics and specifically from a port-centric perspective is arguably still not clearly understood or a strong hesitation from the industry exists due to its unclear values.”

- Taken from Activity 4.1, Section 1.1, Page 2 (Document Version 2.6)

Therefore, the proposed strategies are to be seen as theoretical, first ideas of how to approach this topic.

Activity 4.1 provides the Port and Terminal Processes under section 3.5, page 14 (Document Version 2.6). Which are:

- **Documentation**
- **Tracking and Tracing**
- **Sorting and Processing**
- **Resource Management**
- **Scheduling**
- **Integration of Process Optimization**

In the following, all five points are explained in chronological order. It should be noted that all scenarios generate synergies among each other and should ideally be understood as individual stages of an entire development process.

## Documentation

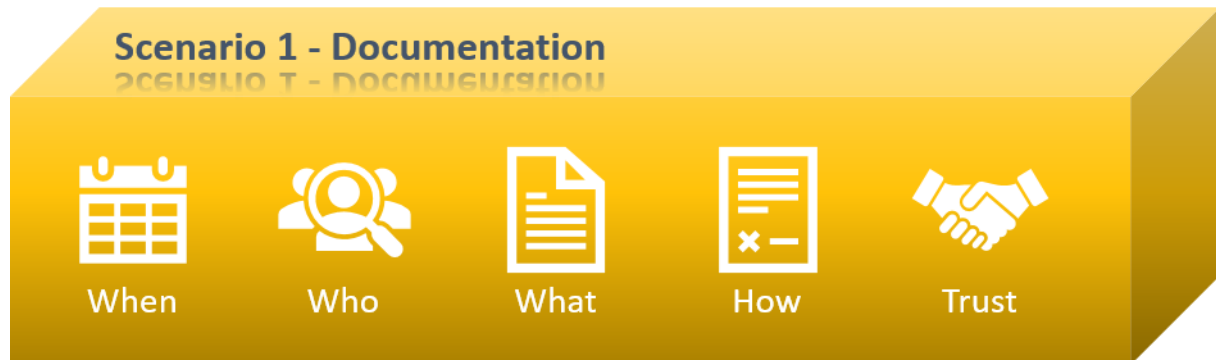


Figure 3 - Documentation

The first scenario describes the documentation process possibilities using Blockchain technology. With that technology and its transparency capabilities all the involved partners can be part of the process. For all the documents that are necessary during the e.g. order it is possible that everyone is involved.

In this scenario fully transparency is created for all parties. Everyone has access to all the Dates (When), it is possible to see Who was involved in any step. Additionally, all the contract details (What) are easy to access and any possible changes too.

The contracts itself can be made using the Smart Contracts technology. This overall can help to establish a strong trusting partnership since smart contracts run on the top of the blockchain technology, and thus, mirror the same advantages that are characteristic for the blockchain technology.

To sum it up the **first Scenario** is the full implementation of the documentation process into a blockchain system

## Tracking and Tracing



Figure 4- Tracking and Tracing

The second scenario is about the tracking and tracing capabilities, it is similar to the first scenario and it is suggested that the two scenarios should be combined. Using the blockchain technology all the participating partners will be able to fully track the cargo flow. That means that all the involved parties will be fully aware of where their goods, ships or trucks are at any time.

With the transparency of the Blockchain technology even damages to the goods can be pinpointed and the responsible partners be identified. This will lead to overall more cautious, careful handling while increasing the quality.

To sum it up the **second scenario** is the development of a blockchain based tracking tool. An ideal pilot scenario could involve one port and one regular external business partner, who moves goods through that port on a regular basis.

## Sorting and Processing



Figure 5- Sorting and Processing

The Sorting and Processing Scenario should be seen as a more internal scenario compared to the previous two. Of course, at the end all the three example scenarios can be combined to create one transparent blockchain application in the port system, but of course these developments have to be approached step by step.

In this last scenario the internal sorting and processing steps are controlled via the smart contract and blockchain technology, that includes the different operations e.g. the unloading of the container or the storing or loading up to the truck. It can also include customs which are mostly located within the port. This is a good opportunity for a port to make their internal processes more transparent.

To sum it up the **third scenario** takes a closer look into the internal processes and transfers the sorting and processing steps into a blockchain system

## Resource Management

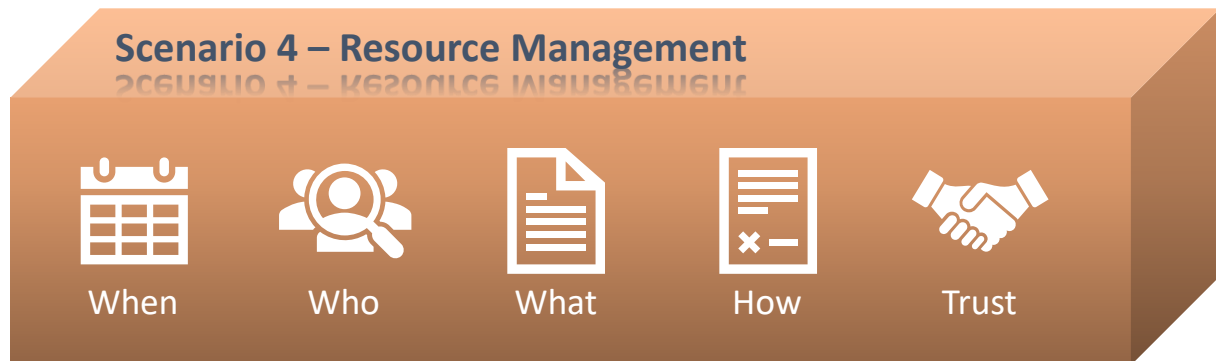


Figure 6- Resource Management

The Resource Management Scenario represents the link between own resources and the supply chain. It is an interface between internal processes and upstream vendors.

The use of blockchain technology is conceivable in many aspects. For example, it is an opinion to combine blockchain technology with intelligent warehousing, ideally even with IoT technology. In this way, incoming and outgoing containers could be automatically reported and stored in the blockchain. The available resources can automatically cause a release for further deliveries. So, the gap between internal communication and other actors involved in the process can be closed and at the same time maximum protection against manipulation can be provided for everyone involved.

To sum it up the **fourth scenario** represents a link between internal and external processes. It connects the blockchain processes with internal capture technologies on the one hand and the individual parties involved in the process via the blockchain on the other.

## Scheduling



Figure 7- Scheduling

The Scheduling Scenario maps the temporal components of the transport and port processes and their implementation in a blockchain technology.

A decisive success factor of value creation through a distributed network in which different parties participate is the timing of processes. This applies to ports as well as to customers and suppliers. A reliable, realistic time schedule with, ideally, real-time mapping of all processes of the network involved is therefore a basic prerequisite for remaining competitive in times of digitization. An important advantage of using blockchain technology in the creation and processing of schedules is that transactions can be bindingly and tamper-proofed in advance and can be executed accordingly without an executing party having to start and confirm the process at the appropriate time. This scheduling of transactions can bring a decisive time advantage, for example, when transporting sensitive and/or perishable goods.

To sum it up time is one of the most important factors regarding economic decisions. However, the prerequisite for time planning with blockchain requires a secure corresponding computing power at the time of transaction execution. There is a need for further enhancements and testing. The **fifth scenario** could therefore represent a decisive advantage of the use of blockchain technologies in ports in the future but needs further development.

## Integration of Process Optimization



Figure 8- Integration of Process Optimization

The Integration of Process Optimization Scenario combines and sums up all previous scenarios. Ideally, it combines the IoT with real-time data processing, fault reporting and solution finding.

Through the use of blockchain technologies, not only the temporal component can be covered, but also manipulation security can be guaranteed, and all participants can be quickly identified and informed. Solutions can also be stored for certain incidents and applied automatically.

Another important factor is the storage of all data at different locations. A process analysis and optimization can thus take place on a comprehensive basis of all parties. This provides an all-embracing overview and makes holistic optimization possible.

To sum it up the **sixth scenario** takes a closer look into the the functionality of processes and reveals weak points, bottlenecks and opportunities for improvement. Due to the manipulation security of blockchain technology and the direct availability of all data, it represents a great opportunity here.



## Preparatory steps for developing blockchain scenarios

### 1. Step – Scenario identification

The first step is the selection of the right scenarios. This has to be done based on three factors:

- Data Authentication and Verification
- Smart Asset Management
- Smart Contracts

Looking back at the previously described scenarios they can all be sorted into one or more of the three factors.

### 2. Step – Agreement on Consensus Mechanism

A so-called **Consensus Mechanism** must be selected. For the purpose of this project it will be assumed that, especially in a pilot run, the partners will know and trust each other from the beginning and therefore data that will be fed into the system will be assumed to be correct.

### 3. Step – Platform selection

Presumably in the project a platform will be created specifically for this project, therefore no external platform has to be selected. If that is not the case there are a large variety of platforms available to choose from such as Ethereum, Openchain and many more.

### 4. Step – Selection of technical equipment

The kind of platform, public or private etc. as well as the operating system and more in-depth systems and technical requirements must be selected.

### 5. Step – Designing Admin and User interface

More detailed configuration of the admin and user interface, this will be necessary to make this system accessible for all the potential users. More details on this step will be in the actual WP in which the system will be programmed.

### 6. Step – Equipping machines & training employees

For machines to send data to the system it is necessary for those machines to be equipped with the right sensors, also the employees who will be using the tool will have to be trained in the use of the system.

## Conclusion and recommendations

The conditions that cover the requirements and preparatory measures that are needed in order to implement digital port modelling, scenario developing and real-life prototyping in pilot small ports are found mainly in the four aspects Data, Processes, Technology and People.

Based on this report the next activities in the Work Package can be started. The more generalized scenarios from this report will be made more specific in the next activities for the direct application in ports.

As the four previously mentioned aspects Data, Processes, Technology and People are overall very important for digitalisation projects this framework can serve the main project output as a guideline for the implementation of sub- and pilot-projects.

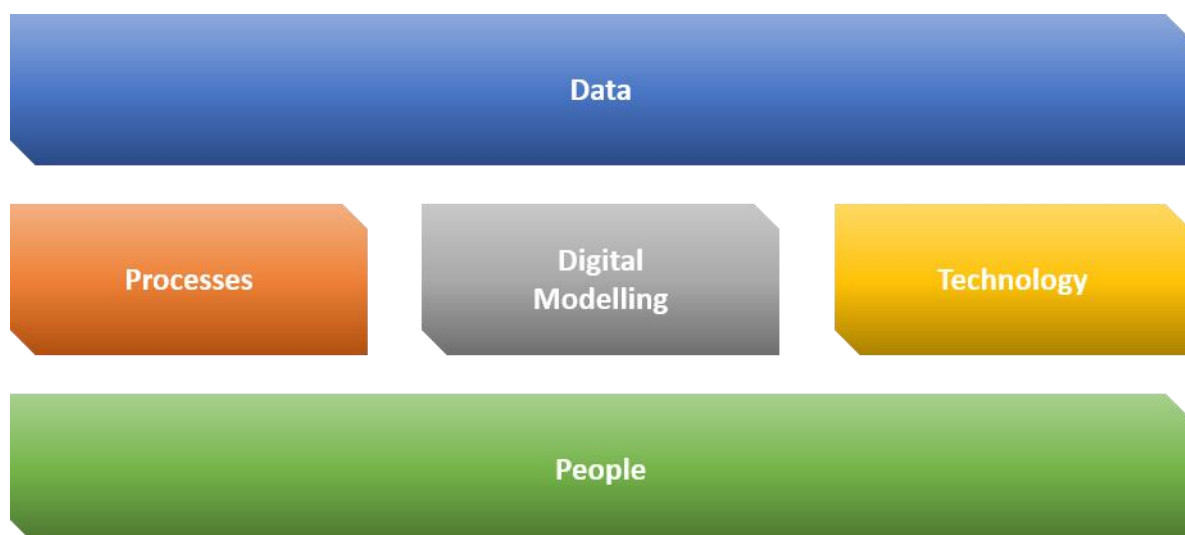


Figure 9 Key Aspects for Digital Modelling

The graphic highlights the importance of the four main framework aspects, for the successful implementation of digital port models, scenarios and real-life prototyping in pilot small ports



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