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PortForward

10.3 – 1st Year Progress Report

Christian Blobner (FhG/IFF)

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1.0	05.07.2019	FINAL	Christian Blobner (FhG/IFF)	ready for submision

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Abbreviations

CSA	Coordination and Support Action
DTF	Dock the Future (project)
ICT	Information and Communication Technology
IMV	Internal Movement Vehicles
INEA	Innovation and Networks Executive Agency
IoT	Internet of Things
KPI	Key Performance Indicators
LCA	Lifecycle Assessment
M	project month
PO	Project Officer
RoRo	Roll-on/Roll-off
ToC	Table of Contents
TRL	Technology Readiness Level
WP	work package

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Executive Summary

The PortForward project successfully concluded its first year in June 2019. The current report provides a full overview of the activities in the project's first twelve months. In this, the report will incorporate the previous deliverable 10.2, which covered the first six months of the project, and extend it by the subsequent project months M7-M12. While the first six months of the project focused on the establishment of the consortium structure and partnership relations with appropriate stakeholders as well as the preparation of the project use cases, the second half of the year build on this and further refined the uses cases with a perspective on the technical implementation. Discussions revolved around the architectural design for the project solution as a whole. Moreover, the development of the individual services for port operators was initiated and their integration in the cloud based solution discussed. Exploitation and dissemination was furthered through individual activities and public events.

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1 Summary

The present document is the Periodic Report submitted by the PortForward project. The purpose of this document is to provide a technical progress report of the work packages and tasks carried out by the PortForward consortium during the first 12 of the project, July 2018 – June 2019 (M1-M12). It will provide an overview about the deliverables produced and, where applicable, the deviations from the Grant Agreement.

As D10.3 is a public technical report, this document includes no explanation of personnel costs and efforts or any major direct costs incurred by PortForward partners.

1.1 Project Details

Grant Agreement number: 769267

Project acronym: PortForward

Project title: Towards a green and sustainable ecosystem for the EU Port of the Future

Funding Scheme: Research and Innovation Action

Activity Period: from 01/07/2018 to 31/12/2021 (42 months)

Project Website: www.portforward-project.eu

Consortium:

Table 1 PortForward consortium members

Participant No *	Participant organization name	Participant Short Name	Country
1	Fraunhofer IFF	IFF	DE
2	ACCIONA Construcción S.A.	ACCIONA	ES
3	IMEC	IMEC	BE
4	Brunel University London	BRUNEL	UK
5	LEITAT	LEITAT	ES
6	Ubimax GmbH	UBIMAX	DE
7	Core Innovation & Technology OE	CORE	EL
8	Port Authority of Vigo	VIGO	ES
9	Autoridad Portuaria de Baleares	PDB	ES

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10	Autorità di Sistema portuale del Mar Tirreno Settentrionale, Northern Tyrrhenian Sea Port System Authority	APS MTS	IT
11	MARTE	MARTE	IT
12	Kristiansand Havn KF	KRISTIANSAND	NO
13	Magdeburger Hafen	MAGDEBURG	DE

1.2 Project Summary

The Port of the Future will be able to enhance sustainable development and to manage the resources to be invested and their employment for a competitive advantage. Therefore, the port of the future must be oriented to port community and have an operative strategic capability to work, in line with European purposes, on the following:

- Smart, through ICT solutions, because it is important to improve exchange of information flows between port and port community;
- Interconnected with the use of a combination of different modes of transport and the integration of different technologies, because it is important to achieve better monitoring and controlling of the freight flows;
- Green through the adoption of green technologies because it is important to reduce the environmental impact of port operations saving the resources.

All in all, sustainable development is the present and future for ports that want to lead the industry supported by three cornerstones: Operational Excellence, Insightful Collaboration with partners through the supply chain, and top-notch Safety, Health and Environmental practices.

PortForward proposes a holistic approach that will lead to a smarter, greener and more sustainable port ecosystem. For its implementation, the PortForward project is broken down in eleven work packages as indicated in Table 2. The current reporting period covers activities in all work packages, whereby work packages one to five, which are mainly concerned with establishing the theoretical base represent the main focus of the period.

Table 2 PortForward work packages

WP No	Work Package Title	Lead Participant Short Name	Start Month	End month
WP1	Stakeholder needs and technical requirements	ACCIONA	1	8
WP2	PortForward framework design	LEITAT	2	18
WP3	IoT-enabled ports	IMEC	2	40
WP4	PortForward services	UBIMAX	4	38
WP5	Green Scheduling & Sustainability of operations	BRUNEL	1	42

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WP6	The PortForward Dashboard & technical validation (TRL 5)	IFF	4	40
WP7	Use cases & impact assessment (TRL 6)	MARTE	4	42
WP8	Valorisation and market assessment	CORE	1	42
WP9	Dissemination/Communication/Exploitation	CORE	1	42
WP10	Project Management	IFF	1	42
WP11	Ethics	IFF	1	42

1.3 Overview of the work done during the reporting period

1.3.1 Objectives of the project for the reporting period

The Grant Agreement does not specify any milestones for the activity period. The relevant deliverables for the period have been submitted. The only deviations to report have been a slight delay in the production of the deliverables D10.2, D1.1 and D1.2.

1.3.2 Summary of progress

The following table provides a general overview of the progress per WP.

Table 3 General overview of the progress per WP

No.	Work Package Title	Status & comments
WP1	Stakeholder needs and technical requirements	Progress according to the project plan – the work package was closed in M8. Work in the work package facilitated a harmonization of approaches to the stakeholder description and the understanding of the structuring of the use cases, as well as the explicit technical capabilities of each partner in the use cases. On-site meetings at relevant use case ports (in cooperation with other work packages) have been carried out to clarify specific aspects. In cooperation with the efforts of especially WP2, the use cases were further defined with a perspective on technical implementation through the envisaged PortForward services. Moreover, the consortium defined relevant KPI to assess the implementation success of the use cases. Deliverables have been submitted with slight delays but did not influence the work progress of this or other work packages. There is one open (sub-)use case definition for the Baleares Port with respect to predictive maintenance, which should be closed in the by M14 at the latest.

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		The relevant Milestone MS1 was reached according the work plan in M8 with the closure of the work package. (With the small caveat of the Baleares Port use case) Further details can be found under 2 WP1 – Stakeholder needs and technical requirements
WP2	PortForward framework design	Progress generally according to the project plan. However, a shift of perspective of the work package might be necessary. The work package is closely coordinating with WP1 to achieve the expected results and synchronize work, e.g. through synchronized surveys in the first six months of the project. Specific focus is put on the technical aspects of the port infrastructures and use case partners. The second six months concentrated on the architecture design, which opened discussions of the role of WP2, especially in its dependence on the concurrent development of the PortForward Services. Here, the consortium is currently in discussion how to properly address the implications of these interdependencies. Deliverable D2.1 is scheduled for M12 but will be delayed and might be redefined in its role for the project implementation. This will, however, not delay the overall implementation effort of the project. The relevant Milestone MS2 will have to be postponed, depending on the discussion of the role of WP2, in coordination with the project offices. Further details can be found under 3 WP2 PortForward framework design
WP3	IoT-enabled ports	Progress according to the project plan. Current focus is on the coordination of partners to ensure the successful technical integration. Coordination of the consequent activities is mainly through telephone conferences and within meetings in the scope of on-site port visits. The work package defined the underlying technical infrastructure (IoT Middleware and Cloud System) and its connection to the envisaged services. Moreover, a first version of the middleware was launched and made accessible to the project partners through an API. The work package produced two deliverables, which were submitted on time. The Milestone MS4 was reached according to the work plan. Further details can be found under 4 WP3 IoT-enabled ports
WP4	PortForward services	Progress according to the project plan. Service development is coordinated with requirements development in work packages one and two. On-site meetings helped to define the scope for the services. There has been further coordination between the relevant use case partners to define the relevant service and technical needs. The work was

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		closely related with WP1 (for which D1.3 especially provided a service oriented perspective on the use cases) and WP2. Additionally, the 2nd project management provided input on the relationship between use cases-architecture-service design. No deliverables have been planned for the work package in the current period. Further details can be found under 5 WP4 PortForward services
WP5	Green Scheduling & Sustainability of operations	Progress according to the project plan. Service development is coordinated with requirements development in work packages one and two. On-site meeting at Vigo helped to define the scope for the service. There have been further coordination between the use case partners, culminating in an extended on-site visit in Vigo by multiple partners from June 17-21, 2019. No deliverables have been planned for the work package in the current period. Further details can be found under 6 WP5 Green Scheduling & Sustainability of operations
WP6	The PortForward Dashboard & technical validation (TRL 5)	Progress according to the project plan. Work is closely coordinated with work package two with respect to architecture design to take into account the requirements for the digital twin concept, dashboard and decision support. The work in the work package progressed in developing and describing the underlying concepts for the port digital twin and the PortForward decision support system. Deliverables D6.1 and D6.2 were produced in the current reporting period. Further details can be found under 7 WP6 The PortForward Dashboard & technical validation (TRL 5)
WP7	Use cases & impact assessment (TRL 6)	Progress according to the project plan. Through a close cooperation with work package one, there is an intensive process ongoing for the comprehensive and structured description of the use cases. The on-site visits were closely coordinated between the use case partners to cover aspects from multiple work packages, incl. use cases. Based on the work carried out in WP1, the work package further elaborated on an assessment framework for the project's use cases. Here the consortium partners explicitly focused on the elaboration on an end-user perspective for the use case evaluation and assessment. The deliverable D7.1 was produced and submitted in the current reporting period.

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		Further details can be found under 8 WP7 Use cases & impact assessment (TRL 6)
WP8	Valorization and market assessment	Progress according to the project plan. Activities were started to coordinate the establishment of the project advisory board. Further coordination with work package nine to identify relevant exploitable results to ensure sustainability. The advisory board was successfully established with a first meeting to be scheduled for M15/M16. No deliverables have been planned for the work package in the current period. The Milestone MS16 was reached with a slight delay in M9. Further details can be found under 9 WP8 Valorization and market assessment
WP9	Dissemination/ Communication/ Exploitation	Progress according to the project plan. Project website and dedicated social media accounts have been launched and coordination with CSA Docks the Future is ongoing. Use of partner networks to ensure presence at relevant events, e.g. Docks the Future or ALICE, to disseminate results. Further cooperation with the above mentioned stakeholders was pursued. The project also used different events to disseminate project information to the wider public. The project website and social media channels were used for wider dissemination. The deliverables for the work package (D9.1, D9.2 and D9.5) were submitted according to schedule. Further details can be found under 10 WP9 Dissemination/ Communication/ Exploitation
WP10	Project Management	Progress according to the project plan. Organization of half-yearly project management meetings (Kick-Off carried out, February 2019 meeting in planning) as well as additional meetings on needs basis. Established project structure as laid out in D10.1, including communication and cooperation rules, so that the consortium has a deep common understanding of the project objectives and how to cooperate to achieve them jointly. Implementation of a common document repository and online workspace. The consortium carried out a second project management meeting in Madrid in February 2019 (M8), which further aligned the work over all work packages. An online coordination meeting between the work package leaders was carried out as well as a regular review meeting with the project officer in Brussels. The planning for a next project management meeting in Kristiansand in September 2019 (15) is ongoing.

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		The deliverables for the work package (D10.1, D10.2, and D10.3) were submitted, in part with slight delays, which did not affect the overall project implementation. Further details can be found under 11 WP10 Project Management.
WP11	Ethics	Progress according to project plan. The work package is closely coordinated with project management to define procedures as well as with work package nine for identifying relevant data sets in the ethics context. The submitted deliverables D11.1 and D11.2 lay out the ethics procedures and requirements for the work in the project. The work in the work package is completed. Further details can be found under 12 WP11 Ethics Requirements.

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1.4 Main Results

The main technical results of this reporting period can be summarized as follows:

- Harmonization and summary of stakeholders' needs and expectations for PortForward use cases (WP1)
- Launching of a stakeholder survey (WP1)
- Definition of a comprehensive and consistent use case structure and description of the relevant framework parameters (WP1)
- Consolidation of use case description in comprehensive framework detailing the relationships with the envisaged PortForward Services (WP1)
- Definition of Use Case assessment Key Performance Indicators (KPI) (WP1)
- Discussion of architecture-service relationship, albeit with no definite result (WP1/WP2/WP4/WP5/WP6)
- Definition of an end-user focused assessment framework for the use cases (WP7)
- Implementation of a project website including a public repository for the dissemination of public deliverables (WP9)
- First definition of exploitable results (WP9)
- First definition of relevant data sets (WP9)
- Publication of a technical paper (WP9)
- Participation in several dissemination relevant meetings, e.g. Poster Presentation at Smart Systems Integration, Barcelona and presentation and booth at Transport Logistic trade fair in Munich (WP9)
- Implementation of an internal online document repository and workspace (WP10)
- Definition of relevant project processes and procedures to ensure smooth project implementation (WP10)
- Carrying out of a Project Kick-Off in Magdeburg, Germany (FhG/IFF, M1) and in Madrid, Spain (Acciona, M8) (WP10)
- Definition of ethics requirements and procedures, incl. informed consent procedures for the project (WP11)

1.5 Deviations from the project schedule / Part A/B

There are no major deviations from the project schedule. There have been slight delays in the submission of the deliverables D1.1, D1.2 and D10.2. However, due to the use of an online workspace for the work in the project as well as regular coordination telephone-conference between project partners, these submission delays do not influence the further progress of the project. Moreover, there is a slight delay in forming the project advisory board (MS16) as approaching candidates over the Christmas/New Year's holidays (M6) was not deemed appropriate. Final discussions on the Advisory Board were conducted during the 2nd Project Management Meeting in Madrid in February 2019 (M8) and the final board was constituted in M10. The first review session with the Advisory Board is scheduled for the time after the next project management meeting, which will be held in September 2019 (M18). So the later constitution of the board did not affect the project implementation.

D1.2 described a large number of individual use cases to be implemented by the partners at the respective port sites. For the Baleares Port there is one sub use case still under consideration, due to a priority shift at the port. The involved partners are currently in talks with respective (project internal and –external) stakeholders to finalize the use case in order to ensure the relevance of the efforts

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within the original mandate of the project and the transport research program. These deviations are currently under discussion with the project's Project Officer.

There is the need for the re-working of the underlying premise for WP2. The project proposal foresaw WP2 to develop the project's basic architecture, which will then inform the development of the services. The current development process regarding the PortForward Services makes this approach rather difficult. The discussion currently revolves around the topic of making WP2 and its deliverables living objects, i.e. under constant revision until the project end. The reason for this is, the services, their granularity and their complex relationships and interactions are not defined enough at this moment, and in fact cannot be, to define an overarching architecture. In fact the flexible cloud solution based on the Fraunhofer research platform "Virtual Fort Knox" should allow for an evolving development of the overall PortForward Solutions, without causing delays in the overall project implementation. These deviations are currently under discussion with the project's Project Officer.

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2 WP1 – Stakeholder needs and technical requirements

2.1 Objectives of WP1 for the reporting period

The main objective of the work package in the reporting period was to foster the joint understanding between the relevant stakeholders involved in the project. This activity revolved around a comprehensive description and structuring of the project's use cases, including the definition of the relevant (also non-beneficiary) stakeholders, the description of relevant contexts, objectives and framework parameters.

In the further progress of the project, the WP provided a comprehensive technical description of the project's use cases as well as definition of relevant Key Performance Indicators (KPI) for holistically assessing the implementation success of the use cases.

The work package was completed as planned within the reporting period.

2.2 Summary of progress

Table 4 provides a summary of the main activities achieved within WP1 for the midterm of the project:

Table 4 Summary of Progress for WP1

No: 1	Implementation of on-site port visits to gather first-hand information on port processes, systems currently deployed, and port needs that could potentially be solved by PortForward
Description:	Through the course of the first six months in the work package 1, specifically Task 1.1 three port visits were been organized (Baleares, Naples and Salerno, Livorno). Moreover, in cooperation with work package five another port visit was organized to Vigo, while during the Kick-Off a port visit was organized in Magdeburg. In this respect the partners got an early impression of the respective use case ports. The port visits also included coordination activities with relevant local stakeholders.
No: 2	Harmonization of user needs and requirements
Description:	The first technical deliverable lays out the comprehensive description of the ports and the activities to be expected in the implementation of the project. It describes the ports, its processes and the overall port systems as well as identifies relevant stakeholders for each port. Moreover, it lays out the ports' economic, social and environmental goals.
No: 3	Analysis of use cases
Description:	The work package's second deliverable directly focuses on the description of the use cases and elaborates for each use case a summary, the underlying rationale, a structured description and identifies typical assessment procedures and tools/services required.
No: 4	Stakeholder survey

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Description	While the main part of the information for work package one was collected through direct feedback with stakeholders in face to face meetings, e.g. during the port visits but also in individual meetings, the project also launched a survey to gather additional stakeholder feedback https://docs.google.com/forms/d/e/1FAIpQLScAvsE5IhssJjc39LfKtlw6_rDnrKNWmXg6Wx8DqQvzYsguqA/viewform, which has been additionally published on the project website. The survey was also shared with the "Port of the Future Network" through Docks the Future. The online survey is still active and available for ongoing collection of data from stakeholders. The feedback collected will be analyzed and used within assessment of the individual use cases in WP7.
No. 5	Discussion and development of structured technical use case description
Description	The project management meeting in Madrid from Feb. 12-14, 2019, specifically included sessions for addressing the open questions for the remaining deliverables of the WP, i.e. D1.3 and D1.4.. To this end the partners defined a structured approach to consistently describe the use cases with respect to technical parameters, supporting the further implementation. The forum for this were dedicated working groups on use cases and architecture, cloud and services. The subsequent work of the partners in this established framework resulted in D1.4
No. 6	Development of use case relevant KPI structure
Description	Furthermore, the Madrid meeting for WP10 addressed the development of an underlying KPI structure for the comprehensive assessment of the use cases. To this end the partners discussed the developed KPI structure of MARTE and further elaborated on use case specific factors in the dedicated working groups on use cases and on KPI, data, dashboard and the digital twin.

2.3 WP1 Meetings

Table 5 Overview of WP1 meetings

No.	Date	Name	Responsible partner & venue	Purpose
1	July 10-12, 2018	Project Kick-off meeting	FhG/IFF, Magdeburg	Kick-Off of WP1 and agreement of overall framework and proceeding of WP1 work and visit to the Port of Magdeburg
2	July 27, 2018	1st PortForward WP1 conference call	ACCIONA, Online	WP1 General planning review,

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				T1.1 (General task planning/Deadlines, Methodology to collect end users' expectations and needs) T1.2 (General task planning/Deadlines)
3	September 11, 2018	2nd PortForward WP1 conference call	ACCIONA, Online	Recap of WP1 General planning T1.1 (Update on task planning/Deadlines, Update on questionnaire status, Field visits/focus groups, Update on D1.1) T1.2 (Update on task planning/Deadlines, Potential questionnaire)
4	September 25-26, 2018	Visit to the Port of Vigo	BRUNEL, Vigo	Raising mutual understanding among partners of WP5 about current practice of port operations at Vigo, the concept of green scheduling of yard operations, sustainability assessment and identifying available data – with relevance to WP1 activities
5	October 4-5, 2018	Palma port visit	PDB, Palma de Mallorca	To carry out a technical visit of the Port of Palma, in order to obtain first-hand information on port processes, systems currently deployed and port needs that could potentially be solved by PortForward. Different meetings with stakeholders internal and external to the port were organized.
6	October 10-11, 2018	Visit and meeting in the Port of Livorno	MAR.TE, Livorno	Use Case identification and description at the port of Livorno
7	November 29-30, 2018	Visit and meetings in the ports of Naples and Salerno	MAR.TE, Naples and Salerno	To carry out a technical visit of the Ports of Naples and Salerno, in order to obtain first-hand information on port processes, systems currently deployed, and port needs that could potentially be solved by PortForward, different meetings with stakeholders internal and external to the port were organized.
8	December 4, 2018	3rd PortForward WP1 conference call	ACCIONA, Online	Recap of WP1 General planning T1.1. Update on task outcomes T1.3. Current status T1.4. Current status

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9	December 13, 2018	WP1.T3 / D1.3 conference call	ACCIONA, Online	Specific discussion on general approach and ToC for D1.3
10	December 17, 2018	WP1.T4 / D1.4 and WP6.T4 / D6.4 conference call	ACCIONA, Online	Overview of Dashboard approaches Initial discussion about integration of the approaches Discussion about relation of Dashboard to KPIs and their definition in T1.4 Discussion about integration of Dashboard with other WP6 developments (Digital Twin / Decision Support System)
11	February 12-14	WP10 Project Management Meeting	FhG/IFF, ACCIONA	Presentation of WP1 progress and further action plan. Discussion and elaboration of deliverables D1.3 and D1.4 in dedicated working groups.

2.4 Deliverables

Table 6 Submitted deliverables in WP1 within the current period

D1.1	**Harmonized user needs and goals**
Author	ACCIONA
Contributors	All
Description	PortForward project proposes a holistic framework that will lead to smarter, greener and more sustainable ports through the implementation of innovative ICT solutions to improve exchange of information flows between port and port community, a tighter integration with different modes of transport and the hinterland/city environment as well as the adoption of green technologies to reduce the environmental impact and resource consumption of port operations. The first step for the development of this framework has been the analysis of the end users expectations and goals, which are in first place the Port Authorities of the ports involved in PortForward project: Baleares, Kristiansand, Livorno/Piombino, Magdeburg, Naples/Salerno, Vigo and by extension, the Port Communities of these ports as well as of any port that could potentially replicate the PortForward framework. The analysis of end users' expectations and goals has been done through different activities, among which the organization of technical visits, focus groups/workshops with key stakeholders in each of the PortForward ports and the analysis of ports' technical documentation can be highlighted. Furthermore, a

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	questionnaire has been launched to retrieve additional feedback from external stakeholders. The analysis performed in each port includes a synthesis of the port main features (locations, activities, etc.), the identification and classification of key stakeholders, the description of main port processes (port general services, commercial services, etc.), the analysis of hinterland transportation and urban environment, a general description of port ICT-based systems as well as economic, environmental, and social expectations of each port. Main economic expectations and goals expressed by the stakeholders are the increase of efficiency and quality of port operations, risk and cost reduction, timeliness and reliability of port operations, and improved planning of port maintenance activities and of the port public domain. Main environmental expectations and goals identified are the prevention and reduction of pollution, improved monitoring of carbon footprint and reduction of CO2 emissions, rational use of natural resources, increased renewable energy generation and consumption at port area, compliance with environmental regulations and policies, and increased awareness of port stakeholders about environmental issues. Lastly, the main social expectations and goals identified include the improvement of working conditions in the port, the socio-economic revitalization of the port region, and the achievement of a positive perception of the port by the society.
D1.2	**Use case restrictions & requirements**
Author:	Vigo
Contributors	All
Description	PortForward project proposes a holistic framework that will lead to smarter, greener and more sustainable ports through the implementation of innovative ICT solutions to improve exchange of information flows between port and port community, a tighter integration with different modes of transport and the hinterland/city environment, and the adoption of green technologies to reduce the environmental impact and resource consumption of port operations. The project is currently developing the specifications of the PortForward framework. After a preliminary analysis of end users expectations and goals, which was documented in deliverable D.1.1, a set of use cases has been developed in order to describe at high level what kind of interactions there will be between the systems, processes and stakeholders of each of the ports involved as use cases of the project (Baleares, Livorno/Piombino, Magdeburg, Naples/Salerno, and Vigo), and the PortForward framework. In order to carry out this task, consortium partners have continued the activities that had been initiated for the analysis of end users' expectations and needs, analyzing the information collected through a set of technical visits to the use case ports, combined with specific meetings with key stakeholders of the corresponding

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	port community. In parallel, the project continues the collection of additional feedback from external port-related stakeholders through an online questionnaire. The use case analysis carried out at each port includes a port introduction, which recaps the main findings from D1.1 that will be more relevant for the use case. This is followed by a summary of the use case(s) proposed for the port. For each use case it is explained its relevance both from the point of view of the opportunities that it will provide to test and validate the PortForward framework, and from the point of view of the potential impact that can be achieved for the port. The use case includes as well an analysis of the main decision makers and stakeholders involved, the expected improvements and how they could be assessed qualitatively and/or quantitatively, and potential drawbacks and restrictions that shall be properly managed. For the Baleares ports, three use cases are proposed. The first one will address the optimization of yard management and operations scheduling for RoRo and/or bulk cargo transportation from the logistic and environmental point of view. The second case will focus on the improvement of centralized supervision and management operations of the port authority, as well as on the development of advanced maintenance strategies. The third use case will focus on the prediction of port-city interactions from the point of view of the demand for city attractions and services by the people arriving to the port through cruise ships, ferryboats, and recreational vessels. The use case in the port of Vigo will focus on the application to the container terminal of PortForward's Green Scheduler and sustainability assessment through Life Cycle Assessment methodology (LCA). The use case encompasses three different aspects of the management and scheduling processes: yard space allocation, yard crane management, and Internal Movement Vehicles (IMVs) scheduling and deployment. In the ports of Livorno and Piombino, two use cases are proposed. The first one will develop advanced assistance services for port pilots, addressing the difficult ship maneuvering within the port of Livorno due to the limited width of the port access channel and the low depth of the quays and docks. The second use case will focus on assistance to goods control and inspection within port boundaries to ensure security and enforcement of the legal framework. For the ports of Naples and Salerno, a global use case has been defined that addresses three closely interlinked issues, namely: logistics and multimodal relations with the surrounding environment, optimization of freight management, and access to data related to environmental and social impact of port activities on the surrounding areas. Lastly, the port of Magdeburg will focus on the application of advanced monitoring of port operations applied on one hand to multi-purpose storage areas for automated analysis of occupation and handled goods, and on the other hand to external transportation traffic (on public roads) between the different port terminals, as data basis for a future slot management.

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D1.3	**Technical requirements specification**
Author:	IFF, LEITAT
Contributors	IFF, LEITAT, ACCIONA, IMEC, MARTE, IMEC, UBIMAX, APS MTS, BRUNEL
Description	This document provides a comprehensive overview on technical requirements by the use cases, which forms an important basis for the further project works on the PortForward Architecture (WP2, T2.2) and all connected works describing data sets, interfaces and service functionalities. The contents of this document enhance the information that were given by the submitted deliverables D1.1 and D1.2 and provide a preliminary analysis, which PortForward services will play a role in several use cases and which ones are yet more use case specific. Furthermore, the Infrastructure Services of IoT Middleware and the VFK Platform are briefly described. These are important modules for the approach of the PortForward Architecture, which is also described in this document. As the single Services and Use Cases are currently in different states of development, there is different level of detail in their description. For that reason, the idea of the project team is to further update information about use cases and services as soon as they are available. Thus, the document shall be treated as a living document beyond its delivery, which will be amended with additional information throughout the project developments. It became clear during the Project Management Meeting in M8, that the project PortForward requires a strong coordination between its different work streams (different services and different use cases). So, this document will grow up while providing support to the coordination task.
D1.4	**KPI catalogue**
Author:	MARTE
Contributors	All
Description	PortForward project proposes a holistic framework that will lead to smarter, greener and more sustainable ports through the implementation of innovative ICT solutions to improve exchange of information flows between port and port community, a tighter integration with different modes of transport and the hinterland/city environment, and the adoption of green technologies to reduce the environmental impact and resource consumption of port operations. The project is currently developing the specifications of the PortForward framework. After a preliminary analysis of end users expectations and goals, which was documented in deliverable D.1.1, a set of use cases has been developed in order to describe at high level what kind of interactions there will be between

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	the systems, processes and stakeholders of each of the ports involved as use cases of the project (Baleares, Livorno/Piombino, Magdeburg, Naples/Salerno, and Vigo), and the PortForward framework. In line with the information contained in deliverables D1.1 and D1.2, this task provides a set of metrics for monitoring the performance of the main port processes. In task 1.3, developed in parallel with task 1.4, are provided the technical requirements specification that will drive the development of all SW and HW modules of PortForward ecosystem. The aim of the Task 1.4 is to create a system of metrics that measures the effective and efficient use of port resources. The KPI definition was carried out starting from the definition of a performance evaluation model built by identifying five macro-areas of analysis: Infrastructure Effectiveness, Port Operations, Economics & Finance, Market Trends, and Green Challenge. Then each port partner provided the description of the main instruments adopted for the monitoring of port activities, with particular reference to the areas considered strategic for port competitiveness (social, economic and environmental). Afterwards, with reference to the five perspectives of analysis, they identified indicators of their interest. Each of them explained for each indicator the degree of relevance, the stakeholders involved and the systems and methods of implementation and calculation. Besides, each partner has suggested additional actors and/or processes to be monitored. So, after the analysis of information and data provided by port partners, a comprehensive set of indicators has been developed. This KPI list, shared with the port stakeholders, constitutes the basis for a useful tool realization for the port authority. It will allow a balanced management of the activities in a complex reality like the port one. The success and effectiveness of the use of the multidimensional monitoring model proposed in this document, depends on critical success factors such as • Widest acceptance possible of performance measurements tools, • Definition of the proper causal link phenomena and impact, • Each traffic category should be monitored and assessed, • Choice of indicators aligned with port policy and port planning, Suitable measurement methods and instruments at suitable costs.

2.5 Deviations from Annex I

There are no major deviations from the project schedule. There have been slight delays in the submission of the deliverables D1.1, D1.2. However, due to the use of an online workspace for the work in the project as well as regular coordination telephone-conference between project partners, these submission delays do not influence the further progress of the project.

In the further definition of the use cases, there have been proposed changes to specific objectives for sub-cases for the Baleares Port. The subsequent changes are still under discussion and necessary coordination with the project's INEA officer are ongoing. This shall not influence the overall

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implementation of the project and the necessary changes to the use case description will be documented in the relevant WP7 deliverables.

3 WP2 PortForward framework design

3.1 Objectives of WP2 for the reporting period

The main objective for the second work package in the reporting period was to assess the already available technical systems within the port as according to T2.1.

3.2 Summary of progress

Table 7 Summary of Progress for WP2

No: 1	Development and deployment of a questionnaire to identify the different services and technologies available in the different port sites.
Description:	In close cooperation with the first work package, the task elaborated a questionnaire to assess the current state within the participating ports, i.e. prior to the use cases. The questionnaire includes questions about the existing communication infrastructure and its interconnections between different available services. Also, it asks for information on the current data collection and storage practices, i.e. how it data can be interfaced with, preferences toward cloud-based data storage and processing solutions, whether external data sources are already used, data storage and processing infrastructure. On the service side it asks for existing services and platforms for e.g. travelers or workers and what roles are defined and/or desired. With respect to stakeholders it asks for their expected openness for contact on service issues, the ports' data privacy manager, if stakeholders run third party services in the port, and available on-site testing areas. Finally, with respect to environmental indicators the questionnaire asks for available KPI in this field, the admission system for vessels, sources of energy, manner of recording energy consumption and emissions, and supply of electrical energy to vessels. As seen from the latter point, also work package five questions were covered in this respect to assess indicators for the lifecycle assessment, which is led by LEITAT, also leader of T2.1. The questionnaires were completed in bilateral meetings between the individual ports and their respective use case partners.
No: 2	Coordination of work between Task1.3 and Task 2.2
Description:	It was assessed that there will be an increased coordination need between the individual tasks from WP1 and WP2, as T1.3 also covers technical issues relevant for the implementation of WP2. Final discussions on this topic took place during the 2nd Project Management Meeting in Madrid, in February 2019.
No: 3	Architecture development

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Description	A major effort for WP in the second half of the project's first year was the discussion and development of the underlying architecture for the PortForward solution. Here the aim was bringing together the underlying infrastructure envisaged for the project, i.e. the IoT Middleware and the Virtual Fort Knox cloud solution, and the services to be developed. As mentioned before, first efforts in this direction were initiated with a close coordination of the tasks 1.3 (and subsequent deliverable D1.3, which already exhibits an architecture perspective for the use case description) and 2.2. To this end also the discussions within the context of the project management meeting in Madrid took this comprehensive approach. In the further progress of the project, there has been further bi-lateral coordination between the responsible partner LEITAT and the partners responsible for the development of the individual service modules in the project (e.g. Acciona, Ubimax, Fraunhofer IFF, IMEC, Brunel). During this coordination partners realized that establishing an ex-ante architecture does not fit within the project's more agile approach to the service development. Also, at the current state of the service development, there are not enough information on the individual services to develop this architecture, especially, with respect to specific data and information flows from dedicated sources and within and between the services. To this end, the partners currently develop a different approach in defining an "early architecture", which can set the basis for the different services available within PortForward framework. This way, WP2 will provide a basic input for coordination to all the technical WPs (3 to 6) and "improve" on it in a later stage. The envisaged benefit of this approach is a more bi-directional flow of information to WPs, receiving updates for the architecture in a later stage, were the developments and collaborations have started.

3.3 WP2 Meetings

Table 8 Overview of WP2 meetings

No.	Date	Name	Responsible partner & venue	Purpose
1	July 10-12, 2018	Project Kick-off meeting	FhG/IFF, Magdeburg	Kick-Off of WP2 and agreement of overall framework and proceeding of WP2 work
2	August 6, 2018	1st WP2, Task 2.1 conference call	LEITAT, online	Kick-Off the work in the framework of this task and gather a set of actions to be done within the next few weeks
3	September 10, 2018	September status call of WP2, T2.1 of PortForward	LEITAT, online	Status update and gather a set of actions to be done within the next few weeks

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4	October 15, 2018	WP2, T2.1 periodic status call of task	LEITAT, online	Continue the alignment and check the progress between partners of WP2 and Task 2.1. Make decisions about the progress achieved and solve the issues found in the execution.
5	January 10, 2019	WP2, T2.2 Coordination and alignment	LEITAT, online	Initiation and coordination of T.2.2 and alignment with WP1 tasks. Preparation for the project management meeting. Decisions about further process.
6	February 12-14, 2019	WP10 Project Management Meeting	FhG/IFF, LEITAT	Presentation of WP2 progress and further action plan. Discussion and elaboration of deliverables D1.3 and D2.1 in dedicated working groups.

3.4 Deliverables

No deliverable was submitted in the reporting period.

3.5 Deviations from Annex I

As described there is a deviation with respect to the description of the underlying architecture for the PortForward. Instead of presenting a fixed and rigid infrastructure in the beginning of the project, the consortium aims at developing a more flexible approach, describing an early architecture model by the end of M14.

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4 WP3 IoT-enabled ports

4.1 Objectives of WP3 for the reporting period

The main objective of the work package in the reporting period was to harmonize the expectations of the consortium members with respect to IoT related platforms within the project and with respect to the use cases. Specifically, partners presented aspects of the IoT middleware and the Fraunhofer Virtual Fort Knox. Moreover, partners used the opportunities of the WP1 port visits to relate those platforms to the individual use case applications.

The second half of the first project year was marked by developing and describing the relevant technical aspects and requirements for exploiting the infrastructure for the PortForward solution. A specific focus was laid in sufficiently describing the necessary IoT infrastructure for partners to interface from the use cases perspective.

4.2 Summary of progress

Table 9 Summary of Progress for WP3

No: 1	Coordination with T2.1
Description:	WP3 coordinated with WP2 regarding technical specifications for the use of the IoT middleware.
No: 2	Coordination with WP11
Description:	As data collection and processing is relevant for WP3, specific requirements were discussed vis-à-vis the project structure as well as GDPR conformity for ports' data collection.
No: 3	Coordination with use cases and IoT middleware demo
Description:	The work package coordinated with the different use cases, i.e. during the port visits as well as during WP3 telephone conferences, to identify relevant scenarios for testing. In this scope a demo of the IoT middleware was set up for partners to familiarize with the system's functionalities.
No: 4	Elaboration of an integration concept
Description:	Specifically the partners IMEC and FhG/IFF elaborated an integration concept for the technical infrastructure provided in the project, namely the IoT middleware (IMEC) and the Virtual Fort Knox cloud platform (FhG/IFF). The aim was to provide an introduction and guidelines for the partners developing services towards the PortForward solution, which resulted in D3.1.
No: 5	IoT device management and application enablement

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Description	In a subsequent step, necessary technical aspects were elaborated to allow the interfacing with the IoT middleware and the Virtual Fort Knox, which was documented in D3.2.

4.3 WP3 Meetings

Table 10 Overview of WP3 meetings

No.	Date	Name	Responsible partner & venue	Purpose
1	October 15, 2018	WP3 Kickoff conference call	IMEC, online	The objective of this call was to introduce the IoT middleware infrastructure (provided by IMEC) that will be used in WP3 and more specifically to provide some "getting-started" information for technical partners connecting to it.
2	November 5, 2018	2nd WP3 conference call	IMEC, online	The objective of this recurrent conference call was to ease collaboration amongst WP3 involved actors.
3	December 3, 2018	3nd WP3 conference call	IMEC, online	The objective of this recurrent conference call was to ease collaboration amongst WP3 involved actors.
4	February 12-14, 2019	WP10 Project Management Meeting	FhG/IFF, IMEC Madrid	Presentation of WP3 progress and further action plan. Discussion and elaboration of deliverables D3.1 in dedicated working groups.
5	May 24, 2019	D3.2: Alignment on Toc and expected contributions	IMEC, online	Presentation and discussing the proposed ToC for the deliverable Agreement on contributions and planning of work for deliverable

4.4 Deliverables

D3.1	**Cloud Platform Integration concept and guidelines**
Author:	IMEC
Contributors	FhG/IFF

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Description	The so called "IoT Stack" provided by IMEC is a state-of-the-art cloud platform designed to securely ingest, store and retrieve historical data from its connected devices, supporting multiple IoT protocols. It acts as a middleware layer by decoupling and shielding the data producer from the data consumer (and vice-versa); consequently easing integration, accessibility and future evolution of the connected systems. This document is structured in five main sections, of which the first one contextualizes the underlying architectural drivers that justify the need of a cloud based middleware layer for the integration of data coming from IoT devices used in ports operations. The second section introduces the so called 'IoT Stack' which is the platform that is provided by IMEC in the context of this project to realize this integration and illustrates it through a 'demo use-case'. It also provides useful tools aiming at supporting partners when developing and troubleshooting the integration of their software components with the IoT Stack. This section is then followed by two more detailed sections; the first one introduces the main underlying concepts defined within the IoT Stack while the latter mostly focuses on concrete instructions for authentication to the platform, pushing data to the platform and finally retrieving data from the platform. Finally, the last section introduces the 'Virtual Fort Knox' (VFK) platform provided by Fraunhofer IFF for this project. This platform will be further defined in later specific deliverables, however as it will host the different software components that will be developed for this project and that those components will need to retrieve data from ports IoT devices, it is as well part of the 'cloud platform integration' and consequently is briefly introduced here. This document is intended for technical partners, members of this consortium, developing in the context of this project device side and/or application side components and provides them the useful information for efficient use of the offered functionalities (and underlying concepts), illustrated when relevant by specific examples.
D3.2	**Application-enablement and device management**
Author:	IMEC
Contributors	FhG/IFF
Description	Deliverable D3.1 introduced both IMEC's IoT stack and Fraunhofer's Virtual Fort Knox platform, two core components for the project's ambitioned IoT-enabled ports. The IoT stack is a state-of-the-art cloud platform that is able to securely ingest data using REST APIs, to perform data storage and to retrieve (historical) data in various ways for consumption by services. These services can be run on the Virtual Fort Knox platform, which offers various ways to develop, aggregate and deploy services.

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	Zooming out, IoT devices come into play, requiring proper device management and data access in a standardized manner and implementable on constrained devices, as well as connectivity. Therefore, the first part of this document describes how the IoT middleware is extended with device management capabilities, leveraging on the LwM2M standard, and with long range communication capabilities over various public and private LPWA Networks. This part of the document is intended for technical partners, members of this consortium, that consider the roll-out of IoT devices, that are confronted with connectivity options and device management needs. The second part focuses on how all IoT middleware components contribute to the enablement of applications in the context of IoT-enabled ports. To this end, several sample use cases realized so far, and covering a subset of the middleware capabilities, are described. This second part is relevant for both technical and non-technical partners, as it illustrates the next steps to be taken to further mature the IoT middleware as well as serves as source of inspiration for enabling IoT-inspired applications.

4.5 Deviations from Annex I

No deviations to report.

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5 WP4 PortForward services

5.1 Objectives of WP4 for the reporting period

The work package 4 objectives for the period are the coordination of the remote assistance services and the people and asset tracking services with the relevant use case partners. The discussions in this work package and accompanying preparatory action fed mainly in the relevant deliverables for WP1 and WP2.

5.2 Summary of progress

Table 11 Summary of Progress for WP4

No: 1	Remote assistance service coordination
Description:	The coordination of the service implementation was initiated during the port visit in Livorno in October with further planning for the use case between the use case partners.
No: 2	Asset tracking service coordination
Description:	The discussion between the use case partners was initiated and the relevant use cases were discussed between the relevant partners, especially PDB, IMEC and LEITAT. During these discussions it was agreed, that the project will not focus on the tracking of people as PDB already had a relevant solution for this. It was agreed between the partners and the project officer at INEA, that in the interest of the project, the use case will be changed to build on the already collected passenger data within the port and develop value-added services, which also takes into account the requirements of the city of Mallorca.

5.3 WP4 Meetings

Table 12 Overview of WP4 meetings

No.	Date	Name	Responsible partner & venue	Purpose
1	November 14, 2018	1st WP4 Kick-Off-Conference Call	UBIMAX, online	Kicking off the work in the work package and aligning the work of the partners
2	November 30, 2019	WP4, T4.1 Kick-off and alignment call	LEITAT, online	Kicking off the work in the task and aligning the work of the partners

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3	February 12-14, 2019	WP10 Project Management Meeting	FhG/IFF, UBIMAX	Presentation of WP4 progress and further action plan. Discussion and presentation of specific technical solutions in the scope of the relevant use cases. Discussion of use case setups.

5.4 Deliverables

The project schedule foresees no deliverables in this work package for this period.

5.5 Deviations from Annex I

No deviations to report. However, from the initial discussions between the use case and technical partners it became apparent, that changes to the initial use case setups will be necessary as some services have been implemented in the time between proposal writing and project start, specifically with respect to the people tracking. These changes were discussed in the 2nd Project Management Meeting in Madrid in February 2019 and with the project officer.

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6 WP5 Green Scheduling & Sustainability of operations

6.1 Objectives of WP5 for the reporting period

The objective for the work package within the period was to initiate the work for the green scheduler, and the sustainability analysis, based on lifecycle assessment (LCA) methodology. Specifically, the work package focuses on the coordination of the use case with the port of Vigo and develops the mentioned solutions in coordination with the relevant partners.

6.2 Summary of progress

Table 13 Summary of Progress for WP5

No: 1	Organization of work package start between the partners in coordination with WP1
Description:	The first port visit in the project was organized between Vigo and the use case partners. Within this meeting the basic framework conditions were discussed for the subsequent work and coordination of Sustainability assessment (task T5.1) and Developing the multi-objective model of green yard scheduling (task T5.2). Subsequently, relevant historic data was identified at the Port of Vigo that are being used by LEITAT for the sustainability assessment of Vigo's Container Terminal (operated by Termavi) as a priority. These data are also being used for defining the scope of multi-objective model for green yard scheduling (task T5.2.1) by Brunel. Major progress was made with recruitment of the two Postdoctoral Fellows to join the project team at Brunel University. This includes obtaining recruitment approvals from Brunel University, job advertisement on public forums, shortlisting of candidates, interview, selection and employment offers to the selected candidates, obtaining employment approvals and signing contracts with the two selected candidates. The two Postdoctoral Fellows started in February 2019.
No: 2	Organization of a survey on sustainability parameters in coordination with WP2
Description:	Within the T2.1 survey among project partners, specifically ports, a specific part was elaborated to assess the current state of indicator and data collection within ports towards environmental and sustainability aspects.
No: 3	Supporting the development of use case KPI with respect to sustainability
Description:	The development of the lifecycle perspective of WP5 also informed the development of the KPI in WP1 with respect to the sustainability focused indicators.
No: 4	Organization of on-site visit for work package coordination
Description:	Multiple work package participants organized an extended workshop on the use case in Vigo on June 17-21, focusing on T5.2 Developing the multi-objective model of green yard scheduling and T5.1 Sustainability assessment. Moreover, the connection

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	to the IoT middleware infrastructure was explored with respect to T5.3 Developing the green scheduler.

6.3 WP5 Meetings

Table 14 Overview of WP4 meetings

No.	Date	Name	Responsible partner & venue	Purpose
1	February 12-14, 2019	WP10 Project Management Meeting	FhG/IFF, Brunel, VIGO Madrid	Presentation of WP5 progress and further action plan. Discussion and presentation of LCA and GYS approaches and accompanying use cases.
2	June 17-21, 2019	WP5 coordination port visit	VIGO & Brunel Vigo	Focusing on T5.2 (Developing the multi-objective model of green yard scheduling) and T5.1 (Sustainability assessment), Explore the feasibility of using IMEC's IoT middleware that will be embedded in T5.3 (Developing the green scheduler)

6.4 Deliverables

The project schedule foresees no deliverables in this work package for this period.

6.5 Deviations from Annex I

No deviations to report.

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7 WP6 The PortForward Dashboard & technical validation (TRL 5)

7.1 Objectives of WP6 for the reporting period

The focus of the work package within the period was to initiate the work on the digital twin concept and the decision support system. The aim of this initial work was to establish a common understanding of the two concepts within the context of the PortForward project and among the consortium partners

7.2 Summary of progress

Table 15 Summary of Progress for WP6

No: 1	Establishment of underlying digital twin properties
Description:	First concepts for the digital twin from the manufacturing context were gathered and discussed among the partners for further adaptation to the port infrastructure concept. Furthermore, coordination with WP3 and WP2 has been initiated to analyze potential interfaces with the IoT aspects as well as implications from/for the overall technical architecture.
No: 2	Coordination of decision support basics
Description:	Some initial decision support concepts were discussed, specifically focusing on the analytical hierarchy process and the ValueSec approach. Further coordination specifically addressed coordination with efforts revolving around the KPI catalogue and the Dashboard to ensure consistency and the necessary synergy between the tasks.
No: 3	Development of the digital twin concept
Description	For the further establishment of the digital twin concept, FhG/IFF coordinated with relevant port partners with respect to requirements for digital twins of ports and which approaches have already been established at ports. The work resulted in D6.1.
No: 4	Development of the Decision Support System concept
Description	The DSS will need to be integrated into the overall service approach of the project and, therefore, work was coordinated with the relevant partners to establish a conceptual approach for a DSS with respect to integration but also how a system can be structured to render the necessary support. The work resulted in D6.2.

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7.3 WP6 Meetings

Table 16 Overview of WP6 meetings

No.	Date	Name	Responsible partner & venue	Purpose
1	October 17, 2018	WP 6 – Kick-Off Web-Conference	FhG/IFF, online	Goal: Kick-Off of WP 6 + common understanding of tasks with main contributors in WP + first discussion of ToC for D6.1
2	November 26, 2018	WP6 – 2nd Conference Call	FhG/IFF, online	Common understanding of tasks with main contributors in WP6; Discussion of ToC V0.2 for D6.1 and ToC V0.1 D6.2; Clarification of the interdependencies of the tasks in WP06 with other WPs
3	February 12-14, 2019	WP10 Project Management Meeting	FhG/IFF, Madrid	Presentation of WP6 general concept and further action plan. Discussion and presentation of infrastructure digital twin examples. Elaboration of approaches in dedicated working group session.
4	May 8, 2019	Call Inputs of Ports for WP6	FhG/IFF, online	A combined call for inputs for D6.1 and D6.2 specifically focused on ports

7.4 Deliverables

D6.1	**Description of Port Virtual Twin Concept**
Author:	FhG/IFF
Contributors	MARTE, UBIMAX, MAGDEBURG, LIVORNO, VIGO, MARTE, ACCIONA,
Description	Within the deliverable D6.1 a holistic overview of the Virtual Twin concept is given as well as a first description of a use case-specific type of a virtual Twin concept. The use case refers to the Port of Magdeburg: “Dynamic storage monitoring”. In the first section general information, which are important for a better understanding of this deliverable, are given. A comprehensive survey about the actual situations in the ports, which focuses Virtual Twin solutions in use and in planning, is ensuring the practical relevance of the conceptual work presented here. Virtual Twin solutions, which are partially in use in the ports are presented. Furthermore, in this survey relevant working tasks and use cases were identified.

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	General approaches in the development of the Virtual Twin and fundamental components of a Virtual Twin are described. The integrated system model, which maps the structural and logical basis for the Virtual Twin is presented. Virtual interactive components, which leads to new forms of interdisciplinary working in VR are described as well in different variations. Use case-specific features of a Virtual Twin, referring to the situation in the port of Magdeburg, are part of the description as well. The ongoing activities of the PortForward project show interdependencies between different project activities. Relevant interdependencies are pointed out to provide a comprehensive picture of the Virtual Twin concept in PortForward. The conceptual descriptions given here will be extended and explained in more detail in the deliverables, performed in the follow-up project activities.
D6.2	**DSS Concept and indicator description**
Author:	FhG/IFF
Contributors	-
Description	Within the PortForward framework, the enhanced availability of port data and information from different systems and sources like IoT sensors will enable new forms of decision support. By integrating different data sets, setting them in their spatial and process context decision-making can be supported for different kinds of applications and for different timescales. This deliverable describes the approach for PortForward to differentiate strategic (long-term), tactical (short-term) and operational (real-time) decision support depending on actual requirements by the ports. By describing general decision support methods, analyzing the ports' requirements and relevant data sets and indicators, a general conceptual frame for PortForward Decision Support System (DSS) solutions and a procedure for the development and implementation of use case specific DSS solutions are worked out. For the main decision support method of the Analytical Hierarchy Process (AHP) and the DSS concept exemplary descriptions are given. Generally, this deliverable does yet mainly provide a conceptual frame for specific follow-up developments of DSS solutions. Thus, development and implementation steps for DSS solutions will be explained in more detail in later deliverables, describing use case implementations.

7.5 Deviations from Annex I

There are no deviations to report. However, discussions within the work package led to the agreement to start T6.4 earlier than scheduled (from M12 to probably M9) to better align efforts between the decision support system and the dashboard.

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8 WP7 Use cases & impact assessment (TRL 6)

8.1 Objectives of WP7 for the reporting period

The work package only started in the last month of the reporting period. The objective is the start of the work.

8.2 Summary of progress

Table 17 Summary of Progress for WP7

No: 1	Use case definition and structuring
Description:	Although not technically part of the work package, there has been a necessary coordination with WP1 towards the consistent structuring and definition of the use cases to ensure the methodological and research framework. At the moment activity 7.1 has started. In this one MARTE is defining the methodology and the main elements (e.g. test site, necessary technical instalments, types of stakeholders, etc.) that will be considered in the research framework. This approach could be discussed during the Madrid meeting.
No: 2	Elaboration of end-user use case requirements and evaluation metrics
Description	Building on the development of the KPI from WP1, the further development focused on the development of evaluation metrics with a specific focus on an end-user perspective. The work resulted in D7.1

8.3 WP7 Meetings

There have been no work package specific meetings in the period. Specific aspects have been considered in a WP9 meeting in Naples, see Table 21.

8.4 Deliverables

D7.1	**Use cases requirements and evaluation metrics**
Author:	MARTE
Contributors	FhG/IFF, CORE INNOVATION, AUTORITA DI SISTEMA PORTUALE DEL MAR TIRRENO SETTENTRIONALE
Description	One of the objectives of the PortForward project is to provide a continuous monitoring and evaluation of Smart Port approaches tested in different environments. Specifically, the Work Package 7 aims at validating the technical specifications identified, and at demonstrating, through the creation of evaluation metrics, the impact that the implementation of new technologies has on processes in the port area. In particular, in this deliverable proposes a unique research

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	framework for the evaluation of the impact of each use case foreseen in the project. The evaluation, obtained through properly identified evaluation metrics, will be focused on the critical functions of the system and on the demonstrated performances. The starting point is the identification of the specific restrictions and requirements of the use cases identified in tasks 1.1 and 1.2. The requirements have influence, in fact, on the development of the PortForward ecosystem and on the experimental activities to be carried out for its validation phases. The definition of the requirements and procedures to be activated must be made taking into account the "context of use" of the single technology. The requirements identified must be translated into a series of quality characteristics, then addressed by the developers in the product design and by the testers in the verification and validation. The creation of evaluation metrics is very useful for deciding which attributes and characteristics should be measured and which should not be. The definition of targets and acceptance thresholds for the different indicators is both a realistically achievable and challenging goal in a perspective of continuous improvement of the whole development of the use case. According to the proposed model, from the customer's point of view, the evaluation is based on two dimensions: • the "ease of implementation", which evaluates the resources needed for the actual process of implementation of the technological solution and its performance of use; • the "effectiveness" of the solution that assesses the improvement of processes in terms of time, reliability and consistency of results. The analysis of these dimensions identified, through the administration of a questionnaire for each ones, is relevant in order to ensure that the deviation between perceptions and expectations is minimal.

8.5 Deviations from Annex I

No deviations to report.

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9 WP8 Valorization and market assessment

9.1 Objectives of WP8 for the reporting period

The main objective of the work package for the reporting period was to structure the composition of the advisory board. The other remaining tasks run concurrent to the project tasks and interface where necessary, here specifically with respect to implications from the exploitation and data management efforts.

9.2 Summary of progress

Table 18 Summary of Progress for WP8

No: 1	Identification of an advisory board long-list and derivation of a short list
Description:	The efforts in T8.2 led to definition of the basic requirements and rationale for the project advisory board. Based on these partners were asked to contribute viable candidates for a long-list, from which the short list has been derived. After receiving formal acceptance from the members, the advisory board will be officially formed after the M6 project management meeting in Madrid, completing the project milestone MS16.
No: 2	Coordination of activities with other WPs
Description	Activities in WP8 and WP9 (and to a degree WP7) need to be coordinated. To this end, the workshop focused on the concrete definitions of the respective activities of the individual tasks of the work package and how they interact with / map the interrelations with other tasks and results from other work packages.

9.3 WP8 Meetings

Table 19 Overview of WP8 meetings

No.	**Date**	**Name**	**Responsible partner & venue**	**Purpose**
1	September 17, 2018	WP8.T8.2 PortForward Advisory Board teleconference	CORE, online	To plan on the next steps for the formation of the PortForward Advisory Board
2	November 06, 2018	Meeting with Inha University	FhG/IFF, Incheon, Korea	Discussions about advisory board collaboration with Inha University

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3	June 3-4, 2019	WP8/WP9 coordination workshop	CORE, MARTE, Naples, Italy	The goal is to have a clear common timeline for WP8 and WP9. This should show the interdependencies and synergies of the different tasks and have concrete dates for the delivery of end- and intermediate results accompanied by the responsible people.

9.4 Deliverables

The project schedule foresees no deliverables in this work package for this period.

9.5 Deviations from Annex I

There was a slight delay in forming the advisory board for the project. The Advisory Board was established as planned after the 2nd project management meeting and advisory board meetings are planned towards the 3rd project management meeting in Kristiansand in September 2019.

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10 WP9 Dissemination/ Communication/ Exploitation

10.1 Objectives of WP9 for the reporting period

For the initial project period, there have been a number of objectives for the work package, including setting up the project website in coordination with establishing a project design, defining the dissemination and exploitation plan as well as defining the data management plan. Moreover, carrying out relevant dissemination activities for the project were important aspects of the task.

10.2 Summary of progress

Table 20 Summary of Progress for WP9

No: 1	Agreeing on a project design and setting up the website
Description:	Discussions on the first design aspects such as the logo started during the project kick-off with an agreement on the logo and subsequent design elements through an online poll among the consortium members. The website was set up towards M3 and used extensively to chronicle the activities of the project towards the public and disseminate relevant information. The project design also includes the establishment of the standard presentation, a project leaflet, a banner and a poster, also to be found on the website. Social media accounts on LinkedIn and twitter were also launched around M3 and are also used for dissemination and communication purposes.
No: 2	Definition of the dissemination and exploitation plan
Description:	Defining the overall strategy and tools for dissemination of project information and results, resulted in the deliverable D9.2
No: 3	Definition of the data management plan
Description:	The identification, definition and structuring of project data sets resulted in D9.5 work was coordinated with WP11 with respect to ethical considerations.
No: 4	Coordination with the Docks the Future CSA and the “Port of the Future” Network
Description	During the project kick-off it was agreed with the Docks the Future CSA that the dissemination/exploitation coordinator will be the main contact person for collaboration, resulting in regular telephone conferences with the CSA and the other “Port of the Future” projects. Moreover, PortForward took part in several Docks The Future events, which can be found in the subsequent dissemination table.
No: 5	Publication of an introductory article
Description	The partners Brunel and CORE successfully submitted an article, which was chosen for publication in PTI Journal - Edition 79, Smart Ports & Supply Chains.
No: 6	Participation in relevant dissemination events

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Description:	Different partners took part in selected dissemination relevant events, which can be found in Table 21. Specifically, the presentation of the project during the Barcelona "Smart System Integration" conference and the participation of the project in the Munich "Transport Logistic" trade fair generated valuable dissemination momentum for the project, with concrete leads towards exploitation potential. The participation in the Transport Logistic fair was also accompanied by a media article of Saxony-Anhalt's investment promotion agency, which published a project online article (de/en/cn) at https://www.investieren-in-sachsen-anhalt.de/Hafen-digital-2019 Also this article provided further visibility for the project, especially in Saxony-Anhalt, and further requests for articles and contributions for the second year of the project.
No: 7	Coordination of activities with other WPs
Description	Activities in WP8 and WP9 (and to a degree WP7) need to be coordinated especially with respect to address market relevant aspects with a view to exploitation. To this end a joint workshop was organized in Naples between CORE and MARTE on June 3-4, 2019. The aim of the workshop was to coordinate relevant tasks from the WP8 and WP with a view on the main technological elements from the WP7 use cases.
No: 8	News and social media dissemination
Description	PortForward regularly updates its news section on the website with information from project events and activities, e.g. from deliverables, on its news section at http://www.portforward-project.eu/news-events/. Moreover, the project uses social media channels such as Twitter (https://twitter.com/portforward_eu, 212 followers) and LinkedIn (https://www.linkedin.com/in/portforward-project/, 129 followers) to disseminate information. Publication of information is based on a social media plan.
No: 9	Interaction with community
Description	The project set up plans for further engaging with the local stakeholder communities in port cities through dedicated workshops, which will be implemented in the second year of the project

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Table 21 PortForward dissemination and networking events

No.	Event	Organizer	Date	Place	Partner/s and persons involved	Topics
1	3rd Naples Shipping Week	The Propeller Club Port of Naples	Sep 24, 2018 - Sep 29, 2018	Naples, Italy	MARTE Alessandra Turi APS MTS (as promoter)	Networking with port communities
2	GreenPort Congress Valencia	Mercator Media Ltd	Oct 16, 2018 - Oct 19 2018	Valencia, Spain	VIGO Carlos Botana	Networking with port communities specifically to Green Scheduler/LCA use case
3	DocksTheFuture experts' workshop	Docks the Future	Oct 29, 2018 - Oct 30 2018	Porto, Portugal	FhG/IFF Christian Blobner MARTE Roberto Cinquegrani	Participation in expert working groups and networking with DTF
4	Collaborative Innovation Day "New Global Routes: One Belt One Road Initiative & TEN-T"	ALICE ETP, ICCS, Greek Ministry of Infrastructure and Transport	Nov 6, 2018	Athens, Greece	CORE Stefanos Kokkorikos	Presentation and poster presentation, coordination with PIXEL project
5	Stakeholder meeting	Inha University	Nov. 6, 2018	Incheon, Korea	FhG/IFF Christian Blobner	Presentation of project and discussion of potential collaboration
6	Meeting of the "Kammerunion Elbe/Oder"	Chamber of Commerce Magdeburg	Nov. 15, 2018	Magdeburg, Germany	FhG/IFF Christian Blobner	Project Presentation at "Kammerunion Elbe/Oder"

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7	DocksTheFuture Expert Workshop »Envisioning the Port of The Future«	Docks the Future	April 3-4, 2019	Trieste, Italy	CORE, Christos Papatheologos MARTE Roberto Cinquegrani	PortForward concept presentation
8	Smart Systems Integration Conference	Mesago Messe Frankfurt GmbH	April 10-11, 2019	Barcelona, Spain	LEITAT, Gabriel Manteca Munoz	Poster presentation on difficulties and issues of the integration of different smart systems and services in the scope of the port of the future framework
9	transport logistic Munich trade fair	Messe München	June 4-7, 2019	Munich, Germany	FhG/IFF Tobias Kutzler Andreas Höpfner Olaf Poenicke MAGDEBURG Dr. Heiko Maly KRISTIANSAND Stian Hagevik Heggeland Mathias Bernander" MARTE Pietro Spirito	Project presentation in booth, presentation of virtual port Magdeburg, project presentation during 3rd party events

10.3WP9 Meetings

There has been a coordinated WP8/WP9 event, see Table 19 for further information.

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10.4Deliverables

Table 22 Submitted deliverables in WP9 within the current period

D9.1	**Project Website**
Author	IFF
Contributors	ALL
Description	This deliverable provides the access details to the project website for the PortForward project.
D9.2	**1st Interim Plan for Exploitation and Dissemination of Results (PEDR)**
Author	CORE
Contributors	MARTE, FhG/IFF
Description	This document is a deliverable of the PortForward project, which is funded by the European Union's Horizon 2020 Program under Grant Agreement #769267. The Plan for Exploitation and Dissemination of results (PEDR) defines how the PortForward results will be exploited and disseminated to achieve a successful commercialization and how each partner will exploit the individual results that will be developed. This is the first version of the PEDR and includes a description of the expected results that each partner will develop and a first approach for their exploitation. Furthermore, it depicts all the activities that need to be carried out to develop the Exploitation and Dissemination Plan for PortForward and to define the characteristics of its potential audience and customers. The deliverable is structured in three sections as follows: • Section 1: Overview of PortForward Project and Exploitable Results • Section 2: The development of Exploitation Plan and the future activities of the project • Section 3: The development of Dissemination Plan and the future activities of the project
D9.5	**Data Management Plan (DMP) V1**
Author:	CORE
Contributors	All
Description	This document is a deliverable of the PortForward project, which is funded by the European Union's Horizon 2020 Program under Grant Agreement #769267.

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	It describes what data the project will generate, how these data will be produced and analyzed. It also aims to detail how the data related to the PortForward project will be disseminated and afterwards shared and preserved.

10.5Deviations from Annex I

No deviations to report.

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11 WP10 Project Management

11.1 Objectives of WP10 for the reporting period

The main objective of the work package in this period was to kick-off the PortForward project and establish the necessary structures and procedures for a smooth running of the project. After establishing the basic structures, project management ensured the progress of the project, the coordination between the work packages and with the project officer, including reporting of deliverables.

11.2 Summary of progress

Table 23 Summary of Progress for WP10

No: 1	Project Kick-Off
Description:	The project was kicked-off in Magdeburg on July 10-12, 2018. The work packages were launched between the partners, a first port visit and use case discussion with Magdeburg port was carried out. It also allowed for the presentation of the INEA PO and the Docks the Future project
No: 2	Establishment of project procedures
Description:	The project manual as represented in D10.1 lays out the basic structure and procedures for the project including communication and documentation. It also includes procedures for the set-up of the document management system and the different communication channels, e.g. the project email pool and contact list.
No: 3	2nd Project Management meeting and coordinative tasks
Description:	The coordinator, together with the partner ACCIONA, organized the second project management meeting in Madrid on February 12-14, 2019. The focus of the meeting was the review of work carried out in the first 6 months of the project as well as planning of the work schedule for the next six to eight months. Focus was put on establishing a format of working groups to address project specific topics across all work packages, in an interdisciplinary way. A status meeting with the PO was organized in April to discuss current topics and potential deviations to the work plan. A telephone conference was organized between the coordinator and work package leaders to inform each other about the current state of the individual project activities and identify cross-work package topics to be addressed.

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11.3WP10 Meetings

Table 24 Overview of WP2 meetings

No.	Date	Name	Responsible partner & venue	Purpose
1	July 10-12, 2018	Project Kick-off meeting	FhG/IFF, Magdeburg	Kick-Off of project and agreement of overall framework for work in project, presentation by INEA PO and Docks the Future
2	February 12-14, 2019	2nd Project Management Meeting	FhG/IFF, Madrid	Review of work in M1-M6 and planning for M7-M12/M15. Work on cross-work-package oriented working groups on relevant topics, see agenda.
3	April 9, 2019	Status meeting with INEA PO	FhG/IFF, Brussels	Review of current status and deliverables, information and coordination regarding open issues and potential changes
4	June 3, 2019	Work Package Leaders coordination call	FhG/IFF, online	Coordination of current tasks and deliverables, identification of cross-work-package topics to be addressed

11.4Deliverables

Table 25 Submitted deliverables in WP10 within the current period

D10.1	**Project Manual**
Author	IFF
Contributors	-
Description	The project manual is a document containing information and procedures for the execution of the PortForward project. It will function as a manual and reference document for the project partners to efficiently execute the project.
D10.2	**Interim Progress Report**
Author	IFF
Contributors	All
Description	This first progress report for the PortForward project gives an overview of the activities of the project consortium within the first six months of the project. The focus for the activities lays in the establishment of the partnership through the

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	project Kick-Off in Magdeburg and the start of the work, specifically in the preparatory work in the first work package. Moreover, a number of activities were started to connect the relevant use case partners, i.e. through on-site visits at the participating ports. For dissemination of project activities, the project established the project website as well as took part in several dissemination related activities. Additionally, the project coordinated with the relevant CSA "Docks the Future" and the respective research projects.
D10.3	**1st Year Progress Report** *(this report)*
Author	FhG/IFF
Contributors	-
Description	The PortForward project successfully concluded its first year in June 2019. The current report provides a full overview of the activities in the project's first twelve months. In this, the report will incorporate the previous deliverable 10.2, which covered the first six months of the project, and extend it by the subsequent project months M7-M12. While the first six months of the project focused on the establishment of the consortium structure and partnership relations with appropriate stakeholders as well as the preparation of the project use cases, the second half of the year build on this and further refined the uses cases with a perspective on the technical implementation. Discussions revolved around the architectural design for the project solution as a whole. Moreover, the development of the individual services for port operators was initiated and their integration in the cloud based solution discussed. Exploitation and dissemination was furthered through individual activities and public events.

11.5Deviations from Annex I

No deviations to report.

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12 WP11 Ethics Requirements

12.1 Objectives of WP11 for the reporting period

The main objective of the work package was to lay out the ethics procedures for the project as a whole. Specific focus was put on the informed consent procedures and the procedures for handling personal data.

The work in the work package is concluded.

12.2 Summary of progress

Table 26 Summary of Progress for WP11

No: 1	Informed consent procedures
Description:	The procedures have been defined and are laid out in D11.1
No: 2	Handling and processing of personal data
Description:	The procedures and processes for collecting and processing personal data have been defined and are laid out in D11.2

12.3 WP11 Meetings

There have been no work package specific meetings in the period

12.4 Deliverables

Table 27 Submitted deliverables in WP11 within the current period

D11.1	**H – Requirement No. 1**
Author	IFF
Contributors	-
Description	The deliverable constitutes the first of two ethics deliverables for the PortForward project. This deliverable is concerned, per Grant Agreement, with procedures and criteria to identify/recruit research participants, the informed consent procedures to be implemented and highlight principles and template for informed consent forms.
D11.2	**POPD – Requirement No. 2**
Author	IFF

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Contributors	-
Description	The PortForward project aims for stakeholder inclusion and the testing of technical solutions in realistic use cases. This will increase the viability and sustainability of the project's results and foster exploitation beyond the project. To this end, it will be necessary to process data from different sources. Ensuring the responsible collection, use and processing of personal data is an important aspect in fulfilling the ethical requirements of the project. This deliverable will, per Grant Agreement, provide insights about how the project consortium is compliant towards the collection of personal data, about how data is handled over the lifecycle of the project (collection, storage, protection, retention and destruction). Furthermore, informed consent procedures will be re-iterated.

12.5 Deviations from Annex I

No deviations to report.

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13 Conclusion

The report at hand provides an overview of the work of the PortForward project during the first twelve months of the project. As expected, important effort was spent on starting the individual work packages and bringing all partners on the same page. Additionally, the methodological base was established for a number of individual aspects, which contribute to the overall PortForward solution.

Substantial effort was put and significant progress was made in setting the scene for the ambitious use cases of the project. This work was condensed in the deliverables for the WP1 but content for these deliverables was elaborated in all technical work packages. WP1 was concluded as planned, with minor open issues to be addressed in subsequent WPs, as was the Ethics WP11.

While there have been minor delays in the submission of individual deliverables, no WP is significantly delayed. WP2 staging work packages 1 and 2. Here especially a number of meetings were organized with the involved use case partners to harmonize the approaches to the implementation of the cases in the later stages of the project.

There have been no serious delays or set-backs in the implementation of the project so far.

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