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(Implementation Note #4)

Maturity Level 6 in Implementing PortCDM
- Full Adoption of PortCDM Principles

by[1]

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Introduction

Port Collaborative Decision Making (PortCDM) is a concept to support those engaged in or associated with port call operations. It aims to improve efficiency and effectiveness of activities in any port by providing a framework for data sharing and enhanced collaboration. The PortCDM maturity model in Figure 1 shows the incremental steps required to successfully establish PortCDM as part of a port's operations and identifies the capabilities required at each level.

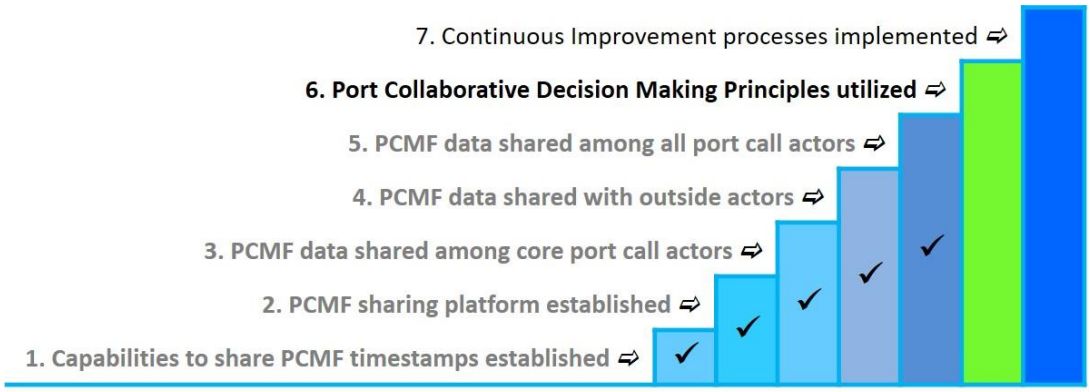

Figure 1 PortCDM maturity scale focusing on Level 6

Building upon the previously published concept note on PortCDM maturity levels,[2] three implementation notes have been published by the International PortCDM Council: one on how to achieve compliance in collaboration and data sharing with PortCDM,[3] another providing guidance on Levels 1 and 2 and a 3rd on how to advance to Levels 3, 4 and 5[4]. This implementation note provides practical advice on how to fully implement the PortCDM concept in compliance with maturity Level 6, as highlighted in Figure 1.

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[2] 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

[3] Lind M., Bergmann M., Andersen T., Haraldson S., Ward R., Andersen N-B., Michaelides M., Watson R.T., Ferrus Clari G., Zerem A., Rylander R., Gimenez J., Karlsson M. (2019) Achieving compliance in collaboration and data sharing with PortCDM, Implementation note #1, International PortCDM Council (IPCDMC)

[4] Lind M., Bergmann M., Andersen T., Haraldson S., Ward R., Andersen N-B., Michaelides M., Andersen T. , Karlsson M., Gerosavvas N., Watson R.T. , Zerem A, Olsson E., Gimenez J., Ferrus Clari G., Angelov A. (2019) Maturity Levels 3 to 5 in implementing PortCDM - increasing data sharing and situational awareness, Implementation note #3, International PortCDM Council (IPCDMC)

This note is based on the practical experience gained in implementing PortCDM in the ports of Barcelona, Brofjorden, Gothenburg, Limassol, Sagunto, Stavanger, Valencia, Umeå, and Vaasa. These implementations were part of the recently completed PortCDM testbed activity, which was part of the wider STM validation project.

This note builds upon the digital capabilities[5] required for sharing Port Call Message Format (PCMF) timestamps (according to S-211) that underpin Maturity Level 1, the establishment of a data sharing environment in Level 2, the increasing participation and data sharing of core port call actors in Level 3, reaching out to relevant outside parties at Level 4, and using PCMF data by all relevant port actors at Level 5. We base our discussion around Level 6 on the successful implementation of each of the five subordinate levels that provide the technical basis. Maturity Level 6 focuses on the establishment of the procedural aspects of collaborative decision making by utilizing those technical prerequisites and expanding the operational collaboration to take full advantage of data sharing. The next implementation note will cover Level 7 - establishing a continuous improvement process.

Collaboration as key to fully utilize PortCDM principles

The key to Level 6 is collaboration. Not only is data shared to create improved situational awareness and support the planning of execution of tasks by individual port call actors, the result of the actor-internal planning is used to reduce the expected overall turnaround time of a ship at port through further coordination among the actors. The port call actors, in a collaborative way, can develop a recommendation or a request for the best possible time slot for a port call. Due to the data sharing enabled by PortCDM and the greater awareness by all actors of their interdependency, this can take into account the commitments made to other ship operators / ship masters and other external actors. Once determined, the recommendation is transmitted to the ship or the operations centre – whoever is in charge of the ships planned arrival time – to allow the ship to consider updating its voyage plan and arriving just-in-time.

<u>The scope of Collaborative Decision Making (CDM)</u>

So, what does it mean to make decisions collaboratively? Port call operations exist in a setting of eco-system collaboration governed by market relationships rather than by authority relationships. While most actors cannot be directly ordered to do something, they must nevertheless adjust their plans according to the actions or plans of others. Based on this, the collaborative decision making (CDM) processes work on two levels:

- agreements on *individual forthcoming / ongoing* port calls, involving:
    - the coordination and synchronization of the actors' individual plans so as to enable just-in-time operations with minimal waiting times, offering short turn-around times for visiting carriers (i.e. ships, hinterland carriers etc.) by taking into account external conditions (arrival times, upstream progress, downstream capabilities, other commitments); and
    - the actors' collective decision-making on recommendations for optimal schedules (e.g. arrival times, departure times) provided to ships, hinterland transport carriers, etc., making episodic visits to the port, by taking into account the capabilities of the port, the status of progress in

[5] As elaborated in Lind M., Haraldson S., Bergmann M., Ward R., Andersen N-B., Andersen T., Michaelides M., Karlsson M., Watson R.T., Zerem A., Olsson E., Gimenez J. (2019) First Steps in implementing PortCDM - establishing the data sharing environment, Implementation note #2, International PortCDM Council (IPCDMC)

previous ports / transport hubs, the capabilities of carriers to reach the port, as well as the capabilities in downstream ports / transport hubs, and together agree on the best option for the port-call eco system in large.

- agreements concerning *future* port calls, that capture:
    - agreement on the principles, technology and commitments to adopt operational and technical collaboration implemented in PortCDM maturity Levels 1 to 5
    - agreement on the constituents of the port call process (the common objects of interest), the accompanying process measurements (such as PortCDM KPIs), and improvement actions associated to enhanced collaborative performance, which are part of PortCDM maturity Level 7 and will be elaborated further in the next implementation note. This includes common agreement on the decision-making process and responsibilities, which may be an agreement of a leading party.

Level 6: Actors using Collaborative Decision Making

At Level 1, all (core) actors have acquired the capability to share PCMF time stamp data using the S-211 data exchange format. On Level 2, at least some of the actors have established a PCMF data sharing platform. Based upon these two capabilities, it is then possible to move to achieving Level 3 of the maturity model, where relevant data is being shared between core port actors. At Level 4 the PortCDM activities are extended outside the port to ships and its operators, other ports and hinterland operators. At Level 5, participation in PortCDM is extended to ALL port call actors involved in the port call process.

The basis for Level 6

As shown in Figure 1, maturity Level 6 builds upon the achievements and implementation of the lower maturity levels. In order to take full advantage of the operational principles of PortCDM, it is essential to first establish the technical capabilities to share PCMF data in the S-211 format so as to have access to relevant information from all involved actors. The data sharing environment, established during the achievement of Level 2, provides the technical basis for this. A growing number of actors having access to relevant data through the process of migrating upward towards higher maturity levels thus creates the necessary infrastructure that enables collaborative decision making.

The operational concept at Level 6

When moving towards full operational use of the PortCDM concept, port call operations are increasingly coordinated through collaborative decision-making. This is an iterative and continuous process where all stakeholders represented in a port agree to use PortCDM for optimal planning of port calls, and take initiative, if and when required, to change existing plans in order to obtain (more) overall optimal port operations. This moves decision making forward to take an holistic view of the port call as opposed to individual decision-making based upon optimization of the situation of each individual actor.

Collaborative decision making during iterative re-planning

During all stages of a port call, capturing the whole turnaround process (from arrival to the port area, realizing the port visit, and the departure process), collaborative planning and re-planning by several actors becomes a necessity to ensure the decision taken is satisfactory, or at least acceptable, to all actors. This could be driven by, for instance, when a ship informs about a delay, or when a berth will not be ready in time

due to delay of operations in another ship's port call, or when there is a delay in cargo operations in the ongoing port call affecting subsequent operations. Such a collaborative decision-making process is dependent upon sharing real-time data to create a common situational awareness, where all concerned are aware of the situation and the plans of others in the operational chain. The cost of re-planning is reduced by the timely sharing of data, both by sharing intentions as well as outcomes of conducted events. The defined process during implementation of PortCDM Level 6 should ensure that both the expected remaining re-planning costs are fair-mindedly distributed to all, as well as the distribution of benefits. The distribution principle of costs and benefits may however vary from case to case and by port community.

The progress and plans for port call events are captured in a system of records maintained by the local PortCDM community, reflecting the progress in the production systems of a port visit. This data should be visible to all authorised port call actors and used by the individual port call actors to enable that their operations take place optimally in relation to others' operations, by reflecting the possible changes that need to be made. Port's specific requirements should be included and brought into consideration in the setup of what data to share in a particular port.

The technical concept at Level 6

On Level 6, all relevant timestamps related to a port call are being shared in real-time and everyone shares what they know about a particular timestamp. This enables each of the engaged actors in the port call to coordinate and synchronize their operations in relation to others through a continuous, iterative process that takes into account the evolving planning and execution of a port call.

As part of the Level 6 digital information environment, timestamps may be compared and analysed automatically in order to provide warnings and benchmarks for the relevant actors. For instance, warnings might be given when events change or where there is inconsistency between different timestamps for the same or related events. This enables potential conflicting plans and schedules to be spotted early and makes it possible to take corrective action.

Other examples could relate to the occurrence of upstream events, where warnings could alert the involved actors about a revised time of arrival to a particular location within the port, an actual time of departure from the upstream port, or the declaring of a new estimated time of departure.

The warnings can indicate three different types of problematic situations:[6]

- missing data, which directs attention towards possible missing data in the system of records[7] based on when they should have occurred in a system of production. One example is a warning when a pilotage that should be requested and confirmed some pre-defined hours before arrival is missing.
- conflicting data, which directs attention towards actor's different conceptions of timestamps. An example is when the port authority, the terminal operator, and the captain report different estimated times of arrival to berth.
- unreasonable relationships, which directs attention towards the relationships between different timestamps. An example is when the time between estimated times of pilotage commenced and

[6] 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 (https://www.ipcdmc.org/galerie)

[7] c.f. e.g. Lind M., Bergmann M., Haraldson S., Watson R.T., Park J., Gimenez J., Andersen T. (2018) Enabling Effective Port Resource Management: Integrating Systems of Production Data Streams, Concept Note #3, STM Validation Project (https://www.ipcdmc.org/galerie)

arrival at berth lie outside a defined range.

Both the indicator and warning concepts can be configured to suit the particular coordination and alignment needs of the individual actors in relation to others. The resulting collective knowledge then provides the basis for the different operations associated with different events in a port call to be arranged in either parallel or sequential just-in-time patterns, as appropriate.

Recommended arrival and departure times

At Level 6, actors in a port will synchronize and optimise the port call. This entails determining the optimum arrival and departure times for ships to achieve minimum turn-around times and just in time arrivals. Benefits can be gained by sending a Recommended Time of Arrival (RTA) to a ship that has previously shared its Planned Time of Arrival (PTA) with the port. Subsequently, once the port call is planned by the involved actors and collaborative decision making has taken place, a Recommended Time of Departure (RTD) can be shared with the ship to benefit planning for the subsequent voyage. These type of data are also relevant and for the ship's operation centre in their efforts to improve fleet planning.

However, experience from the PortCDM validation showed that there are a number of challenges mitigating against achieving success.[8] We found that sometimes, there is

- an initial reluctance to send an RTA because of the competitive nature of ports, (by following a first come, first served principle);
- an inability to commit to an RTA because of congestion at berth and uncertainty in planning; or
- such a late sharing of the PTA by the ship that it makes the sending of an RTA obsolete.

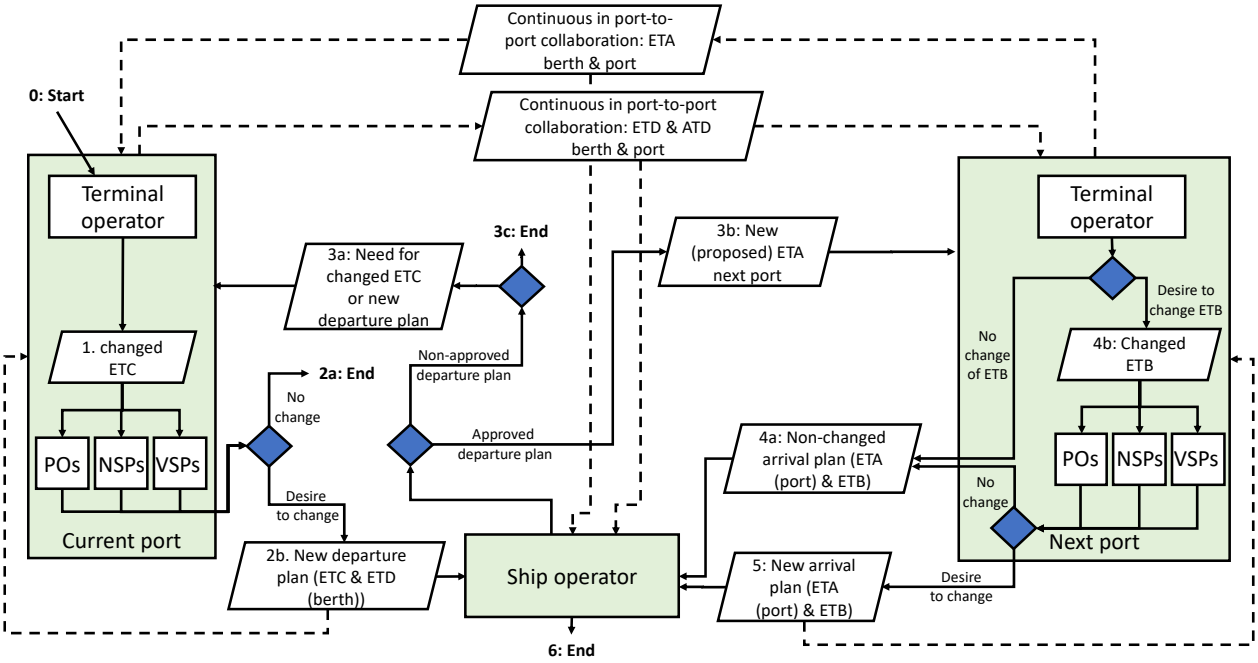
Notwithstanding the initial hesitancy on the part of some actors as described above, the PortCDM validation also showed that once the benefits became clear to the participants, they became supporters and they actively took part in improving just-in-time efforts and increased turn-around times.

Potential for slot management

An obvious outcome of optimized and synchronized port call operations (including RTA and PTA as well as RTD) is the potential for berthing slot management – a concept widely used in the aviation industry, with various similar arrangements gaining in popularity in the maritime world both for traffic management and for port call operations. Due to the fact that maritime transport is most often affected by upstream disruptions, it is important that any slot management is managed dynamically. PortCDM facilitates this. Dynamic slot management also requires aligned contracts and rich base information for the collaborative decision making, as well as the ability of taking commercial contracts (commitments) into consideration. There may be a need to change some existing contractual conditions to achieve this. As an example, BIMCO has changed its chartering agreement to include a special clause to allow for flexible travel speed (virtual arrival clause, also called the STM clause) and adjustments to arrival time, supporting the establishment of slot management processes.

Port to Port synchronization at Level 6

Including upstream (previous ports) and downstream (next port to be visited) ports is absolutely vital in order to achieve the port call synchronization at Level 6. More accurate data streams provided under PortCDM assist decision-makers in making better informed decisions downstream. The flowchart in Figure 2 illustrates how the main actors in the current port and the next port can be assisted by receiving the crucial timestamps on all key events from the PortCDM processes. An example is in planning a new port arrival, when an existing plan is no longer achievable due to delays at the current (upstream) terminal.



ETA = Estimated time of arrival, ETB = Estimated time of berthing, ETC = Estimated time of completion at a terminal, ETD = Estimated time of departure.
POs = Port operators, NSPs = Nautical Service Providers, VSPs = Vessel Service Providers

Figure 2 Example flow chart of the port call plan revision process[9]
- an interplay between operators in the current and next port and the ship operator

In figure 3, the full synchronization process at Level 6 is illustrated, building upon the ship's / ship operator's continuous updates of Planned time of Arrival (PTA) and (calculated) Estimated Time of Arrival (ETA). These continuous updates are both used for actors at the port of destination to coordinate the events conducted for serving the ship's purpose of call as well as (possibly) Recommended Time of Arrival (RTA).

The exchange of relevant data in the PortCDM S-211 format between ports, both upstream and downstream, enables collaborative decision making on the Recommended Time of Departure (RTD) from the previous upstream port and the Recommended Time of Arrival (RTA) at the current port, as well as the Planned Time of Departure (PTD) to the next downstream port. In this way, port-to-port data exchange and collaborative decision making can result in efficiency gains not only for the port call in question, but for the full voyage of the ship encompassing multiple consecutive port calls.

[9] Built upon Lind M., Ward R., Michaelides M., Lane A., Sancricca M., Watson R.T., Bergmann M., Bjorn-Andersen N., Haraldson S., Andersen T., Park J., Theodossiou S. (2018) Reducing idle time with collaboration and data sharing, Concept Note #16, STM Validation Project (https://www.ipcdmc.org/galerie)

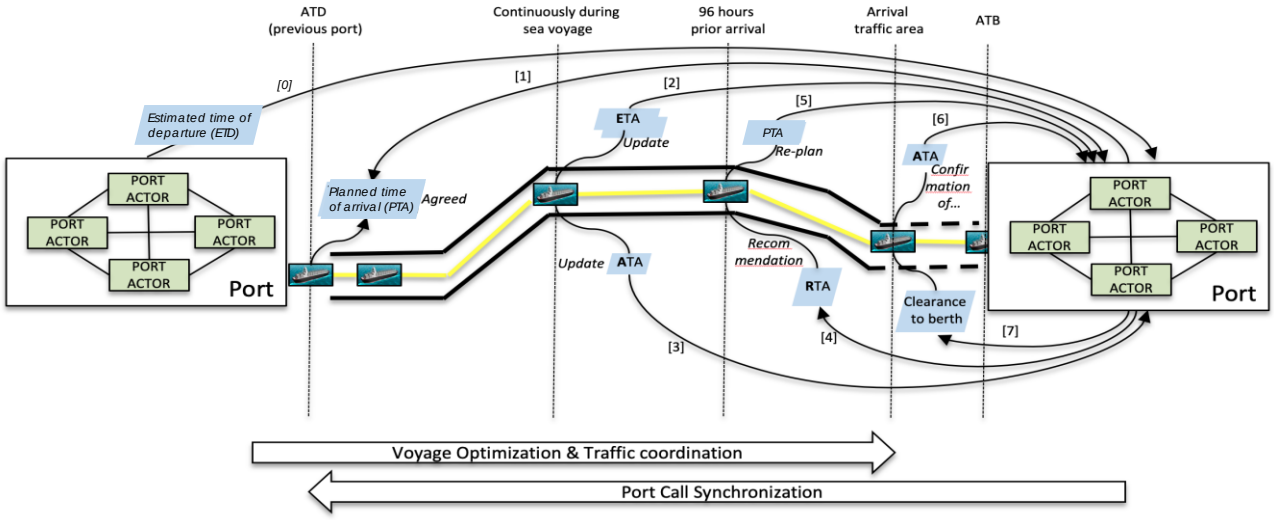


Figure 3 PortCDM synchronization, in a Sea Traffic Management context, at Level 6

Opportunities with digital tools for supporting Collaborative Decision Making

As the processes of the PortCDM implementation moves towards Level 6, and a port is achieving the full implementation of the PortCDM principles, there are opportunities to expand the data sharing platform as well as the tools used by port call actors.

It is advisable to improve the data sharing experience by creating new digital tools for: (i) visualization of situational awareness that is made common and shared instantly among the participants, and (ii) flashing notifications when others are changing timestamps (for example reporting that cargo operation have been completed), to allow subsequent actors to consider making changes to their plans and ensuring that idle time is avoided as much as possible. Furthermore, there is an opportunity to establish warnings for actors, when changes of timestamps create potential overlaps in activities, so that those affected can find a solution. Enhancements of this type of data sharing tools, will also support the full utilization of the PortCDM principles, especially in more complex situations involving port operations at larger ports and connected ports in multi-modal transport possibly including multiple ship voyages.

Conclusion

Maturity Level 6 is the level which fully reaps the benefits gained by establishing a data sharing environment and enabling data sharing in the earlier maturity levels and is also where the operational principles of PortCDM are fully recognized, implemented and executed.

While certain improvements to the technical tools implemented at earlier levels help to support the operational aspects highlighted at Level 6, the main focus of this level is primarily an increase in collaborative decision making itself. It also puts the focus on the holistic flow of the port call and places the activities of the individual actors and their operation optimization in context in order to gain the full benefits from having an end-to-end view.

Finally, maturity Level 6 broadens the view from an internal port-centric view to looking at the upstream and the downstream progress in port operations, utilizing the principle of port-to-port synchronization to archive efficiency gains above and beyond the individual port call.

As such, reaching maturity Level 6 enables a port to further strengthen its capability to support Just-In-Time operations of maritime transport and meet the real demands of the users of this mode of transportation. This will enable the maritime domain to keep up with the developments within the full logistical chain of multi-modal transport.

More information

The International PortCDM Council, comprising representatives from relevant international organizations, shipping interests and ports as well as industry wide recognized experts in the maritime domain provide guidelines and advice on PortCDM. Guidelines and advice on general PortCDM concepts are available from the IPCDMC website[10]. This note has been elaborating specifically on the PortCDM maturity Level 6. PortCDM maturity Level 7 will be elaborated in the next implementation note.

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PortCDM brings sea transports to become an integrated part of the global transport chain by providing means for ports to enhance their 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 and/or www.ipcdmc.org.

[10] https://www.ipcdmc.org/