

## Achieving compliance in collaboration and data sharing with PortCDM

by<sup>1</sup>

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### Introduction

Port Collaborative Decision Making (PortCDM) has been developed for the maritime sector as an enabler of Sea Traffic Management (STM) as well as being an enabling boundary concept connecting maritime transports to the overall supply chain. The overall objective of PortCDM is to enable enhanced coordination and just-in-time port call operations through collaboration and data sharing. For ships, this would mean just-in-time arrivals, just-in-time departures, just-in-time operations and shortened turnaround times providing optimal utilization of a shipping companies assets (e.g. ships and crew) and the port infrastructure. It also allows actors to optimize utilization of their time and assets. For each port call operator that serves the port call process, this requires that operations can be performed either in sequence or in parallel, as required. The aim being to achieve minimal waiting times between each operation covering the full process from a ship arriving in the port area to it leaving the port area after completing the purpose of its call. The same goes for a hinterland carrier paying a visit to the port. Ports, similarly, gain efficiency benefits through better utilization of assets based on more predictable and reliable planning and execution of the various port call activities.

This short document outlines the maturity model<sup>2</sup> for the general implementation of PortCDM, highlighting how the different actors in a port should scale the maturity ladder to reach higher levels of collaboration and thereby reap the full benefits of PortCDM. This concept note expands upon the earlier concept note #13 on the PortCDM maturity model. It also indicates that within a given port particular logistical segments may be chosen to lead an implementation; for example, starting with the container or passenger sector before migrating towards including others.

### PortCDM

PortCDM, which has been designed and tested/piloted as part of the MONALISA 2.0 and STM Validation projects, enables a holistic view, higher transparency, enhanced situational awareness and higher harmonization of operations. This is achieved by having the following in place:

- Time stamp data collected from multiple sources associated to the same port call as well as voyage identifiers to present the most correct view
- A unified format for port call messages (the port call message format - S-211)

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<sup>2</sup> 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 (also presented at IHMA 2018)

- A set of globally defined KPI's<sup>3</sup>
- A system of indicators and warnings enabling port call actors to coordinate actions and manage disruptions (e.g. due to missing data, conflicting data, breakdown of communication, and unavailability of reactions)<sup>4</sup>
- A governance structure at the global, regional, and local (port) level:
  - Global: A framework specifying the necessary minimum requirements to ensure that key objectives are met, defining global standards, guidelines and compliancy indicators ensuring international harmonization and interoperability
  - Regional: A specification of the common ground and agreements within a region (e.g. adapting to regional legal conditions), which is built upon the global governance structure by further defining
  - Local: A more detailed implementation as needed locally in each port, which is compliant with the overarching global and regional framework

### Harmonization

Successful PortCDM fosters two levels of harmonization and collaboration; the local level, emphasizing necessary alignments and data sharing between port call actors within a specific port or port section; and the global level, emphasizing necessary alignment and data sharing between ports and their external stakeholders in the global maritime transport chain.

### Collaboration Arenas

The figure 1 indicates, in no particular order, the four primary arena<sup>5</sup> for PortCDM collaboration and data sharing:

- port operations
- pre-sailing and pre-arrival planning and timing
- port and hinterland transport planning, and
- port-to-port information exchange.

The last two collaboration arenas are of particular importance in short-sea shipping

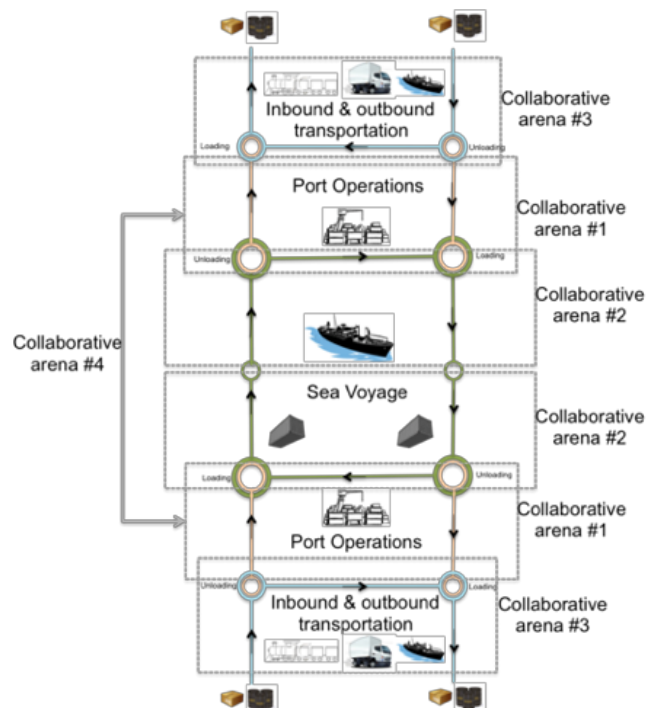


Figure 1: The four collaboration arenas assisted by PortCDM

<sup>3</sup> The KPI's of PortCDM are: Duration time, waiting times/anchoring times, predictability, punctuality, berth productivity, and capacity utilization (c.f. Lind M., Haraldson S. (2016). New KPIs will show how ports become more efficient with PortCDM, STM Validation project

<sup>4</sup> Lind M., Rygh T., Bergmann M., Watson R.T., Haraldson S., Andersen T. (2018) Balancing just-in-time operations – coordinating value creation, Concept note #6, STM validation project

<sup>5</sup> Lind, M., Haraldson, S., Karlsson, M., & Watson, R. T. (2015) *Port collaborative decision making – closing the loop in sea traffic management*. Paper presented at the 14th International Conference on Computer Applications and Information Technology in the Maritime Industries, Ulrichshusen, Germany.

enabling downstream ports to enhance their planning horizons.

Each arena represents the forum and the discussion themes that engage particular actors that are obliged to collaborate to reach particular outcomes in that arena. This collaboration can be both analogue (paper-based) and/or digital. The recent PortCDM validation project highlighted the benefits of initial face-to-face discussion as a means of establishing trust in planned digital collaboration. This can be achieved through the establishment of a local “PortCDM community” to bring all the interested actors together.

### **The operational and technical dimensions of port call operations**

PortCDM covers both the technical and the operational dimensions of port call operations. PortCDM compliance must address both aspects.

- Operational compliance is concerned with inter-organizational processes. It covers the operational prerequisites and procedures for internal and external collaboration and harmonization. In other words, collaboration and harmonization within the port and between the port and shipping companies/ships, other ports, and hinterland operators. The following goals are associated with operational compliance:
  - Standardized processes for collaboration and interaction established for internal (within the port community) and external collaboration
  - Internal processes within each participating organization established for external collaboration
  - Agreement among collaboration partners on what information is to be shared and that which cannot be shared because of competitive reasons
  - Agreement within the port community on the goals for the common object of interest (being the successful use of PortCDM) expressed through KPI's that monitor the coordinated port call process
  - Established procedures on what information to share and at what time, including agreement on the appropriate responses to be made to actions taken by others
- Technical compliance is concerned with the level of usage of maritime service infrastructures. It covers the level of data sharing capabilities such as the usage of universal message formats and interfaces, platforms for instant messaging, as well as tools for providing common situational awareness. The following goals are associated with technical compliance:
  - Unified message formats enabling sharing of port call data as part of PortCDM
  - Technical interfaces established for data sharing
  - Automatic sharing of event data in real-time (or near-real-time)
  - Tools for common situational awareness in use among participating actors

### **PortCDM Compliance**

During the implementation of PortCDM, each port defines its specific conditions and how PortCDM will be implemented given the local conditions. The result of this work is expected to be a local PortCDM Compliance Document (CD) that, among other things, defines which port call actors are classified as “core actors”, given the local conditions. The CD will detail the local PortCDM implementation thereby enabling a relevant notified body to certify the PortCDM implementation in accordance with the CD and the overall principles

of PortCDM.

If applicable the CD will also need to take into consideration regional specifications for PortCDM, for example, a particular regional authority may have introduced specifications to support PortCDM in its jurisdiction. Notifying bodies would consider those documents as well, where they exist and are applicable.

More details on the Compliant Document and examples will be provided in a subsequent Implementation Note.

### PortCDM Maturity Levels

In order to support the implementation of the PortCDM concept both from an operational and a technical compliance perspective, a maturity level model has been devised. This model allows for incremental compliance with the generic service specifications in accordance with the needs and desires of each individual actor in a port implementing PortCDM. It also indicates to outside actors which level of PortCDM services individual actors currently support. The maturity level model takes into account the fact that most ports can be regarded as a self-organized maritime ecosystem, where each actor unilaterally decides when and how to implement higher levels of maturity of their own operation. It also recognizes that there can be big differences between how well these ecosystems may be functioning and how much coordination between independent actors that is available.

The incremental implementation reflected in the PortCDM maturity model mirrors how digital capabilities are being implemented for other aspects of maritime operations. One example is the approach to digital maturity being pursued by the port of Rotterdam and described in the white paper '*Move forward: Step by step towards a digital port*'. Other ports are also moving in the direction envisaged by the PortCDM concept. Singapore's *Just-In-Time* initiative or Hamburg's increased digitalization work are further examples. Other actors involved in maritime transport are progressing in a similar fashion, such as Maersk with its *Pit Stop*<sup>6</sup>

In the PortCDM maturity level framework, seven levels of maturity<sup>7</sup> have been defined. Each maturity level is considered as a particular state at which both operational and technical capabilities exist for a port community. Reaching the various levels then becomes the implementation target for local governance of a port, individual port call actors, and systems/service/tool providers. In turn, they can be used to indicate what a port and its actors have implemented and as such, what can be expected by others, such as other ports and ships/ship operators that are not part of that particular PortCDM implementation.

In an ideal and full implementation the maturity model assumes that each level includes all the lower levels; in other words, level 7 will also include all the other levels from 1 to 6. The model caters both for an incremental implementation in a port as a whole or in a port on a sector-by-sector basis, as is described briefly later in this note.

On level 1, the standard S-211 port call message format (PCMF) is being used for submission and the consumption of time stamps by the port actors using standardized interfaces. The necessary input from ships could be received by S-211 data exchange or by other means, e.g. if the ship isn't equipped with S-211 capable systems. On this foundational level coordination is limited but PCMF data still enables each actor

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<sup>6</sup> <https://www.maersk.com/en/news/2018/06/29/the-quest-for-the-perfect-pit-stop>

<sup>7</sup> Lind M., Andersen T., Bergmann M., Watson R.T., Haraldson S., Karlsson M., Michaelides M., Gimenez J., Ward R., Andersen N-B., 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

to connect to others for the purpose of sharing data, such as key time stamp data.

On *level 2*, a data-sharing platform has been established within the port for exchanging PCMF compliant timestamps. This is used for port actors who agree on sharing and consuming timestamps instantly and in real time. Here, operational aspects are being shared amongst the participating actors on a defined level of collaboration guided by the sequence of events that constitute a port call<sup>8</sup>.

On *level 3*, core port call actors<sup>9</sup> are sharing timestamp data using the PCMF with tools that provide a common situational awareness. These data are used to ensure that all actors involved share the same view regarding ongoing and future port calls. Sharing a common view manifests itself in closer collaboration and operational interactions for improved operational efficiency.

On *level 4*, communication with actors outside the port (ship-to-port, port-to-port, and port-to-hinterland) has been enabled. PCMF compliant standards are being used throughout. The utilization of data sharing between the port and external actors means that all port actors can take into consideration the concerns and circumstances of players external to the port and integrate their input into evolving operational plans. External actors can also be advised automatically when plans related to the port's capabilities are changed.

On *level 5*, all actors<sup>10</sup> within the port are following the PortCDM principles of access management<sup>11</sup> using a common data sharing platform for sharing and consuming timestamps related to all states that constitute the port call process. The data are shared through machine-2-machine (M2M) or EDI connectivity. Such connectivity builds upon the use of the PCMF format. This level of technical compliancy increases the ability for closer operational collaboration. As all actors are involved, any aspect of a given port call can be covered in the collaboration efforts, further improving the reliability of shared data.

On *level 6*, port call operations are fully coordinated to enable collaborative decision-making. All stakeholders represented in a port have agreed to use PortCDM for optimal planning of port calls as well as for taking initiatives if and when required to change existing plans in order to obtain more overall optimal port operations. This is based upon a holistic view of the port call as opposed to individual decision-making based upon optimizations of the situation of each individual actor.

On *level 7*, the port is using the PortCDM key performance indicators (KPI's) and their own local defined KPIs to measure and continually improve port call operations through innovations, taking all aspects of the lower levels into account.

The seven levels can be summarized as follows:

Level	Short description	Details
1	Basic foundation	Capabilities to share of timestamps (PCMF)
2	Real-time data sharing	PCMF sharing platform established

<sup>8</sup> Lind M., Haraldson S., Karlsson M., Watson R.T. (2016) Overcoming the inability to predict - a PortCDM future, 10th IHMA Congress – Global Port & Marine Operations, 30th May – 2nd May 2016, Vancouver, Canada

<sup>9</sup> Core port call actors are the ones that are essential to bring a ship to/from the berth place, such as VTS, port control, pilot operators, tug operators, linesmen, ship agents, and terminal operators, and port authorities

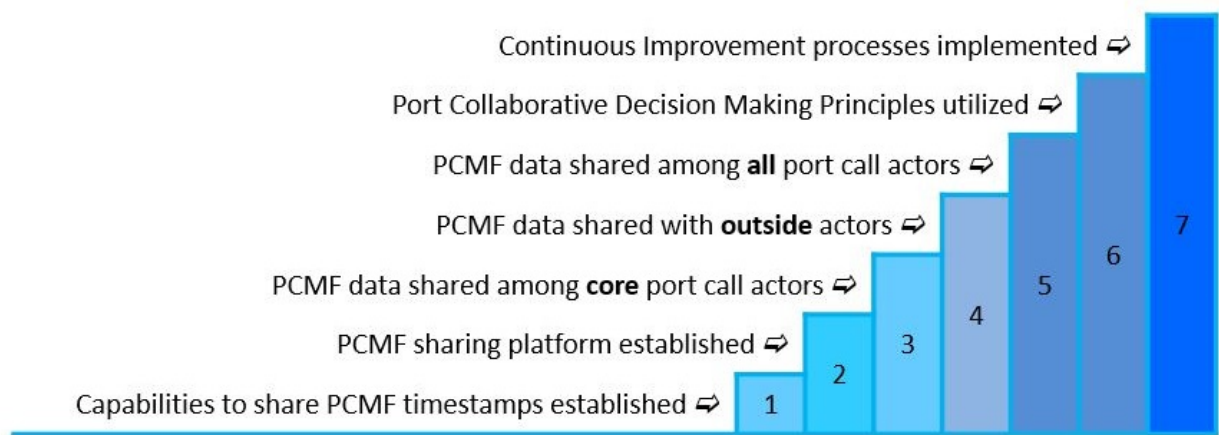
<sup>10</sup> This would complement with more actors that are engaged in the port call process, such as different service providers (waste, bunkering, sludge, slop, water etc.) as well as to actors in more detail related to the purpose of call (e.g. security, surveyors, customs, tour operators etc.) engaged when ships are at anchor and/or berth.

<sup>11</sup> PortCDM promotes the adoption of the access management principle of 'need to know'. This means that some operations, e.g. not all aspects of cargo operations might be available to all, while time stamps of initiation and conclusions of the operations are shared among everyone. In this way, events within cargo operations are just shared between the actors directly involved.

3	Core port call actors included	Core port call actors share PCMF data
4	Outside actors included	PCMF sharing with outside actors established
5	All port call actors included	All actors are using real time PCMF data sharing
6	All actors use CDM	Actors use full Collaborative Decision Making
7	Continuous Improvement	Actors use continuous improvement processes

**Table 1: Definition of the seven layers of maturity in PortCDM**

The following figure 2 shows how the different maturity levels build upon each other:



**Figure 2: The seven-step maturity framework**

### Compliance of port actors in meeting the PortCDM maturity levels

The remaining part of this concept note will elaborate on the PortCDM maturity model and the operational and technical compliance objectives in relation to the different collaboration arenas.

PortCDM compliance is first and foremost about the extent to which an organization has established the capabilities necessary to make sure that all its operations in dealing with other organizations are in compliance with minimum standards or level of service that have been agreed previously. However, the second objective of compliance is to be able to communicate the achieved level of compliance to external actors in order to reinforce expectations, trust, collaboration and openness.

To ensure that the expectations of all PortCDM participants can be properly met, detailed criteria for the different maturity levels have been developed. The criteria are related to operational and technical capabilities required to operate in the identified collaboration arenas in order to achieve “just-in-time” operations.

The various maturity levels for PortCDM should not be confused with the capabilities or professionalism at a given port; they simply identify within defined specifications, which level of implementation of PortCDM a given port has established. In this way, PortCDM implementation can be seen as an incremental process putting focus upon both operational capabilities of collaboration as well as on technical capabilities on data sharing and the establishment of common situational awareness enabling each actor to coordinate and synchronize its plans in relation to others.

Each maturity level can be seen as an implementation phase of PortCDM, where some actors charge ahead as frontrunners to achieve effectiveness advantages, while other actors may face difficulties in achieving a higher level given their local circumstances. These might catch up at a later stage, when circumstances



improve and they have the opportunity.

PortCDM is about achieving enough maturity among involved participants and is why the maturity level of each actor needs to be defined early in the process. In the development of a port's maturity, each of the port call actors participating in the port community needs to achieve corresponding capabilities in order for a port to reach a particular level of maturity. Expressed in other terms, to be PortCDM compliant, operational and technical principles need to be adopted for the individual organization, internally within the port community (as the port as a compound actor). Additionally including externally data exchange and collaboration with shipping companies, other ports, and hinterland operators may be added to increase benefits of PortCDM on higher maturity level.

### Operational and technical compliance in the four collaboration arenas

The different maturity levels include various operational and technical compliance issues on the different collaboration arenas (see section above). The relationships are shown in the table below:

Compliance type Collaboration arena	Operational	Technical
<b>Internal collaboration within ports</b>	Agreed schemas on when and what to share related to plans and outcomes of operations as key components for establishing common situational awareness and the basis for coordination and synchronization. Different operational implementations complement each other rather than creating issues for collaboration	Digital distribution and consumption of time stamps utilizing the same data standards and interfaces (e.g. S-211), as well as implemented tools for visualizing common situational awareness (within existing systems and/or separate tools)
<b>External collaboration: Between ports</b>	Connecting ports with each other's operation at defined coordination points. At the minimum the upstream port shares data on estimated and actual time of departure with the downstream port.	Digital distribution and consumption of time stamps utilizing the same data standards and interfaces (e.g. S-211) to allow for international, system independent data exchange both ways
<b>External collaboration: Between ships and ports</b>	Operational principles to exchange intentions and outcomes that are important means for the operational success of other actors. This means that ships / ship operators would communicate intended arrival times and ports would agree or respond with recommended preferred arrival times	Exchange PCMF in S-211 format between ship / ship operator and the port (as a compound actor) to allow for international, system independent data exchange both ways
<b>External collaboration: Between ports and hinterland operators</b>	Integrate hinterland operations in port operations and vice versa for increased efficiency in the turn-around process of hinterland carriers	Exchange PCMF in S-211 format between the hinterland operator (with logistical systems) and the port (as a compound actor) to allow for international, system independent data exchange both ways

Table 2: PortCDM operational and technical capabilities in context

### Advancing in maturity - moving between different levels

A maturity level framework could be either a passive prognosis of what might happen (life cycle model) or a form of strategy plan, where the aim is to move up to the highest level dependent on what is desirable for a port. The PortCDM maturity model can be both, but the latter is the driver for those actors that are engaged

in port call operations. In order to increase the competitiveness of a port, it is most desirable to reach the higher levels of PortCDM before others do. Getting all port actors involved and engaged is key to enabling PortCDM to reduce overall costs, and reap the effectiveness benefits and increase economic growth. It is also a prerequisite for enhancing competitiveness of maritime transport in comparison with air or land transport.

As has been presented above, the development of PortCDM maturity is both about establishing capabilities for the digital sharing of relevant data among all involved parties, as well as coming to agreement among the port community on how to interact and handle “normal” cases, and collaboratively interact when communicating to external actors about exceptions, as well as reaching agreements on the goals for the ideal port call process. Some PortCDM maturity levels will be relatively easy to reach, while others may be more difficult, because they require a re-engineering of infrastructure or organizational relationships.

The entry point for anyone - an internal or an external actor, is to establish capabilities for sharing time stamp data in accordance with the S-211 Port Call Message Format. This capability is the fundamental building block for PortCDM. In the table 3 below some of the core tasks in developing capabilities that will enable the move to the next level of maturity are shown.

Transitions	Task to enable a move to the next level of maturity
Level 1 to level 2	<ul style="list-style-type: none"> <li>Obtain agreement among interested actors that the sharing of position time stamps is an agreed common object of interest.</li> <li>Adopt and/or establish a data sharing environment that allows instant sharing of time stamps with all connected actors.</li> </ul>
Level 2 to level 3	<ul style="list-style-type: none"> <li>Identify and agree upon which port call actors are core to the port call process and ensure that these become part of the collaborative mechanism by sharing data and coordinating operations based on the shared data.</li> </ul>
Level 3 to level 4	<ul style="list-style-type: none"> <li>Disseminate and provide access to the PortCDM interfaces and commit to follow the PortCDM principles of interaction and data sharing and operational coordination with external actors</li> </ul>
Level 4 to level 5	<ul style="list-style-type: none"> <li>Expand the community of actors being part of the collaboration</li> </ul>
Level 5 to level 6	<ul style="list-style-type: none"> <li>Establish arenas and means for engaged port call actors to coordinate and synchronize their operations based on a shared common situational awareness</li> </ul>
Level 6 to level 7	<ul style="list-style-type: none"> <li>Measure the performance of port call operations according to agreed PortCDM KPI's</li> <li>Agree upon goals for port call performance and establish means for reaching to agreement on which improvements to realize.</li> </ul>

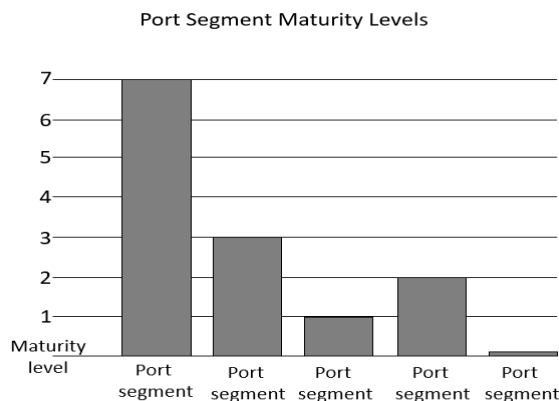
**Table 3: Core tasks in developing capabilities on higher level of maturity**

### **PortCDM compliance on a sector-by-sector basis**

The incremental implementation of PortCDM through the compliance model also allows for incremental implementation on a sector by sector basis if required. It may be that some sectors, such as cruise shipping or vessels trading on regular routes will be easier and keener to adopt PortCDM than other sectors. If this is so, then the PortCDM infrastructure, organizational and administrative arrangements, and documentation can be made to reflect this.



In any given port, there may be sectors, which may want to implement a higher PortCDM maturity level than others.



**Figure 3: Different segments within a port on different maturity levels**

While PortCDM aims for a holistic implementation in any participating port, there may be reasons to deviate from this generic point of view. It could be that a port decides to pursue an incremental implementation, for example starting with a specific segment of the port, for example, the container terminals or the passenger section of the port, and have the tanker and dry bulk section follow later. It could also be that a port may start with key actors and ships calling one terminal operator and later expand to include the other sections of the port (see figure 3). How this implementation will work will be covered in a subsequent implementation note.

## Conclusion

With the establishment of criteria for PortCDM compliance, ports are now in a position to standardize the validation of their capabilities to provide trustworthy, reliable estimates and increased efficiency in handling port calls and as such create transparency and comparability with other ports. They can provide evidence for increased transparency of their activity to allow clients, partners and affected players, like shipping lines, shippers, cargo owners, or upstream and downstream ports, to improve their contribution in the overall supply chain. Being in compliance with PortCDM standards, it is possible for port actors to develop their operational and technical maturity in order to achieve collaboration in all four collaborative arenas.

The focus on both operational and technical compliance ensures that a holistic view of a port's contribution in maritime transport is taken in consideration and the technology is not pushed into the role of decision-maker for port operations as such, but is used as an enabler for the smart operation of ports.

Establishing PortCDM maturity levels makes it possible for decision makers and other actors in a port to identify their current and targeted level of maturity and to communicate what other actors and visitors to their port can expect.

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*PortCDM brings sea transports to become an integrated part of the global transport chain by providing means for ports by enhancing its capabilities in collaboration and data sharing. The International PortCDM Council (IPCDMC) is an independent association with global reach providing international standards and guidelines for regional and local implementations of PortCDM.*

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](http://www.stmvalidation.eu) and/or [www.ipcdmc.org](http://www.ipcdmc.org).