Document id	Title	Organisation / Author	Date	Status
OMI-PB-0001 | HP001	Harbours & Ports Project Proposal	CU/AB, HJ; AEC3/NN; CCCC/SL	2017-03-24	V02- Shared

Harbours & Ports Project Proposal

0 Project Details

0.1 Descriptive Name

IFC Infrastructure for Harbours and Ports (IHP)

0.2 Contact Information

buildingSMART – Richard Petrie (RP), Christophe Castaing (CC)

CCCC: China Communications Construction Company Ltd – Project Leader
Ziyu SUN (ZS, Team Leader), Li QIAN (LQ, Key Member), Song LIU (SL, Key Member), Xi WEN (XW, Key Researcher)
CU: Cardiff University – Project Partner
Haijiang LI (HL, Project Investigator); Alex BRADLY (AB, Key researcher)
AEC3 - Project Partner
Nick NISBET (NN)
DUT: Dalian University of Technology – Project Partner
Shaohua JIANG (SJ)

0.3 BuildingSMART Room

Infrastructure Room

0.4 Project Outline

To provide the extensions, definitions, property sets and guidance necessary to facilitate the definition and use of IFC in the design, construction, operation and maintenance of harbour, port & waterway infrastructure.

1 Background

The creation of standardized Infrastructure asset & project data throughout the lifecycle of a facility is a key factor for the effective and efficient planning, design, construction, operation & maintenance Infrastructure. A comprehensive neutral data exchange model capable of representing both the semantic and geometric aspects of a give project or asset is a requirement for the open data exchange and effective data utilization in the context of developing, operating & maintaining harbour, port & waterway infrastructure.

The inclusion of Infrastructure elements within the IFC has both expanded and redefined the scope of IFC, moving its remit to include all aspects of the environment that are either built or managed. Several national standardization initiatives have emerged developing proposals for the extension of the standardized data exchange schema within different infrastructure domains. Examples are the Korean IFC-Road project, the Chinese IFC-Rail project, IFC-Bridge initiatives from the United States and France, and IFC-Tunnel from Germany. Issues with overlapping scope and an effort to internationalize these initiatives has resulted in the recent and planned work defining the overall architecture & common definitions, to provide a conceptual foundation to infrastructure developments.

Currently within the realms of transportation infrastructure the infrastructure room is engaged in the domains of road and rail transportation, with its common dependent of bridge engineering, in addition a separate BuildingSMART room has begun for airports, to address the unique place they sit between the buildings and infrastructure domain. These domains address two of the three major modes of transport for people, goods and services utilized in today's economy.

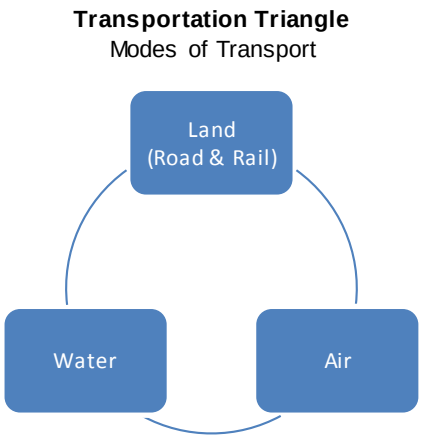

Figure 1 Transportation Triangle

Sea transportation and maritime structures form a substantial part of the global economy, and has been growing consistently over the past 20 years. Total transport capacity has steadily grown from 800 million tons in 2000 to 1200 million tons by 2010. The shipping industry within the UK alone is worth over £4 billion. Considering this identified gap in the coverage of IFC for Infrastructure, this is a proposal to start the international development of IFC for open maritime infrastructure, beginning with its expansion to cover the domain of ports and harbour design, construction and operation.

This project will draw on the expert knowledge from the BuildingSMART international community and leading organizations in ports and harbour construction to provide a framework for open data standardization. This framework will include domain specific IFC schema extension, Model View Definition (MVD) development, and software & model demonstration, documentation for the extensions and MVDs plus guidelines on use of the information. The project would align its efforts with the outcomes from the overall architecture project and concurrent developments of the common definitions project. As shown in Figure 4 the project would need to draw from and align its efforts with the work of IFC Rail and Road, to achieve full integration.

This document outlines the organization of work and development that is needed to engineer an extension to IFC plus supporting framework and documentation capable of exchanging and leveraging critical ports and harbour information.

2 Objectives

The IFC for Ports and Harbours Project is set to achieve:

- Define the use cases for the development, operation & maintenance of Ports & Harbours taking into account existing use cases developed during the Overall Architecture and other related initiatives.
- Set out the data exchange requirements for the use cases to be implemented within the Ports & Harbours project.
- Develop & document the IFC Infrastructure for Harbours and Ports data exchange standard to be known as IHP 1.0.
- Development of modelling guidelines, and an IHP IDM & MVD.
- Provide planning for Deployment of IHP 1.0 and highlight future developments for IHP and Maritime Infrastructure.
- Develop (or extend existing) tool to view/edit IHP 1.0 models and create example models

In addition to these objectives the following is recognised:

- Integration of IFC Road, IFC Rail & IFC Buildings is a key component to the overall domain of Harbours and Ports and needs to be considered (for more information please see the *Scope of Work* section).
- Engagement with the common definitions project is important as the base definitions being developed under this project are important elements of Harbours & Ports projects.

3 Achievements

The Project outline states the following main achievements in order to fulfil the stated objectives for the IFC Infrastructure for Harbours and Ports.

- A Clear definition of Scope for Harbours & Ports
- Process Maps and Use case definitions for Harbours & Ports
- Draft Conceptual model and IFC Extension for the exchange of Harbours & Ports data.
- A Harbours & Ports Model View Definition (MVD) and supporting Information Delivery Manual (IDM)
- Modelling Guidelines for Harbours & Ports datasets
- An IFC Viewer and example model for demonstration and validation
- Deployment Plan & Future Developments for IFC Infrastructure for Ports & Harbours
- Engagement and collaboration with currently running BuildingSMART projects & Initiatives
- Facilitation of Expert Panel Reviews and collaboration with Infrastructure Room steering Committee

4 Project Execution

The IFC Ports and Harbours project will be executed according to the BuildingSMART International standards Process (see Figure 2). The need has been identified by third party work between Cardiff University, AEC3, China Communications Construction Company and Dalian University of Technology (China). In reviewing the current ports and Harbours Industry and current IFC capabilities within the domain. This project proposal and evolution into project plan will complete the initiation phase depending on approval by the steering committee of the infrastructure room and the stakeholders of the project. This project proposal outlines the work to be covered in the solution development phase.

The Project team will form the core group with a Project Leader (CCCC) & a Project Investigator (CU) responsible for leading the project team, coordinating with the project steering committee of the Infrastructure Room, coordinate with the BuildingSMART Standard Committee Executive.

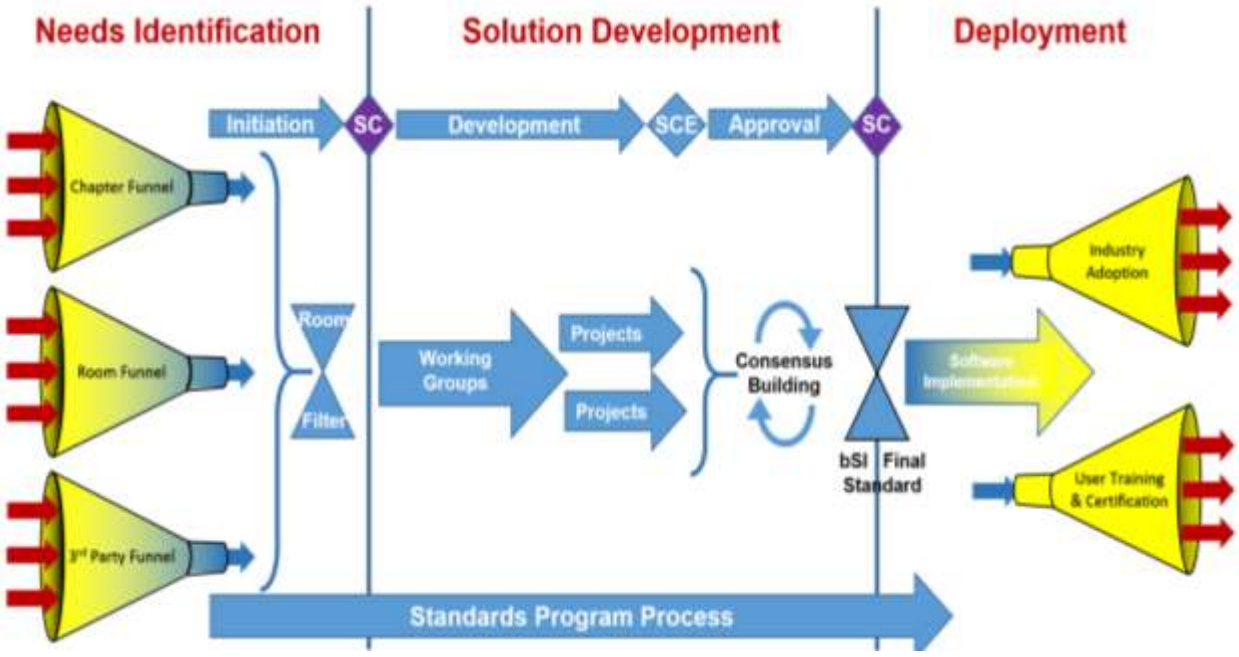

Figure 2 BuildingSMART Standards Process

The Project will also be executed under the governance of the BuildingSMART Infrastructure Room (see Figure 3). The main groups involved will be:

- The Infrastructure Room Project Steering Committee with project Stakeholders
- Members of the Infrastructure Room Steering Committee and the appointed Project Coordinator
- The Project Team and Appointed Project Team Investigator and Manager
- The Expert Panel comprising domain and software experts.

Document id	Title	Organisation / Author	Date	Status
OMI-PB-0001 | HP001	Harbours & Ports Project Proposal	CU/AB, HJ; AEC3/NN; CCCC/SL	2017-03-24	V02- Shared

The project team responsible for executing the project will be made up from members of the following organisations:

buildingSMART – Richard Petrie (RP), Christophe Castaing (CC)

CCCC: China Communications Construction Company Ltd – Project Leader
Ziyu SUN (ZS, Team Leader), Li QIAN (LQ, Key Member), Song LIU (SL, Key Member), Xi WEN (XW, Key Researcher)
CU: Cardiff University – Project Partner
Haijiang LI (HL, Project Investigator); Alex BRADLY (AB, Key researcher)
AEC3 - Project Partner; Nick NISBET (NN)
DUT: Dalian University of Technology – Project Partner; Shaohua JIANG (SJ)

For international consensus building the project team will rely on expert panel review; members of this expert panel will be formed from invested BuildingSMART Stakeholders with expert knowledge in the domain of Ports & Harbours development, the IHP project requests help from the InfraRoom Steering Committee (IRSC), bSI Standards Committee (SC) and national Chapters in identifying and engaging maritime experts from the domains of:

- Maritime Design industry
- Maritime Construction industry
- Maritime operations & Planning industry
- Maritime Maintenance industry

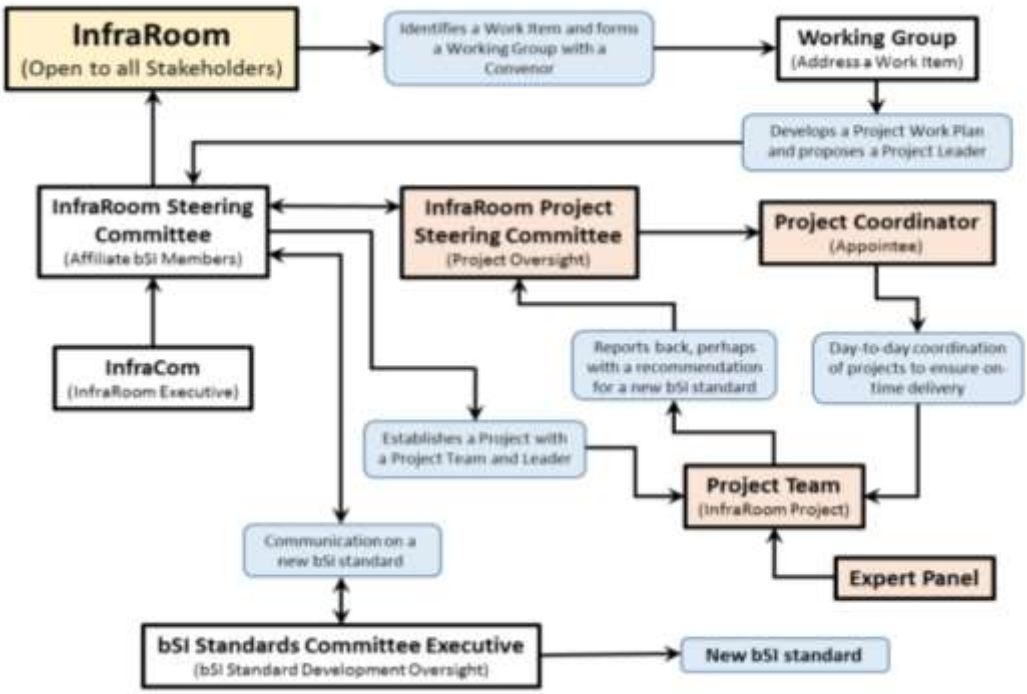

Figure 3 Governance Diagram of the Infrastructure Room

5 Scope of Work

The scope of the work covers the semantic description of locations, assets and operations relating to the design, construction & operation of maritime facilities. The extent of maritime infrastructure and the constituent elements that form maritime facilities are depicted in Figure 4. (Please note Offshore wind turbines/platforms & subsea cables/pipelines are not included within this project but do form part of the maritime infrastructure domain).

Locations

Locations describe the different functional areas that are combined to form a harbour or port facility, but equally can exist as individual facilities or assets themselves. Figure 4 depicts how a combination of locations within a network of waterways can be combined to form a modern port facility. Locations within ports are broken down into two main areas water locations and land locations.

1. Land Locations
    a. Cruise & Ferry facilities
    b. Shipyards
    c. Military Facilities
    d. Freight Facilities (bulk, containerized & Roll-on-Roll-off (Ro-Ro) cargo)
    e. Transition Zones – where people, goods & services move from water to land or vice versa
        i. Wharfs
        ii. Berths
        iii. Marinas
    f. Access & transport- for movement around and through the Facility
        i. Roads*
        ii. Rail*
        iii. Tunnels*
        iv. Bridges*
        v. Entrance Gates
    g. Intermodal yards and storage
    h. Coastal management
2. Water Locations
    a. External Waters
        i. Harbour Access
        ii. Outside Anchorage
    b. Harbour Waters

i. Harbour Channels
ii. U-Turn Waters
iii. Harbour Anchorage
iv. Basins

* These locations are referenced as forming a part of a port but are developed by the other existing BuildingSMART projects.

offshore wind turbines/platforms & subsea cables/pipelines are deemed out of scope due to them not generally forming part of a port facility and associated assets.

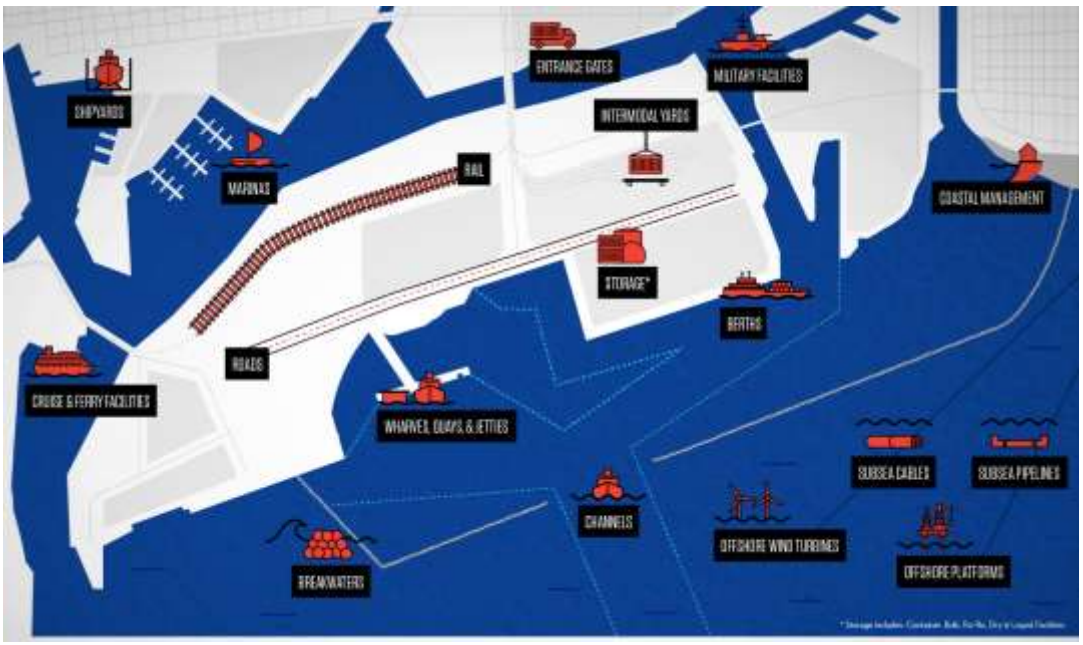

Figure 4: Harbour and port locations

Products and Physical Entities

These are the physically built components (grouped as products and systems) of a port or harbour facility this is a list of items that will be considered within the project, this is not a comprehensive list of all physical entities within a port facility.

1. Vehicles, goods & Cargo
2. Operable Equipment
    a. Locks
    b. Tidal gates
    c. Cranes
    d. Ship-lifts

3. Man-made Structures
    a. Breakwaters
    b. Quays, Jetties, piers, pontoons
4. Enhanced natural features such as geo-strengthening
5. Natural Features
6. Geology & Strata
7. Hydrology & Tides
8. Flora and Fauna

Processes

Whilst the modelling of construction and operational processes to be used are already within the existing scope of IFC, attention may be needed to the dynamics and uncertainty arising from hydrology and moving structures. Figure 5-10 demonstrate the completed and ongoing projects conducted by CCCC, which will be utilised for development, testing and validation.

Figure 5: Harbour facility (IDP, Brazil)

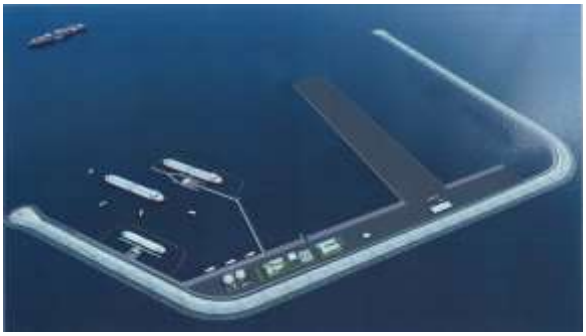

Figure 7 Offshore Deepwater Container Terminal (Venice, Italy)

Figure 6 Container Terminal (Zhuhai, China)

Figure 8 Liquid Chemical Terminal 2 (Zhangzhou, China)

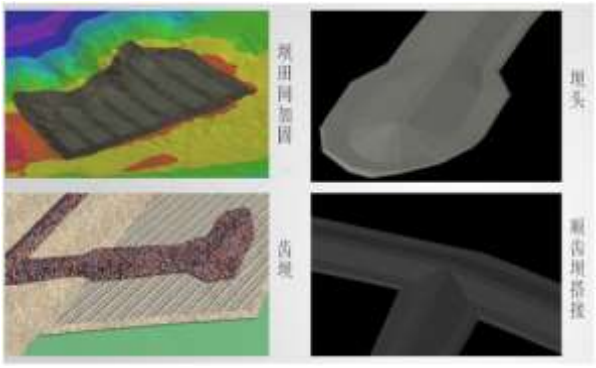

Figure 9 Waterway Dredging Project (HeiShaZhou, China)

Figure 10 Ship lock Project (Mengli, China)

6 Work Packages & Deliverables

WP0 – Project Execution Planning

Based on this project proposal presented to the Infrastructure room and feedback and comments for the BuildingSMART Infrastructure room and project steering committee a full project execution plan has to be developed, providing finalised details of work packages, deliverables, work schedule, budget plan, project team and project organisation in terms of the responsibilities, reporting structure and governance.

Tasks:	T0.1	Project Announcement @bSI Summit Barcelona
	T0.2	Organisation/Appointment of Project Team
	T0.3	Recruitment of expert panel members
	T0.4	Development of Project Execution Plan
	T0.5	Agreement of Project Execution Plan
Deliverables:	D0.1	Project Execution Plan @M0
Milestones:	M0	31.05.2016

WP1 – Requirements Analysis and Existing Review

Analyse the requirements of the planning, design, construction, operation and maintenance of a port/harbour facility. Using example models, documentation and domain experts, typical user scenarios and use cases must be captured in reference to the domain. Identification of the current content and favourable content of harbour models is required to finalize the scope of the delivered package. Existing data exchange standards that are relevant to the domain need to be taken into consideration, plus engagements with concurrent projects that have an overlapping scope. The methods of the Information Delivery Manual (IDM) are used to analyse example projects, to create process maps and exchange requirements from identified user requirements or information exchanges. Providing a documented reasoning for the development of new locational, physical and process entities, and documenting the domain specific use.

Tasks:
- T1.1 Identify and Obtain appropriate example projects and facilities data.
- T1.2 Identify initial scope of locational, physical & process entities
- T1.3 Identify User scenarios & use cases and develop associated process maps & ERs
- T1.4 Review of existing representations for consideration
- T1.4.1 Review of overall architecture & common definitions representation
- T1.4.2 Review of GML representations
- T1.4.3 Review of hydrology, tidal and operational resources
- T1.4.4 Consideration of IFC Quay for reuse (TU/e, Netherlands 2012)
- T1.4.5 EU Inspire and Rotterdam harbour project developments (Netherlands, ongoing)
- T1.5 Refinement of Scope from Reviews and Expert Engagement

Deliverables: D1.1 Requirement analysis & final scope definition @M1

Milestones: M1 31.08.2017

WP2 – IFC Schema Extension and Modelling

The scope of the modelling is defined from the outcome of WP1. A model extension will be defined as a conceptual schema using the Unified Modelling Language (UML) as a graphical representation. The corresponding EXPRESS, XSD and OWL schemas are derived from the conceptual schema. The development will be staged and incrementally improved with feedback from an expert panel. The Extension will be modelled from the baseline of the newest release available of the IFC specification (published by BuildingSMART International).

Tasks:
- T2.1 Develop Conceptual Schema – Entities Types
- T2.1. Develop additional Characteristics (property sets)
- T2.3 Develop Draft IFC extension
- T2.4 Develop Draft MVD from extension for Harbours & Ports Exchange
- T2.5 Develop Final IFC extension
- T2.6 Develop Final IFC Infrastructure for Harbours & Ports (IHP) MVD

Deliverables:
- D2.1 Draft conceptual extension @M2
- D2.2 Draft IFC extension @M3
- D2.3 Draft IFC Harbours & Ports MVD @M4
- D2.4 Final IFC extension @M5
- D2.5 Final IFC Harbours & Ports MVD @M5

Milestones:
- M2 30.11.2017
- M3 28.02.2018
- M4 31.05.2018
- M5 30.08.2018

WP3 – Documentation & Guidelines

Documentation of the main IFC extension via available tools (such as IFCDoc) and in line with BuildingSMART documentation standards and outcomes from the requirements analysis. Development of

modelling guidelines to advise in the intended and recommended application of the ports and harbours extension.

Tasks:
- T3.1 document for IFC extension
- T3.2 Develop modelling Guidelines for IFC Harbours & Ports
- T3.3 Document Harbours & Ports IDM-MVD

Deliverables:
- D3.1 Draft IFC extension Documentation @M5
- D3.2 Outline IFC Harbours & Ports modelling guidelines @M5
- D3.3 Final IFC extension Documentation @M6
- D3.4 Draft Harbours & Ports IDM @M6
- D3.5 Draft IFC Harbours & Ports modelling guidelines @M6
- D3.6 Final Harbours & Ports IDM @M7
- D3.3 Final IFC Ports & Harbours modelling guidelines @M7

Milestones:
- M6 30.11.2018
- M7 28.02.2019

WP4 – Software Deployment & Validation

Enhance the existing tools to read and write IFC Ports & Harbours data to the scope defined in the requirements analysis, for demonstration of project outcomes. Create sample datasets for demonstration and use during deployment phase. Develop IFC Ports & harbours 1.0 Deployment phase.

Tasks:
- T4.1 Extend/Develop IFC viewer software for IHP 1.0
- T4.2 author IHP 1.0 example models from examples used in WP1
- T4.3 Develop Plan for Deployment Project and Maritime Infrastructure future work

Deliverables:
- D4.1 IFC Ports & Harbours Viewer/Editor @M5
- D4.2 IFC Ports & Harbours Example Models @M5
- D4.3 Draft IFC Ports & Harbours 1.0 Deployment Plan & Future Developments @M6
- D4.4 Final IFC Ports & Harbours 1.0 Deployment Plan & Future Developments @M7

Milestones:
- M5 30.08.2018
- M6 30.11.2018
- M7 28.02.2019

WP5 – Facilitate Expert Panels and Engagement in other Initiatives

Facilitate the expert panels, via online and in person meetings to validate work as it develops. This includes regular communication updates via communication platforms. Provide engagement to the user community via communication platforms (EPR - Expert Panel Review).

Tasks:
- T5.1 Set-up & scheduling of expert panels
- T5.2 Facilitate reviews with the expert panel
- T5.3 maintenance of communication channels

Deliverables:

D5.1	EPR 0 – Project Start Discussion	@M0
D5.2	EPR 1 – Requirements & UCs	@M1
D5.3	EPR 2 – Validate Conceptual Schema	@M2
D5.4	EPR 3 - Validate Draft IFC extension	@M3
D5.5	EPR 4 – Review of IHP MVD	@M4
D5.6	EPR 5 - Validate Final IFC extension & MVD	@M5
D5.7	EPR 6 – IFC Docs & modelling Guidelines	@M6
D5.8	EPR 7 – Project Review	@M7

Milestones: M0 to M7

WP6 – Project Management

Manage the Development work of the project, including reporting to the steering committees according to Figure 3. Author quarterly reports on project and inform stakeholders of developments. Engage with the infrastructure room project steering committee project representative. Organise any collaboration with other projects (such as Common Definitions Project) and invested organisations (such as OGC in regards to GML).

Tasks: T6.1 Project Management (Reports, bSI representation & Manage Engagements)

Deliverables:

D6.1	Publish Candidate and final standard	@M7
D6.2x	Quarterly project progress reports	@Mx
D6.3x	Project Final Event/Presentation @BSi Summit	@M8

Milestones: M8 1.04.2019

7 Schedule

Planning & mobilization April / May 2017

Start: 1st June 2017

Estimated Finish: April / May 2019

The project is expected to commence in June 2017 and Run for 2 years.

Milestones:

M0	31.05.2017
M1	31.08.2017
M2	30.11.2017
M3	28.02.2018
M4	31.05.2018
M5	30.08.2018
M6	30.11.2018
M7	28.02.2019
M8	01.04.2019

Document id	Title	Organisation / Author	Date	Status
OMI-PB-0001 | HP001	Harbours & Ports Project Proposal	CU/AB, HJ; AEC3/NN; CCCC/SL	2017-03-24	V02- Shared

Annex I : Project Time Plan

ID	Task Name	Start	Finish
0	**IFC Infrastructure for Harbours & Ports (IHP)**	**Mon 03/04/17**	**Fri 05/04/19**
1	**WP0 - Project Execution Planning**	**Mon 03/04/17**	**Wed 31/05/17**
7	M0 - Planning Complete (Project Start)	Wed 31/05/17	Wed 31/05/17
8	**WP1 - Requirements Analysis & Review**	**Thu 01/06/17**	**Thu 31/08/17**
19	M1 - Requirements & Scope Complete	Thu 31/08/17	Thu 31/08/17
20	**WP2 - IFC Schema Extension & Modelling**	**Fri 01/09/17**	**Fri 31/08/18**
30	M2 - Conceptual Extension Complete	Thu 30/11/17	Thu 30/11/17
31	M3 - Draft IFC extension Complete	Wed 28/02/18	Wed 28/02/18
32	M4 - Draft IHP MVD Complete	Thu 31/05/18	Thu 31/05/18
33	**WP3 - Documentation & Guidelines**	**Thu 31/05/18**	**Sun 31/03/19**
44	**WP4a - Software Validation**	**Thu 19/04/18**	**Fri 31/08/18**
47	**WP4b - IHP 1.0 Deployment Plan & Future Developments**	**Mon 15/10/18**	**Thu 28/02/19**
50	M5 - final extension & MVD, draft docs Complete	Fri 31/08/18	Fri 31/08/18
51	M6 - Draft Guidelines, Final Docs Complete	Fri 30/11/18	Fri 30/11/18
52	M7 - All Deliverables Complete	Thu 28/02/19	Thu 28/02/19
53	WP5 - Expert Panels & Engagements	Tue 01/08/17	Thu 28/02/19
54	**WP6 - Project Management**	**Thu 01/06/17**	**Fri 05/04/19**
56	M8 - Project Presentation Close Out	Fri 05/04/19	Fri 05/04/19