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PortForward

10.4 – 2nd Year Progress Report

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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 concluded its second year in June 2020. The second year also encompassed its first reporting period (until M18) and its first project review. This report provides an overview of the activities carried out between M12 and M24. The second year of the project focused on the technical preparation for the implementation of the project uses cases. Main points of work for the consortium were the establishment of the technical architecture and the actual planning of the project use cases. Also in dissemination the project implemented successful activities to establish the project as an innovative project for its target group with significant reach through print and TV articles.

The final months of year two were marked by the onset of the COVID-19 pandemic in Europe. Lockdowns and restriction all over Europe hindered the project implementation, especially the project's crucial step from planning and concept development to actual implementation in the use cases. These delays are persistent as of time of submission and no perspective is available if and when normal operations continue. Apart from on-site use case implementation, especially dissemination was hard hit by the effects of the pandemic with the cancellation of a number of high profile dissemination events and local/regional/national restrictions on organizing own 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 project's 2nd year (Y2), July 2019 – June 2020 (M13-M24). It will provide an overview about the deliverables produced and, where applicable, the deviations from the Grant Agreement.

As D10.4 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
10	Autorità di Sistema portuale del Mar Tirreno Settentrionale, Northern Tyrrhenian Sea Port System Authority	APS MTS	IT

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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
WP6	The PortForward Dashboard & technical validation (TRL 5)	IFF	4	40
WP7	Use cases & impact assessment (TRL 6)	MARTE	4	42

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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 objective for the work in the second year was to take the project from a conceptual level to a more technical level and initiate the on-site implementation of the individual use cases within the ports.

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	The work package was closed in M8.
WP2	PortForward framework design	The work package was closed according to plan in M18. However, a shift of perspective of the work package was necessary. The work package was 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 was put on the technical aspects of the port infrastructures and use case partners. The work focused 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 found a way to adjust the work in an ad-hoc manner to properly address the implications of these interdependencies, without a significant shift of resources. Deliverable D2.1 was delayed in accordance to agreements with the project officer to take account of the realignment of the work packages tasks and to redefine its role for the project implementation. This did, however, not delay the overall implementation effort of the work package and the project. The WP's final deliverable D2.2 was submitted on time to **close the WP** on M18.

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		The relevant **Milestone MS2** was postponed according to the delay of D2.1 but ultimately achieved in M13. The **Milestone MS3** was reached with the successful submission of D2.2 on M18.
WP3	IoT-enabled ports	The WP focused its work in the reporting period on coordinating partners to ensure the successful technical integration, with a specific focus on IoT components for the use cases and the set-up of the cloud infrastructure for the service delivery. 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 with the availability of the middleware to the partners in M4. The **Milestone MS5** was reached in M12 according to the project with first versions of (i) IPv6-compliant IoT device software for LPWAN end devices, (ii) an adapter container for mapping legacy to LwM2M APIs and (iii) extended open source LwM2M client/server software including the coupling with IoT middleware.
WP4	PortForward services	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 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 meeting provided input on the relationship between use cases-architecture-service design. With respect to the COVID-19 pandemic the WP4 made suggestion on how to use its services to cope with the pandemic's effects. No deliverables or milestones were planned for the work package in the current period.
WP5	Green Scheduling & Sustainability of operations	Service development is coordinated with requirements development in work packages one and two. Extended on-site meetings at Vigo towards the beginning and at the end of the reporting period helped to define the scope for the service. No deliverables were planned for the work package in the current period. However, the project published first results on the environmental

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		assessment of port operations by applying the life-cycle assessment methodology prototyped for Container Terminal of Port of Vigo in its second press release. First results of the Green Yard Scheduler were presented at TRA2020 online seminar.
WP6	The PortForward Dashboard & technical validation (TRL 5)	Work is closely coordinated with work package two with respect to architecture design and data exchange to take into account the requirements for the digital twin concept, dashboard and decision support. A specific focus on the strategic aspects of the port authority dashboard was discussed with the Advisory Board. Preparatory integration work was started focusing on the individual use cases. 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, resulting in deliverables D6.1 and D6.2.
WP7	Use cases & impact assessment (TRL 6)	Through a close cooperation with work packages one and nine, there is an intensive process ongoing for the comprehensive and structured description and implementation 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 of an end-user perspective for the use case evaluation and assessment. The deliverables D7.1, establishing the underlying use case evaluation metrics, and D7.2., applying those metrics as baseline to the project use cases, were produced and submitted in the current reporting period.
WP8	Valorization and market assessment	Activities coordinated the establishment of the project advisory board and organized two remote meeting of the board. Further coordination with work package nine was undertaken to identify relevant exploitable results, costumer needs, market segments and PortForward's joint results and competitive position, in order to ensure sustainability. Standardization activities were started. No deliverables were planned for the work package in the current period. With respect to the COVID-19 pandemic the WP carried out an ad-hoc survey among port partners to identify potentially shifted priorities.
WP9	Dissemination/ Communication/ Exploitation	Project website and dedicated social media accounts were used extensively and reach could be expanded significantly. Coordination with CSA Docks the Future and RIAs PIXEL and COREALIS is ongoing, e.g. through joint document repositories and participation in project events. Partner networks are used to ensure presence at relevant events, e.g. Docks the Future or ALICE, to disseminate results. Coordination with further projects was established.

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		The project also used different events to disseminate project information to the general public. Dissemination reach could be extended significantly through dedicated articles in widely circulated magazines and through TV article in German TV. COVID-19 related contingency measures were planned and already partly implemented (online seminars, videos, coordination of stakeholder engagement with other projects) to ensure dissemination impact.
WP10	Project Management	Organization of half-yearly project management meetings (September 2019 meeting in Kristiansand, January 2020 meeting in Palma de Mallorca, Review meeting in Brussels in March 2020) as well as additional meetings on needs basis (after COVID-19 lockdowns exclusively online). The consortium's project management meetings further aligned the work over all work packages and reviewed the consortium's work by using a dedicated project de-briefing process (Kristiansand meeting). Online coordination meetings between the work package leaders were carried out as well as a regular review meeting with the project officer in Brussels.
WP11	Ethics	The work package was closed in M6.

1.4 Main Results

The main technical results over the whole project 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) *(unsuccessful, information to be gathered in dedicated consultations and workshops with partner ports and stakeholders in the next reporting period)*
- 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(WP1/WP2/WP4/WP5/WP6)
- Definition of an underlying technical architecture for the project (WP2)
- Definition of data exchange and interoperability (WP2)
- Launch of the IoT middleware for testing among partners (WP3)
- Definition of cloud integration concept and device management (WP3)
- Technical definition of relevant use cases and underlying services (WP4)
- Proposition of COVID-19 contingency measures through use cases to EC (WP4/WP8)
- Establishment of a LCA based methodology for environmental factor assessment in ports (WP5)
- Problem definition for Green Yard Scheduling (WP5)

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- Preliminary estimation of trade-off potential for Green Yard Scheduling and presentation of results at TRA 2020 online seminar (WP5/WP9)
- Definition of concepts for Digital Twins for ports and decision support systems (WP6)
- Definition of an end-user focused assessment framework for the use cases and application to project use cases (WP7)
- Implementation of a project website including a public repository for the dissemination of public deliverables (WP9)
- Definition of exploitable results and relevant data sets (WP9)
- Dissemination of project results in various national and international media (TV/Press/Online/Trade papers) (WP9)
- Publication of a technical paper (WP9)
- Participation in several dissemination relevant meetings/events, e.g. Poster Presentation at Smart Systems Integration, Barcelona and presentation and booth at Transport Logistic trade fair in Munich, Presentation RFID & WIOT Tomorrow in Darmstadt (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 Management Meetings, i.e. Kick-Off in Magdeburg, Germany (FhG/IFF, M1) in Madrid, Spain (Acciona, M8), in Kristiansand, Norway(M15), in Palma de Mallorca, Spain (M19) (WP10)
- Successful completion of P1 (M18) technical and financial reporting, including Review Meeting in Brussels (M21) (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

The PortForward Project successfully passed its review in M18 and was able to hold the relevant review procedures in M21 (March 2020) just before the full scale lockdown procedures due to the COVID-19 pandemic. Until this point the project was well under way to achieve its technical achievements. The project was at a crucial point to start the technical implementation in the ports, especially within WP4 and WP5 (WP3 and WP6) and with a general connection to WP7's use cases. Due to the lockdown and travel restrictions, it is expected that delays in implementation will come to pass. The degree of delays can only be assessed, when "normal" project based exchange starts again, especially with cross-border use case implementations, e.g. Vigo (ES) use case cooperation with Brunel (UK), Livorno (IT) use case cooperation with UBIMAX (DE), PDB use case with mainland-island connections between Madrid, Barcelona and Mallorca.
Moreover, especially with respect to dissemination, the COVID-19 pandemic saw the cancellation of a number of high-profile events, in which PortForward was scheduled to have a present, e.g. TRA2020 in Helsinki (with a substitute webinar in June), TEN-T Days in Sibenik and the Green Energy Ports Conference in Vigo (Co-hosted and co-organized by the PortForward consortium member VIGO). Moreover, at least for 2020 there is no clear perspective in how fare high-impact events will resume, which will significantly reduce the dissemination impact of the project.

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2 WP1 – Stakeholder needs and technical requirements

Work package one was already completed within year one of the project. Within the second year no additional work was carried out. Please refer to D10.3 for an overview of the work.

3 WP2 PortForward framework design

3.1 Objectives of WP2 for the reporting period

Within the second year of the project work package two was able to define the underlying architecture for the cloud platform as well as the different interactions between different IoT components and the port services to be developed and to be deployed through the platform. The work package was successfully closed in M18 with the delivery of the architecture in D2.2 (pending revisions).

3.2 Summary of progress

Table 4 Summary of Progress for WP2

No.: 1	Definition of Communication Interfaces and Data Model Fields
Description	To ensure that the defined services are interoperable, the consortium decided on a series of communication interfaces to be used as the standard mean of communication between services. This way, the PortForward framework can be easily extended and its different services can be reused as needed. On the other hand, after the previous questionnaire aiming to the collection of information, a harmonization process has been conducted with the objective of reusing different values that were required by different partners, so all the data was contained in fewer entities. Finally, an update procedure to ensure that future changes are applicable without an uncontrolled impact in the project has been designed and documented. With these achievements, the expected result has been achieved and is considered completed.
No.: 2	Legal frameworks and security measures at architecture level to be considered during development
Description	In order to ensure that the PortForward framework follows all the legal frameworks applicable, the data needed for development was analyzed to detect possible legal needs. The identification of the legal frameworks has been conducted in collaboration with T9.5 and included in the scope of D2.2. On the other hand, the technical partners decided on the different security measures to adopt during the development of the services, mainly regarding authentication and authorization policies that need to be considered before the deployment.

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	All these results have been collected and reflected in D2.2.
No.: 3	Revision of deliverable
Description	Based on the reviewer's comments the consortium revised the deliverable D2.2 to better account for the process of elaborating the security aspects considered in the architecture. Additionally, Data curation aspects were further elaborated.

3.3 WP2 Meetings

Table 5 Overview of WP2 meetings

No.	**Date**	**Name**	**Responsible partner & venue**	**Purpose**
1	September 3-5, 2019	WP10 Project Management Meeting	IFF, LEITAT, Kistiansand	Presentation of WP2 progress, results achieved on the previous months and further action plan. Discussion over the contents and depth of D2.2.
2	September 20, 2019	WP2, T2.3 Communication interfaces and Data Model technical group	LEITAT, online	Discussion and decision about the best approach to perform the communication between services and the model to be used.

3.4 Deliverables

D2.2	**Data management and security on PortForward architecture**
Author:	LEITAT
Contributors	LEITAT, UBIMAX, ACCIONA, IFF, MARTE, BRUNEL
Description	This document is a step forward after D2.1, using the architecture defined for each Aggregated Service (AS) as the base for the creation of this document. D2.2 focuses on the communication between the services defined in the previous deliverable and the security aspects of the data required and the services by themselves. Since the approach chosen for the architecture is quite ambitious, the communication between services is one of the most important aspects to be considered and defined. Specifically, all the services must use the same communication means to ensure that they are interoperable. In the same way, it is

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	necessary to use a common data model to guarantee that entities are understandable by each service and make easier the reusability. Due to the early stages of the development processes, some changes are expected within the data model defined in this document once the services are more defined and the research advanced. For this, an update mechanism has been proposed as well. The last critical aspect for the success of this project is related with the security of the data and the access to it, including the isolation that it must have. As in the case of D2.1, this deliverable will be a basis to be improved, iterated and reworked with the inclusion of changes once the developments are advanced and the different research initiatives provide more insights about the needs of each service. This cycle of improvements will make this document collaborative and iterable.

3.5 Deviations from Annex I

No deviations to report.

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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

The work in the work package is a continuation of the work from the previous period.

Table 6 Summary of Progress for WP3

No: 1	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: 2	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 Fraunhofer 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. For FhG/IFF it was necessary to change the integration approach from the planned Virtual Fort Knox platform to an own dedicated cloud platform for the project. The reason for this is the discontinuation of the Virtual Fort Knox platform.
No: 5	IoT device management and application enablement
Description	In a subsequent step, necessary technical aspects were elaborated to allow the interfacing with the IoT middleware and the Fraunhofer Cloud Platform, as well as the interfacing between IoT devices and the IoT middleware over various communication infrastructures, pushing forward standard-compliant solutions and device management capabilities. All aspects were documented in D3.2.

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No.: 6	Revision of Deliverables
Description:	Deliverables for the work package were revised based on comments by the external reviewer to take better account of the IoT Middelware / IoT Stack / Obelisk distinction, i.e. the development of the naming conventions throughout the project. Moreover, the revisions also took account of the further unavailability of the Virtual Fort Knox Platform and its alternative solution.

4.3 WP3 Meetings

Table 7 Overview of WP3 meetings

No.	Date	Name	Responsible partner & venue	Purpose
7	September 03-05, 2019	3rd Project Management Meeting	Kristiansand	Presentation of WP3 progress. Sharing the main takeaways of D3.2 towards all partners and illustrating sample use cases that can be realized upon the IoT middleware.

4.4 Deliverables

No additional deliverables were submitted in year two.

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 in the fourth work package included mainly the further definition and description of the use cases between the port partners and research partners. The period was supposed to end with the first technical implementations within the port but the COVID-19 restrictions made this practically impossible

5.2 Summary of progress

Table 8 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 2018 with further planning for the use case between the use case partners. A first proof of concept for specific processes was established and tested between UBIMAX and LIVORNO
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. Further asset tracking components were defined for the Magdeburg Port use case. Further discussions were carried out between PDB, Leitat and IMEC on using the infrastructure for COVID-19 related tracking to, e.g. survey quarantine zones. This was also suggested to the project officer in the context of pandemic response actions under H2020. (see also https://www.portforward-project.eu/how-ports-de-balears-use-case-monitoring-of-port-authoritys-activities-could-help-to-minimize-the-effect-of-covid-19/)
No: 3	PDB use cases for Stowage Optimization and air quality monitoring
Description	ACCIONA coordinated with PDB and external stakeholder Trasmediterránea to define a use case for the stowage optimization of lorries on ferries. LEITAT coordinated with PDB and the municipality to define a use case for air quality monitoring in the port. The first analysis of available equipment resulted in procurement and updating of sensors.

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5.3 WP4 Meetings

Table 9 Overview of WP4 meetings

No.	Date	Name	Responsible partner & venue	Purpose
1	January13, 2019	WP4.2/WP4.3	Ubimax, online	2nd call for the tasks.
2	June 25. 2019	4.2/4.3	Ubimax, APT MTS	Data input and workflow
3	December 10, 2019	WP4, T4.1 Baleares alignment call	LEITAT, online	Alignment on the different possibilities to be deployed in the PDB use case
4	January 9. 2020	4.2/4.3	Ubimax, APT MTS	Demo Data input and workflow

5.4 Deliverables

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

5.5 Deviations from Annex I

A change in use cases might be realized in the remainder of the project to tackle COVID-19 related challenges of ports..

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6 WP5 Green Scheduling & Sustainability of operations

6.1 Objectives of WP5 for the reporting period

The second year for the work package five saw a further refinement and application of the lifecycle assessment (LCA) methodology for the port of Vigo. The partners did a calculation of environmental indicators for the port, which was then used to calculate optimizations in the terminal port operations with the Green Yard Scheduler (GYS). Through this, first estimation for trade-off potentials could be assessed.

6.2 Summary of progress

Table 10 Summary of Progress for WP5

No: 1	Categorizing the container terminal decision making problems
Description:	To develop GYS as an inference engine for the decision support system, the main decision problems in the area of the container terminals should be explored and classified. In this order, the relevant literature has been reviewed systematically and sixteen decision problem was defined.
No: 2	Analyzing the current situation of the container terminal in Vigo by historical data
Description:	Historical data (2010-2018) of all operations in the Vigo container terminal were analyzed. It not only helps us to understand the current situation of the Vigo but also illustrate the main challenges of the Vigo container terminal. The amount of consumed and used resources in terms of different operation was found. This data is used also to calculate the sustainability performance of the baseline scenario of the Container Terminal of the Port of Vigo.
No: 3	Exploring the preference and importance of decision problems for the end-user
Description:	The Brunel team present the decision problems that were explored from the literature review as well as the results of historical data for the container terminal operator in Vigo (Termavi). So, the relative importance of the problem for the end-user were identified.
No: 4	Scoping the GYS decision problems
Description:	Two sub-modules were defined for GYS including Yard Scheduling Module (YSM) and Container Positioning Module (CPM). These modules aim to improve the overall performance of the yard in container terminal, and environmental sustainability. All features, assumptions, inputs and outputs of the model were identified.
No: 5	Economic and green objective function formulation

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Description:	The Yard Scheduling Module is seeking to optimize the yard cranes (i.e. RTGs and RSs) jobs. To allocate and schedule the yard cranes, the Brunel team develop two objective functions including the processing time and energy consumption. The energy consumption and processing time of the yard's resources would be minimized by allocating the appropriate resources and scheduling jobs for each resource. CPM aims to find the exact slot position in the container yard for containers that undergo a handling operation (e.g. export, import, inspection) so as to increase the operational efficiency and reduce the fuel consumption of RTGs, RSs, and IMVs. The allocated slot positions determined by CPM are conveyed to YSM for the scheduling of RTGs and RSs.
No.: 6	First calculation of the Green Yard Scheduler and presentation of results
Description:	Bringing together the results from the LCA and the first calculations of the GYS modules, the partners in the use case were able to provide a first analysis of trade-off potential between operational efficiency and environmental efficiency for yard operations. It could be shown that potential is there to decrease energy use for yard operations, albeit by losing operational efficiency, e.g. increasing number of operations on site. Results of this were presented during the TRA2020 online seminar https://www.portforward-project.eu/the-future-of-ports-tra-online-seminar-with-alice-and-port-of-the-future-projects-on-june-23-2020/

6.3 WP5 Meetings

Table 11 Overview of WP4 meetings

No.	Date	Name	Responsible partner & venue	Purpose
1	September 3-5, 2019	WP10 Project Management Meeting	All partners	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)
2	October 3, 2019	WP5 Videoconference meeting	Brunel and container terminal operator (Termavi)	The main aims of videoconference were: a) defining the operation in the container terminal; b) finding the data entry process in TOS; c) identifying decision making algorithms in TOS; d) clarifying resource interconnection and coordination in the container terminal.

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3	October 21-24, 2019	WP5 Vigo visit: Problem identification	VIGO & Brunel & container terminal operator (Termavi)	The main aims of this visit to the Port of Vigo was: a) Presenting the result of the port of Vigo data analysis; b) Discussing on the problems of container area; c) Exploring the main problems of container terminal; d) Finalizing the problems and defining the features of the Green Yard Scheduler package.
4	December 19, 2019	WP5 Videoconference meeting	VIGO & Brunel & Container Terminal Operator (Termavi)	Recognizing the data flow in Vigo container terminal as well as clarifying the operation management process.
5	January 20-21, 2020	WP5 Vigo Visit	VIGO & Brunel & Container Terminal Operator (Termavi)	Defining the features of the Green Yard Scheduling, focusing on container area optimization

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 second year was mainly to support the second work package with respect to the integration preparation of the project's architecture. Additionally, project partners worked towards establishing a common understanding and approach to developing the project's Dashboard approach, which will integrate aspects of several work packages to support decision making.

7.2 Summary of progress

Table 12 Summary of Progress for WP6

No.: 1	Ensuring common understanding of the PortForward Dashboard (PFD)
Description:	The KPI catalogue developed in D1.4 mainly focusses on strategic KPIs for Port Authorities. Further indicators, decision supports and other information (mainly tactical and operational) will be derived from the Services and within the Use Cases. All these data and information shall be integrated in the PFD as main user interface of the PortForward framework. Additionally, the consortium further elaborated the concept for a port authority dashboard, which supports the strategic approach of managing ports. The port authority dashboard was further discussed with the Advisory Board, see WP8.
No.: 2	Supporting integration in cooperation with WP2
Description:	The WP contributed to T2.2, more specifically to both deliverable D2.1 and D2.2. Through way of workshops integral parts of the architecture have been described and refined in a second step (as now published in D2.1) and will be used as input for the integration plan and process definition.
No.: 3	Integration of tools and services
Description:	To work towards the implementation and roll-out of the use cases at the different ports, T6.3 has been defined to deal with integrating tools and services. An integration plan will be compiled and documentation of this based on the individual use cases has started. The effort was already started now to track the integration progress and early detection of potential delays.

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7.3 WP6 Meetings

Table 13 Overview of WP6 meetings

No.	Date	Name	Responsible partner & venue	Purpose
1	Sep 3-5, 2019	WP10 Project Management Meeting	FhG/IFF, Kristiansand	Presentation of current state of WP6 tasks and further action plan. Discussion of the role of Decision Support and Dashboard within the project in dedicated working group. Identification of the need for an intermediate Dashboard Concept.
2	Oct 25, 2019	WP6 – Conference Call	MARTE, online	Coordination of further steps concerning a Dashboard Concept. Agreement for a face-2-face workshop.
3	Dec 13, 2019	WP6 – Coordination Workshop	FhG/IFF, Berlin	Workshop for forming a common understanding of the role of the PFD within PortForward and identification of approaches for PFD development.
4	January, 23, 2020	Project Management Meeting	FhG/IFF, Palma de Mallorca	Working group on Dashboard development and integration of the previously discussed concept
5	June 11, 12, 2020	WP6, T6.3 preparatory call	IMEC, online	Considering integration aspects for the use-case(s), clarify the goal and expectations of the documentation, and start sharing the information already at disposal

7.4 Deliverables

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

7.5 Deviations from Annex I

Deviations are becoming apparent due to the restrictions of the COVID-19 pandemic, especially travel restrictions, which hinder the technical integration and testing on site.

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8 WP7 Use cases & impact assessment (TRL 6)

8.1 Objectives of WP7 for the reporting period

The work package focused on further refining the metrics for the assessment of the project's individual use cases. More specifically, it took assessment metrics as defined in the previous period to develop an assessment tool, which will allow for the consistent assessment of the individual uses cases over the whole project.

8.2 Summary of progress

Table 14 Summary of Progress for WP7

No: 1	Development of evaluation process and tool
Description:	The evaluation metrics represent an easy to read summary giving a multidimensional assessment from the perspective of the customer. Part of the proposed model refers to ISO/IEC 9126. The defined evaluation process allows the partners, during the implementation of the project, to identify the main specifications that must be respected in the implementation of a technological innovation. The work package defined the structure of D7.2 and coordinated its drafting. This deliverable is focused on the description of objectives and evaluation metrics for each use case and will be submitted with this report.

8.3 WP7 Meetings

There have been no WP7 specific events yet. However, WP7 relevant coordination work was carried out in the respective project management meetings, e.g. as part of respective working groups.

8.4 Deliverables

D7.2	Use Cases set up report
Author:	MARTE
Contributors	FhG/IFF, ACCIONA, IMEC, BRUNEL, LEITAT, UBIMAX, CORE, VIGO, PDB, APS MTS, MAGDEBURG
Description	One of the main objectives of WP7 is to create an evaluation system to demonstrate the impact that the implementation of the PortForward project technologies has on port processes. WP7 activities aim to verify the effectiveness and efficiency in real environments of the technologies developed in the laboratory. Possible corrective actions will be implemented so that each tool reaches the level of technological maturity TRL 6, as foreseen in the Work Package 7. MARTE created an Excel tool - the Evaluation Tool - to support the application of the methodological approach developed for WP7. It has the objective to backing and keep consistent the activities put in place to test the impact of the technologies.

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	In other words, the Evaluation Tool can guide the different phases of the testing activities by collecting the key information in a standard way for all of the nine Use Cases. This report introduces the Evaluation Tool, which, in this phase of the project, aims at collecting information about the objectives, the metrics for measuring the impact of technologies and the frequency of these measurements. According to the information indicated in the deliverables D1.2 and D1.3 of the project, the objectives of each Use Case will be selected from a list conveniently indicated in the methodological approach (deliverable 7.1). The definition of a shortlist of objectives will facilitate - in the following activity of WP7 (Task 7.3) - the comparison between the different Use Cases. Once the objectives have been identified, quantitative and qualitative metrics have to be selected in order to assess the impact of new technologies in a clear and measurable manner. It is important to underline that at this phase of the project the KPIs defined should not measure the performance related to port activities but only the impact of new technologies, in terms of effectiveness and efficiency. For each of the metrics, the report will provide the measurement plan that will be applied during the testing phase in the relevant environment. The measurements will allow the continuous comparison between the technology providers and the users, in order to verify the degree of satisfaction with the objectives achieved in view of those set. Ultimately, the activities reported in this deliverable will standardize the evaluation process of Use Cases, allowing, during the subsequent tasks, a comparative analysis among the nine Use Cases foreseen by the PortForward project. At the same time, the information collected in this report will be critical to guide the next testing phase.

8.5 Deviations from Annex I

At the moment there are no deviations to report but it will be expected that a delay in implementing the use cases will cause a delay in this work package.

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9 WP8 Valorization and market assessment

9.1 Objectives of WP8 for the reporting period

Within the second year the work package focused on the market preparation for the results. Here the focus was on the one hand to better understand the market for a potential PortForward solution and on the other hand to better understand and consolidate the message PortForward wants to send to its potential customers. Moreover, interaction with the Advisory Board was a focus point in the work.

9.2 Summary of progress

Table 15 Summary of Progress for WP8

No: 1	Consolidated SWOT Analysis for PortForward joint results
Description	CORE has consolidated the input from partners regarding the strengths, weaknesses, opportunities and threats of their individual results and the joint PortForward solution in order to provide a SWOT analysis that refers to the joint solution of PortForward. The results will help outline PortForward's competitive position and the development of the business model.
No: 2	Definition of the PortForward value proposition and target customers
Description	CORE and MARTE have jointly worked to identify what will be the project's offering, while defining the possible customer segments that the project will bring value to. This will be the basis of the business model development throughout the duration of WP8 and will be revised along the way of the project, in close interaction with the work done in the technical WPs and WP9, especially as regards the monitoring of the innovation potential of the project.
No.: 3	Port Survey on COVID-19 implications and priority shifts
Description	The consortium conducted an ad-hoc survey among its port partners to evaluate in how far individual ports' priorities changed with the COVID-19 pandemic. In general the conclusion was, that most of the priorities as defined in the project, esp. WP1, are still valid. More emphasis is now put on remote monitoring of assets and processes as well as supporting remote assistance / supporting remote working. (WP4 for example, made an attempt to use the project infrastructure to also survey quarantine zones as well as social distancing in ports)

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9.3 WP8 Meetings

Table 16 Overview of WP8 meetings

No.	Date	Name	Responsible partner & venue	Purpose
1	September 18, 2019	WP8.T8.2 PortForward 1st Advisory Board meeting	CORE, MARTE, FhG/IFF	The subject of this first meeting is the Port Authority Dashboard (PAD) that is part of the tools developed during the PortForward project as an instrument for monitoring port activities and evaluating port performance. It would be a pleasure to share the status of present activities on the topic.
2	September 03-05, 2019	3rd Project Management Meeting Value proposition workshop	CORE, MARTE Kristiansand	To exploit the collective knowledge of the consortium, either as target customers and users of such a product/ service or as the developers of the different parts of the platform and its services, in order to have the first definition of the value proposition and the customer segments of the PortForward joint results.
3	March, 17, 2020	Advisory Board meeting	MARTE	The main focus of the Advisory Board meeting was to present the current progress of the project and put a special emphasis on the role of port authorities. The project presented the work on the port authority dashboard and discussed implications with the Advisory Board members.

9.4 Deliverables

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

9.5 Deviations from Annex I

No deviations to report.

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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 17 Summary of Progress for WP9

No: 1	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/ (including re-design of the website for better engagement and overview). Moreover, the project uses social media channels such as Twitter (https://twitter.com/portforward_eu, from 212 followers in Y1 to 468 in Y2) and LinkedIn (https://www.linkedin.com/in/portforward-project/, from 129 followers in Y1 to 389 in Y2) to disseminate information. Publication of information is based on a social media plan.
No: 2	Dissemination activities and interaction with community
Description	The planned interaction with the further community was hindered by the COVID-19 pandemic. However, several initiatives were started in order for further engagement: - Participation in *DocksTheFuture* events on decision making - Participation in *Corealis* events on Livorno Living Lab - Coordination with other projects to collaborate, e.g. PROSPECT2030, DataPorts, SmartShip - Organization of special session for Green Energy Ports Conference Vigo (cancelled) - Organization of TRA2020 booth with Waterborne ETP and panel discussion (cancelled and transferred to webinar) - Organization of participation in TEN-T Days in Croatia (cancelled) - Successful submission of academic papers to conferences in Rostock, Germany (postponed – online) and Seoul, Korea (cancelled) - Project partner from MAGDEBURG port, Dr. Heiko Maly, got elected to the Saxony-Anhalt's Digitalization advisory board - Publication of Articles in RFID & Wireless IoT Global, Magdeburg Chamber of Commerce Magazine, SWM Magazine - One TV article on German TV (further available online at https://www.mdr.de/wissen/videos/aktuell/digitaler_hafen-102.html) on PortForward Use Case in MAGDEBURG

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	- Organization of a training and awareness raising event for staff of the MAGDEBURG port - Publication of press releases and newsletters Regular updates on social media and on the project website give an overview of the project's activities towards dissemination of results.
No.: 3	Coping with COVID-19 effects on dissemination
Description:	Due to the COVID-19 pandemic a number of events and project activities could not be carried out as planned. To this end the work package had additional effort, e.g. for coordinating alternative (online) formats for dissemination events. Moreover, first plans were drafted and partly put in place to make the dissemination more "video-heavy", i.e. producing a project video and technology shorts, which can be used in lieu of concrete interaction with stakeholders. At the moment, the consortium also needs to evaluate in how far the scheduled stakeholder interactions/consultation workshops can be maintained as they were connected to specific events, e.g. Vigo's Green Energy Ports Conferences (already cancelled), Naples Shipping Week (tbc), Inland Waterways Workshop Saxony-Anhalt (tbc).

Table 18 PortForward dissemination and networking events

No.	Event	Organizer	Date	Place	Partner/s and persons involved	Topics
1	Baltic Ports Conference 2019	Baltic Ports Association	Sept 5-6, 2019	Stockholm, Sweden	CORE Stefanos Kokkorikos	Project presentation during the first day of the conference
2	Schelde Conference at Port of Antwerp	Management Producties	Oct. 10, 2019	Antwerp, Belgium	IMEC, Jeroen Hoebeke	Project Presentation focusing on IoT enabled Ports
3	BILOG Logistics & Maritime Forum	La Spezia Port Authority and Municipality of Piacenza	Oct. 16-17, 2019	La Spezia, Italy	MARTE, Roberto Cinquegrani	Project Presentation focusing on port – city relationship

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4	Green Port Cruise And Congress	Mercatormedia	Oct. 15-18, 2019	Oslo, Norway	VIGO, Carlos Botana	Presentation planned but session dropped by organizers
5	RFID & Wireless IoT Tomorrow 2019	RFID & Wireless IoT Global	Oct. 29-30, 2019	Darmstadt, Germany	IFF, Christian Blobner	Project presentation focusing on IoT in project use cases, specifically Magdeburg
6	Collaboration coordination meeting	DataPorts projects	May 6, 2020	Online	FhG/IFF, Christian Blobner	Project presentation and discussion on collaborative opportunities with DataPorts and SmartShip projects
7	De-carbonization strategy and opportunities for greening enterprises in Saxony-Anhalt	Interreg project PROSPECT2030	June 22, 2020	Online	FhG/IFF, Christian Blobner	Project presentation focusing on GreenDeal and Magdeburg Use Case
8	TRA 2020 “The Future of Ports”	TRA2020	June 23, 2020	Online	FhG/IFF, Christian Blobner	Project presentation focusing on preliminary results from Vigo Use Case

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10.3WP9 Meetings

No.	Date	Name	Responsible partner & venue	Purpose
2	December 5, 2019	Information and training event for the use case "Port of Magdeburg"	IFF, MAGDEBURG	Information and training event for the employees of the port of Magdeburg. The aim of the event was to raise awareness of the PortForward project among port employees, focusing specifically on the topics related to the use case in the port. Furthermore, the event aimed to foster and facilitate acceptance of the project solutions and to engage relevant stakeholders in the port.

10.4Deliverables

Table 19 Submitted deliverables in WP9 within the current period

D9.3	**2nd Interim Plan for Exploitation and Dissemination of Results (PEDR)**
Author	CORE
Contributors	
Description	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 second version of the PEDR and includes a description of the expected results that each partner will develop and a further 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
D9.6	**Data Management Plan (DMP) V2**
Author:	CORE

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Contributors	All
Description	This document describes the data the project will generate and how it 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

Deviations are becoming apparent with the restrictions and lockdowns associated with the COVID-19 pandemic. A number of highly relevant events have been cancelled or transferred online, which might result in lack of impact for the project. It is expected that this will be the case until the end of 2020. Efforts will have to be increased in the project's final full year to achieve a wide dissemination of results. (It needs to be stated however, that the reach of the project's dissemination activities, especially online already surpasses the initial projections and can generally be considered a success.)

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11 WP10 Project Management

11.1 Objectives of WP10 for the reporting period

The objectives for WP10 in the second year were focused on issues of organizing two project management meetings (Kristiansand and Palma de Mallorca), organizing the financial and technical reporting for M18 plus the first review of the project in Brussels in M21 and managing the effects of the COVID-19 on the project.

11.2 Summary of progress

Table 20 Summary of Progress for WP10

No.: 1	3rd Project Management meeting and first year Debriefing Workshop
Description:	The project organized the third project management meeting in Kristiansand on September 03-05, 2019. Part of the activities for the meeting was the organization of a project management debriefing workshop, to review how the consortium worked in the first year and what are implications for collaboration for the future of the project. The focus of the project meeting was the review of work since February 2019 planning of the work schedule for the next six to eight months. The consortium continued to work in working groups focusing this time on the topics PortForward value proposition, architecture design, integration of services into decision support & dashboard.
No.: 2	Project Technical and Financial Reporting, Project Review
Description:	The 1st reporting period for the project ended with M18. This meant that the coordinator managed the technical and financial reporting process for the consortium and consolidated the various input. Together with the work package leaders, a review meeting for the project was carried out in Fraunhofer's Brussels offices in M21, including the project officer from INEA and the external evaluator.
No.: 3	4th Project Management meeting
Description:	The project organized the fourth project management meeting in Palma de Mallorca on January 22-23, 2020. The focus of the meeting was to give all partners an update on the current state of the project work. Furthermore, the project working groups focused on specific topics, such as reporting preparations, architecture and data exchange, and the PortForward dashboard.
No.: 4	COVID-19 Risk Management
Description:	From early March (M21) most of the project partners have been in some form of lockdown and/or remote working, with travel restrictions encumbering the on-site project work at the ports. At the time of reporting, this issue is not solved yet and procedures in the project are still in an adapted mode. COVID-19 related risk

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	management has been set up, esp. with respect to use case implementation and dissemination, which are activities hardest hit by the crisis. With the project officer several coordination efforts have been undertaken to position the project to use the project activities and results to specifically address the effects of the COVID-19 pandemic.

11.3WP10 Meetings

Table 21 Overview of WP2 meetings

No.	Date	Name	Responsible partner & venue	Purpose
1	July 16, 2019	Coordination call with PO regarding use case realignment	FhG/IFF, online	Discussion with PO on realignment of PDB use case based on new requirements of use case partner
2	September 03-05, 2019	3rd Project Management Meeting	FhG/IFF, Kristiansand	Project Debriefing of M1-M15. Review of work in M6-M15 and planning for M16-M20, and reporting in M18. Work in cross-work-package oriented working groups on exploitation, virtual twin, services, architecture.
3	November 05, 2019	Reporting preparation	FhG/IFF, Magdeburg	Preparation of reporting procedures for the Port of Magdeburg
4	January 22-23, 2020	4th Project Management Meeting	FhG/IFF, Palma de Mallorca	Review of work in M15-M18 and planning for M18-M24, preparation of technical reporting. Work in cross-work-package oriented working groups on architecture and Dashboard.
5	March 2-3, 2020	Project review meeting	FhG/IFF, Brussels	Presentation of the project implementation status and review with the project officer and external evaluator.
6	May 15, 2020	Work package leaders meeting	FhG/IFF, online	Update on current implementation work and delays, COVID-19 risk management procedures

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11.4Deliverables

Table 22 Submitted deliverables in WP10 within the current period

D10.3	**2st Year Progress Report** *(this report)*
Author	FhG/IFF
Contributors	-
Description	The PortForward project concluded its second year in June 2020. The second year also encompassed its first reporting period (until M18) and its first project review. This report provides an overview of the activities carried out between M12 and M24. The second year of the project focused on the technical preparation for the implementation of the project uses cases. Main points of work for the consortium were the establishment of the technical architecture and the actual planning of the project use cases. Also in dissemination the project implemented successful activities to establish the project as an innovative project for its target group with significant reach through print and TV articles. The final months of year two were marked by the onset of the COVID-19 pandemic in Europe. Lockdowns and restriction all over Europe hindered the project implementation, especially the project's crucial step from planning and concept development to actual implementation in the use cases. These delays are persistent as of time of submission and no perspective is available if and when normal operations continue. Apart from on-site use case implementation, especially dissemination was hard hit by the effects of the pandemic with the cancellation of a number of high profile dissemination events and local/regional/national restrictions on organizing own events.

11.5Deviations from Annex I

Deviations are becoming more and more apparent with the ongoing lockdowns and restrictions due to the COVID-19 pandemic. Intra-consortium communication and exchange has been transferred exclusively online. It is expected that especially remote working and travel restrictions (be it government- or company-mandated) will lead to delays in the implementation of the use cases.

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12 WP11 Ethics Requirements

Work package eleven was already completed within year one of the project. Within the second year no additional work was carried out. Please refer to D10.3 for an overview of the work.

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13 Conclusion

This report gives provided an overview of the current state of the project PortForward after concluding its second year M24. It shows that the project was on a good track to reach its objectives. Until M21 (March 2020) the project was on schedule with respect to the overall project plan and in fact was in preparation to make the step towards starting the on-site implementation of the project use cases. This was delayed and in fact is still delayed as of the time of submission for this report. The full effects of the delays can only be estimated when procedures have been established, which makes on-site visits safe again, in fact possible again.

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