20th of March 2019

(Concept Note #21)

PortCDM: Validation of the concept and next steps

by

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Introduction

The concept of Sea Traffic Management (STM) was developed by a number of European partners within academia, governmental bodies, and industry as part of EU-financed research and innovation projects. Its purpose is to create a safer, more efficient and environmentally friendly maritime sector by connecting and updating the maritime world in real time, through digital data exchange. STM is intended to overcome many of the existing challenges of communication and data sharing between stakeholders in the maritime transport industry. It is expected to create significant added value for the maritime transport chain, in particular for ship and cargo owners as well as port actors.

The STM Validation Project was set up in 2015 to demonstrate the concept in large-scale test beds in both the Nordic and Mediterranean Seas. The intention was to test and validate the key strategic enablers of STM over a nearly three-year period that has just ended. The project intended to involve about 300 ships, 13 ports, five shore-based service centres, and 13 connected simulator centres.

Validation was sub-divided in to five sub-activities or focus areas:

1. **Port Collaborative Decision Making** (PortCDM) - the use of improved data sharing, increased situational awareness, more efficient processes, and enhanced collaborative decision making during port calls to increase the efficiency of port calls for all stakeholders.
2. **Voyage management** - the provision of support to individual ships in both the planning process and during a voyage, including route planning, route exchange, and route optimisation services.
3. **Maritime Simulator Network** - the use of the European Maritime Simulator Network (EMSN) and the test beds for Voyage Management, both to simulate varying traffic conditions and to further test and validate other parts of STM that were not possible to test and validate in real life at this stage, such as area management.
4. **Maritime Service Infrastructure** - the use of a common Maritime Service Infrastructure using System Wide Information Management (SeaSWIM) to facilitate data sharing in the validation test beds using a common information environment and structure (such as the *Maritime connectivity platform*).
5. **Analysis & Evaluation** – consideration of many aspects of the future changes: business, socio-economic, risk, technological, legal, and institutional including competencies and training requirements for STM implementation.

Activity 1 - PortCDM testbeds concluded in the first half of 2019. Over a three-and-a-half-year period, the PortCDM concept was validated in nine ports clustered into two testbeds - the Mediterranean and the Nordic testbeds. A comprehensive report on the validation of PortCDM has been delivered within the STM

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validation project. [1] This concept note provides a summary of the results, conclusions, and recommendations.

The practical validation of PortCDM

Under the auspices of the STM validation project, PortCDM was validated in four of the ports in the Mediterranean testbed (Limassol, Sagunto, Valencia, Barcelona) and five ports in the Nordic testbed (Gothenburg, Brofjorden, Vaasa, Umeå, Stavanger). More than 80 different organizations involved in port calls across these ports participated.

During the PortCDM validation activity, port call actors shared data during at least two *focus months* in accordance with the principles of PortCDM. This was done as part of the normal operation of the various ports including the vessels participating in the project. Several specially developed software applications and a dedicated platform for sharing PortCDM data, such as ETAs and ETDs, were made available. In all, over 1.7 million records were shared successfully.

Some of the ports went beyond the *focus months* and used the PortCDM concept more or less continuously. Several are preparing to adopt the principles of PortCDM as a permanent operating practice, which is an overwhelming endorsement of the concept and heralds the beginning of the operational implementation of PortCDM.

Why PortCDM?

In today's connected world, greater cooperation within and across markets is necessary for survival. Almost all airlines collaborate in alliances and work closely together, for example setting up code-share flights, even in a very competitive environment. Without collaborative decision making, well connected airports would not be able to meet the demands in the aviation transportation chain. Collaboration in the car industry results in vehicle designs being shared between competitors. To remain competitive the maritime transportation chain must work similarly.

Maritime transport is a highly distributed ecosystem. In some cases, up to 40 different and economically independent actors might be involved in one maritime supply chain. The current low levels of coordination often disappoint charterers and other customers, because they experience greater variability of arrival, especially when compared to other options such as air transport. The reliability of container ships arriving or discharging cargo within one day of the original estimate is below 70%, and far too often, multiple days of delay are experienced. In the multimodal full supply chain such a level of performance becomes increasingly unacceptable. In addition, goods owners, and shippers are increasingly demanding transparency of the status of goods in the specific section of the logistical chain. The pressure of maritime transport for data sharing to support full transparency across all sectors of the supply chain is growing.

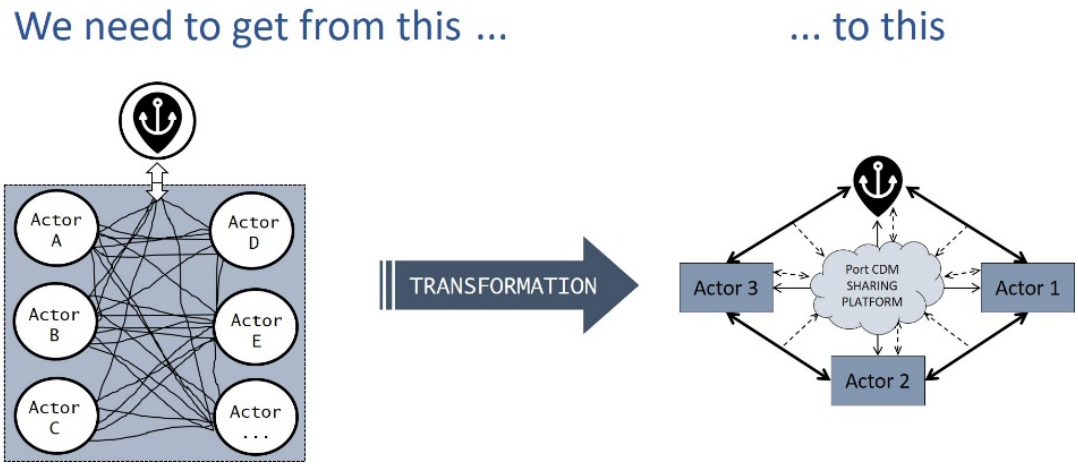
The air transport sector has led the way in successfully working collaboratively through data sharing. Activities are better synchronised and more dependable than in the maritime transport chain. Airport Collaborative Decision Making (A-CDM) is now well established. So much so, that PortCDM, like STM itself, is a concept inspired by the advances made in the air transportation sector. It is not surprising that the

[1] Lind M., Haraldson S., Ward R., Bergmann M., Andersen N-B., Karlsson M., Zerem A., Olsson E., Watson R., Holm H., Michaelides M., Evmides N., Gerosavva N., Andersen T., Rygh T., Arjona Arcona J., Ferrus Clari G., Gimenez Maldonado J., Marquez M., Gonzalez A. (2018) Final PortCDM concept description incl. generic specification of identified services - Improving port operations using PortCDM**,** STMVal_D1.3, *forthcoming report*

collaborative decision-making concept is now also beginning to be embraced by the rail transport sector.

What is PortCDM?

PortCDM operates on the principle of sharing relevant port call data between ships and all relevant port call operators, mainly through standardised timestamps and related metadata to create a joint situational awareness. This means that all port call actors know about the plans and the progress or changes to events under the control of other actors. In doing so, all actors can better adjust their plans and actions by knowing and accommodating the constraints or changes to the plans of others both upstream and downstream in the maritime transportation supply chain. In doing so, more dependable planning and synchronisation occurs and there is more efficient use of resources, ultimately resulting in better customer satisfaction and enables increased transparency for the clients.



From unstructured to structured data sharing for enhanced efficiency in port call operations

As well as improving the port call process, standardised data sharing under PortCDM also allows the optimisation of the sea voyage between port calls, as ships get information on when a port can best serve them and this allows them to sail "*just-in-time*" to reduce fuel consumption and lower their environmental footprint.

PortCDM supports the port call optimisation process by promoting:

- The extension of the planning horizons through intra-port collaboration, ship-to-port collaboration, port-to-hinterland collaboration, and inter-port collaboration
- The sharing of the timing of future events for the coordination of the port call process
- The combination of multiple sources of data for enhanced predictability
- Shared situational awareness by sharing data on the progress of a port call among internal and external involved actors

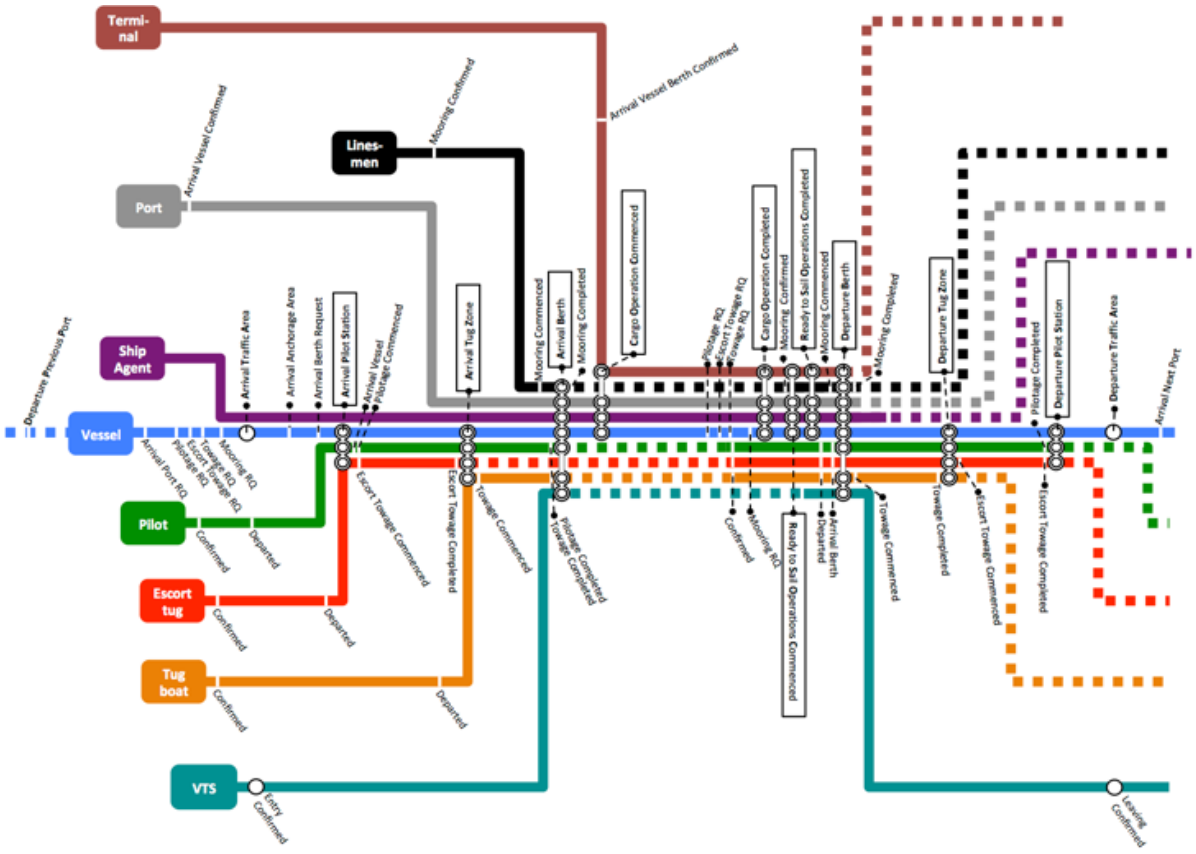
More detailed information on various aspects of PortCDM can be found in the series of previously published concept notes posted at STMValidation.eu and/or www.ipcdmc.org.

The validation process

The fundamental baseline used to validate the PortCDM concept has taken the prior absence of a collaborative port call process and identified the impact of introducing it. This was done firstly by getting all

the participating port call actors together in workshops based on the *living labs* principles,[2] where they gained an understanding of each other, how things operate at present, and how and where they have inter-dependencies. In many cases, the interactions and discussions in the *living lab* workshops were the first time many of the actors had met or communicated directly with each other - a telling example of the existing lack of collaboration or synchronisation.

As well as providing valuable feedback and ideas about PortCDM, a key activity of the *living labs* workshops in each port was to develop an organisational *metro map* that identified the actors, their functions, their interdependencies, and the pinch points in the port call process. This leads to a better understanding among the various actors of how the actions or timetable of one actor affects another – and where collaboration and synchronisation are critical to efficiency.



Typical *metro map* showing status and coordination points in a port call process[3]

Following a workshop, participants put the principles of PortCDM and data sharing into practice during their normal port call activities over at least two separate *focus months*. The data sharing was done as part of normal operational activities, which included the various ships that were participating in the validation. Software, including both fixed and mobile apps, were provided to the actors to enable data sharing. Over

[2] A **living lab** is a research concept. Its philosophy is to turn users, from being traditionally considered as observed subjects for testing modules against requirements, into value creators by contributing to the co-creation and exploration of emerging ideas, breakthrough scenarios, innovative concepts and related processes.

[3] Lind, M., et al., *Overcoming the inability to predict - a PortCDM future*, in *10th International Harbour Masters' Association Congress – Global Port & Marine Operations*. 2016: Vancouver, Canada.

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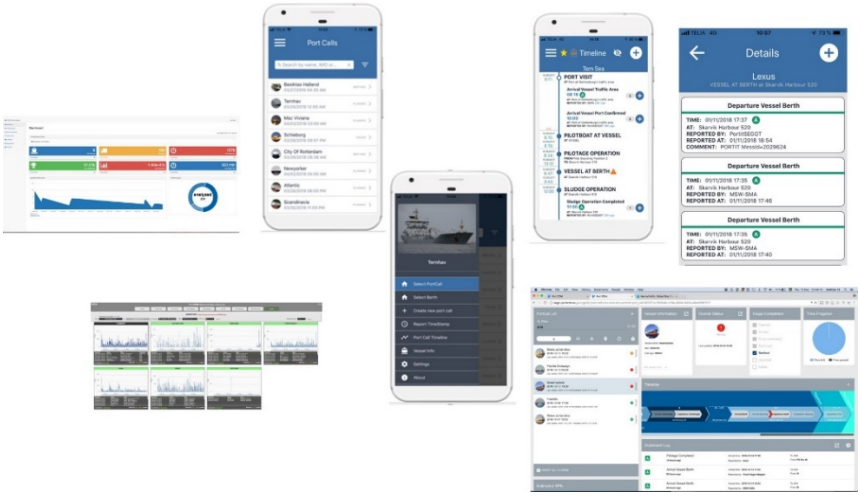
1.7 million records were shared successfully. The software package, working as the PortCDM demonstrator, consisted of back-end and front-end services.



Web-based apps and API's were developed and available for data sharing during the project

Throughout the validation period, feedback and suggestions were provided through the *living labs* workshops, questionnaires, and interviews. The results were used first during the validation period to refine and improve a number of the PortCDM principles, as well as to define extensions to the S-211 data exchange standard to accommodate data parameters identified as a result of practical experience during the *focus months*. The feedback, questionnaire, interview results, and the message statistics were analysed at the end of the validation project to determine if the claims of PortCDM were actually valid.

Results

The results of the PortCDM validation project show that the participants overwhelmingly considered that the enhanced situational awareness provided by data sharing following the principles of PortCDM is valuable. Any resultant increase in the reliability of ETAs and ETDs for port actions was seen as providing substantial benefits.

The results show that most participants agreed that PortCDM will encourage closer collaboration between actors by exposing the benefits of data sharing. There was clear agreement among participants that the success of PortCDM is dependent on each actor sending and receiving relevant and timely data to enable all actors to coordinate their actions. However, overcoming the culture of data protectionism may still be a challenge for some. While all actors welcomed access to the key elements of the plans and the progress of others, a few were more reluctant to make their own situation known, primarily driven by a fear that others may gain a competitive advantage.

The actors agreed that enhanced situational awareness, enabled by PortCDM data sharing, provides them with access to more reliable data and a greater appreciation of other actors' intentions, leading to positive effects for operations, including:

- making better estimates for ETAs and ETDs (100% of respondents agree 'to some extent' or 'more' with this conclusion)
- improved work procedures (> 50 % agree to some extent or more)
- reduced time spent on information gathering (> 80 % agree to some extent or more)

- reduction of administrative workload (> 80 % agree to some extent or more)

What was clearly indicated through the various feedback mechanisms used in the validation project was that the introduction of PortCDM is strongly supported. No significant adverse criticism was reported - any negative comments were generally aimed at improving what was presented during the validation period. Overwhelmingly positive benefits were identified by the ports and the actors who participated in the validation project. A number of the ports intend to continue and build upon the PortCDM concept introduced as part of the validation. As a result, there is high confidence in recommending the establishment of standardised data sharing environments within and between ports as an essential step on the path towards increased efficiency and sustainability of the port call process as part of the maritime transportation chain.

The PortCDM validation project showed clearly that:

- *the Port CDM concept and digital data sharing provide significant positive benefits by enabling port call actors to plan, coordinate, and synchronise activities more efficiently and giving rise to enhanced and more efficient overall port call performance;*
- *the basic doctrine, procedures, and standards for PortCDM have reached a level of maturity that enables them to be used as the foundation for the global implementation of PortCDM*

Port CDM requires changes in attitude as well as procedures

As stressed consistently in earlier reports and concept notes on PortCDM, PortCDM is not simply a technical enabler for sharing port call data based on the standardised data exchange format. Importantly, PortCDM is a new and innovative operational concept that suggests and requires a change to the collaboration culture within ports and among ports, among ports and shipping companies, and among ports and hinterland operators, so as to build the necessary operational and cultural foundation for efficient use of resources. It stresses data sharing, collaboration, and synchronisation. This requires attitudinal changes among many of the actors in the maritime transportation chain and was put to the test during the validation project. In particular, reluctance to share key data must be overcome. To support this, a minimalistic message format was developed, giving rise to S-211, which enables port call actors to share non-competitive data in a standard format.

The validation process made significant efforts to foster the required changes in attitude and the ways of interacting between the various actors. In particular, the use of the *living labs* process was most successful in getting the actors to appreciate the constraints, perspectives, needs and motivation of others in their chain, the mutual benefits of having a common situational awareness, and the impact of the actions of one actor on another. This had a significant effect in reducing the traditional tendency to restrict the sharing of data and is reported as enhancing collaboration and enabling a better understanding of the overall situation leading to more effective individual operations. However, as already reported, a minority of the participants remain sceptical.

PortCDM Maturity Levels

It is clear that it is not possible for any port to achieve all the functionalities of PortCDM in a short time span. Furthermore, it is to be expected that different ports (or even terminals in a port), will adopt PortCDM in an incremental way.

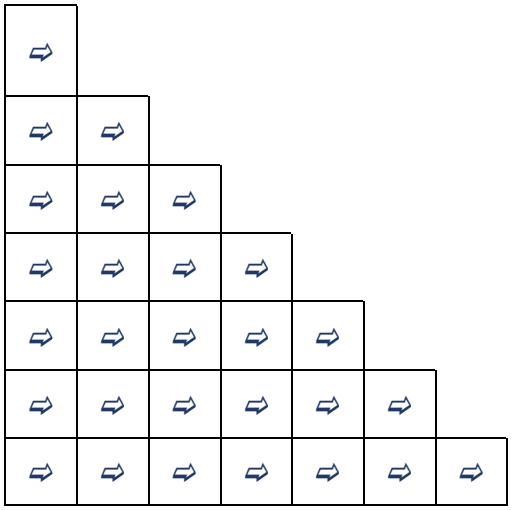
Accordingly, it is relevant to have a framework for identifying the maturity level of a particular port (or part of a port) in terms of the adoption of the PortCDM functionalities. We developed such a framework in an

earlier concept note 13[4]. The overall purpose of such a maturity framework is to both communicate expectations on the collaborative capabilities of the port as well being a guidance for what is required to reach different level of maturity.

Determining the maturity level for a particular port takes into account the infrastructure for collaboration and local/global integration in terms of (1) the network effectiveness of the many individual competing and collaborating port actors, (2) infrastructural and technical capabilities, and (3) capabilities for individual actor collaboration.

The basic requirement is that the port and its actors can receive and use digital data, in other words, that they have established capabilities, based on the port call message format (PCMF) according to the S-211 standard. This foundational capability is the basis for developing the maturity levels of PortCDM. This enables both internal (local) and external (global) port collaboration, thereby expanding planning horizons and enabling each to inform down-stream actors about progress and possible disruptions using a standardized format.

The seven levels of maturity are visualized in the following figure. Progression moves through the levels from the foundational capabilities (levels 1 and 2) to the use of digital instant message-sharing among all port call actors (levels 3 to 5), to the continuous improvement enhancing effectiveness and also competitiveness of a port (levels 6 and 7).



1. Individual **capabilities** to share timestamps using the PCMF
2. PCMF sharing **platform** established for all to share
3. PCMF data shared among **core** port call actors
4. PCMF data shared among **all** port call actors
5. PCMF data shared with **outside** actors
6. PortCDM **principles** utilised
7. Continuous **improvement** processes implemented

PortCDM maturity levels

Assistance from the International PortCDM Council

Building on the consistently favourable support of PortCDM from the participants of the validation project, a range of strategies to promote PortCDM and to encourage the operational implementation of PortCDM globally was developed as part of the project.

The International PortCDM Council (IPCDMC), comprising representatives from all the key actors and stakeholders in the maritime transportation chain, was originally established as a support mechanism for the validation project to collect advice on common procedures, standards, data formats, guidelines and

[4] Lind M., Andersen T., Bergmann M., Watson R.T., Haraldson S., Karlsson M., Michaelides M., Gimenez J., Ward R., Bjørn-Andersen N., Gonzales A., Holmgren B., Zerem A., Rauer F., Sahlberg H., Lindberg J. (2018) The maturity level framework for PortCDM, Concept Note #13, STM Validation Project

guiding principles. It now stands ready to provide governance and coordination for the implementation of PortCDM at the local, regional and global level. The IPCDMC oversees and maintains the S-211 standard and contributed to the development of a strategy for incremental implementation of PortCDM, based on a six-tiered approach that enables ports and their actors to implement PortCDM in a flexible way, from a basic level to a comprehensive level, according to a particular port's situation, capabilities and requirements. A complementing monitoring framework was also defined, based on several Key Performance Indicators - *duration time*, *waiting time*, *berth productivity*, *capacity utilisation*, *predictability*, and *punctuality*. These KPI's are purposely based on output performance not on the size or complexity of the infrastructure that supports PortCDM.

While the IPCDMC is not seeking to define how PortCDM should be implemented in any given port or in a region, it can provide the necessary over-arching guidance to ensure that any of the implementations meet the overall aims of PortCDM and therefore serve the needs of sea traffic that moves from port-to-port, country and continent. More details of the IPCDMC and how to participate can be found at *www.ipcdmc.org*

Next steps towards the general implementation of PortCDM

PortCDM has now been validated and the key building blocks are now available to enable its operational implementation around the world; in particular:

- A PortCDM maturity model that provides the flexible pathway for incremental implementation of PortCDM, according to each port, its scope and its circumstances
- An International PortCDM Council that stands ready to provide governance and coordination for the implementation of PortCDM at the local, regional and global level
- The S-211 Port Call Message Format for data sharing, which is fully e-navigation compatible and interoperable
- Development of foundational apps and APIs for developing third party service applications
- The demonstrated use of the *living labs* process to ensure that all involved actors are informed and engaged in any PortCDM implementation
- The practical value of a *metro map* for each port to identify the key areas and actors where data sharing is essential to overall improvement

Based on these building blocks, those actors that now wish to move towards the widespread use of PortCDM should consider the following next actions:

- ensure that the digital data reporting mechanisms being used in your business become increasingly interoperable with the S-211 data exchange format
- discuss the mutual benefits of PortCDM with the other actors in your locality
- discuss the mutual benefits of PortCDM with the other actors in your profession or business
- help to establish a local "PortCDM community" to bring all the interested actors together
- participate in the IPCDMC either as a participant or an observer

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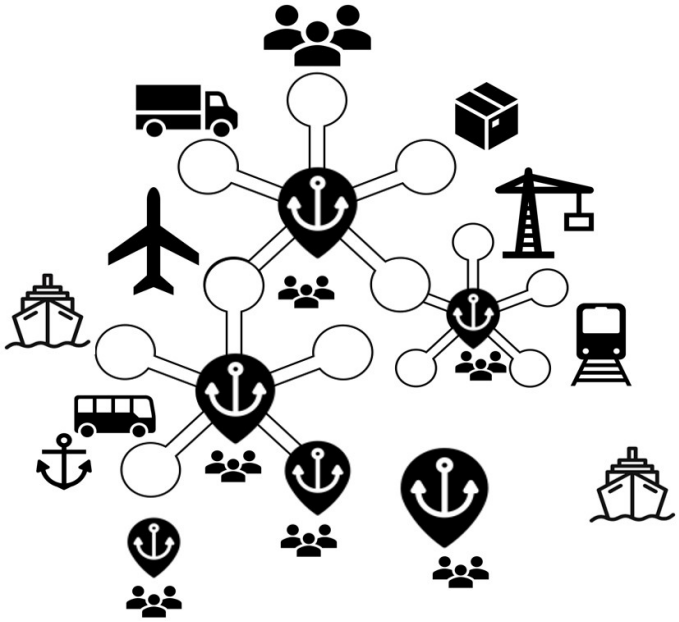

The data sharing, collaborative, synchronised vision for PortCDM

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Detailed information on various aspects of the PortCDM concept can be found in the series of previously published concept notes posted at www.stmvalidation.eu and/or www.ipcdmc.org.

STM connects and updates the maritime world in real time with efficient information exchange. In the 60s the standardised container revolutionised shipping. The next revolution is the containerisation of information – creating a safer, more efficient and environmentally friendly maritime sector.

Published in cooperation with Fathom.World

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