

## Extending the efficiency boundary from ports to hubs: A new role for container terminal operators

by

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### Ecosystem options

Previously, we have described the shipping industry as a self-organizing ecosystem characterised by no dominating actor managing the eco-system. This is in contrast to coordinated ecosystems where a keystone contributing firm or organization, in effect, orchestrates the work of the others. Some good examples of the latter are the eco-systems of smart phone companies and car manufacturers. From a logistics perspective, the shipping industry is primarily a self-organizing ecosystem without a dominant player because the costs of having complete control over all the resources from exporter to importer are prohibitive. It is simply extremely difficult to effectively manage the utilization of a wide span of resources located in different countries, and it is more effective to have distributed ownership. If there were a better solution, market forces would have fashioned it over time.

Accordingly, it is most effective to have a large number of independent actors, each one responsible for managing its operations. However, a self-organizing ecosystem, such as the shipping industry, still has to coordinate, particularly when there is tight coupling between the activities of two or more actors. On the highest level, the captain of a vessel and a terminal operator for cargo handling need to coordinate. In general, the tighter the coupling, such as ownership of the terminal serving one shipping line, the higher the potential for a speedy turn-around and optimization of resources. What joint ownership cannot achieve, must be realized by coordination and synchronization through data sharing.

Some 70% of port operations in Europe are associated with short-sea-shipping<sup>1</sup>, which requires transshipment. A port is a (complex) transshipment hub that makes the majority of its profit by storing and forwarding cargo to another port. As a result, it is not surprising that many ports aspire

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<sup>1</sup> Commission's 2001 White Paper, *European transport policy for 2010: time to decide*.

to be a major hub in a global transport backbone network based on transport links between the hubs by shipping lines and, as a result, get more business than peripheral nodes. A major port could be a hub for its country by being the entry/exit point for imports and exports, respectively. Whereas, another hub might handle transshipment traffic for a region. The ultimate goal of a hub is to aggregate sufficient volume at the national and/or regional level to give it economies of scale beyond those potential competitors.

An excellent example is Singapore, which has successfully developed its port and terminal facilities to become one of the largest and most important maritime transshipment hubs in the world with a very high level of efficiency.

An important requirement of a transshipment hub is to efficiently coordinate intermodal transport links with the hinterland. In this note, we explore the role that Port Collaborative Decision Making (PortCDM), as an enabler of Sea Traffic Management (STM), can play in making ports more effective, particularly from the perspective of container terminal operators.

### **Types of ports**

It may be useful to think of ports as fitting into three broad classes, which to a large extent is determined by their size and their ability to move goods onward in the transport chain. This will enable us to investigate and discuss their different data needs.

#### *First tier – global hubs*

First tier ports have regularly scheduled visits from vessels belonging to the three major alliances.<sup>2</sup> They handle much of the world's cargo, and they are large transshipment centres serving second and third tier ports. The world's top 20 ports handle about 50% of the world's cargo<sup>3</sup>. It is the cut-off point that we have used to differentiate between tier 1 and tier 2 ports. Accordingly, tier 1 includes Shanghai and Singapore in Asia, Rotterdam in Europe, Dubai in the Middle East, and Los Angeles in North America. Given the volume of business, first tier ports can face considerable competition, particularly in the transshipment arena, when there are other first tier ports in their vicinity, such as the one on eastern seaboard of Asia.

#### *Second tier – regional hubs*

The second tier comprises ports that have significant transshipment volume but are not in the first tier. They are typically national or regional hubs and are often an intermediary between first and third tier ports. Their success depends on the aggregate demand of the third-tier ports that they

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<sup>2</sup> The ocean alliance (CMA CGM, COSCO, OOCL, APL, Evergreen), The Alliance (NYK Group, MOL, "K" Line, Hapag Lloyd, UASC, Yang Ming), and the 2M Alliance (Maersk Line, MSC, HMM, Hamburg Sud)

<sup>3</sup> See <http://www.worldshipping.org/about-the-industry/global-trade/top-50-world-container-ports>

service. Thus, they compete with other second tier ports for business in their region. Valencia, Barcelona, and Limassol, among many others, fall into this tier.

#### *Third tier – local hubs*

Third tier ports have little transshipment traffic. They typically serve a limited geographic area, and their main competition usually comes from nearby third tier ports. Depending on their geographic location, road and rail might be a competitive threat by enabling the land movement of cargo from second tier ports directly to importers.

#### **Container terminal operations – historical developments and challenges of tomorrow**

Our classification of ports – as first, second or third tier, tends to divide ports as those that do or do not include significant terminals. Accordingly, it may be useful to begin by reviewing the evolution of terminals.

#### Evolution of container terminals

On April 26<sup>th</sup>, 1956 Malcolm McLean's *Ideal-X* sailed from Newark port to Houston and gave birth to containerization. Since this maiden trip between two improvised container terminals, global container terminal throughput using containers has grown to exceed 700M TEUs in 2017. This is thanks to the proliferation of specialized container terminals serving the main production and consumption regions connected by the East-West routes linking the Far East, Europe and the USA. In parallel, a global network of hub and spoke terminals has expanded to serve secondary markets through transshipment services. While terminals serving East-West routes and large regional hubs nowadays have a very high level of operational efficiency using a plethora of automated technology, smaller and peripheral terminals are not very different from McLean's era. As a consequence, industry's technological fragmentation is still a drag on productivity. During the last 60 years terminal operators in the Asia-Pacific, EU and USA regions have increasingly adopted capital-intensive mechanical equipment to handle growing throughput. Size, speed and reliability of ship-to-shore cranes and yard equipment have been constantly on the rise.

On top of more and more efficient physical resources the adoption of Terminal Operating Systems (TOS) to plan and control yard and ship stowage operations started during the 1970s. The use of digital, stand-alone TOSs boosted the productivity of operations and paved the way for the adoption of integrated TOS solutions (like the one delivered by NAVIS to American President Lines in the late 1980s is an example), able to manage more complex functions. The first automated terminal, where Automated Stacking Cranes (ASCs) and Automated Guided Vehicles (AGVs) were remotely controlled through an advanced TOS, was the Port of Rotterdam Delta Terminal, opened in 1993. Since then, tens of semi- and fully-automated terminals have opened across the globe. As of today, the largest, state-of-the-art automated terminal is Shanghai Yangshan Deep Water Port where all

the ship-to-shore, yard and gate operations are fully automated and remotely controlled. Running at full capacity, the terminal's 26 bridge cranes, 120 ASCs, and 130 AGVs can handle a 6.3 M TEUs throughput without a single human working outside the control tower.

#### Current standing of terminal operators

Many ports have several types of terminals in place, each operated by different terminal operators. The larger shipping lines, such as Maersk, MSC, COSCO, and CMA/CGM operate their own terminals in strategic ports - most often in first tier ports, in order to secure control of the necessary factors that enable a fast turnaround. This type of terminal is so-called dedicated terminal. On the other hand, a terminal operator, such as Hutchinson, has established a network of terminals and offers shipping lines a highly coordinated service to achieve fast turnaround.

Historically, many terminals have been owned and operated by governments but more recently this has changed and many of those governments now prefer to be landlords and leave the operations of the terminals to private actors.

Up and until 2008, global container handling demand was growing at 10-15% per annum, and in the period between 2001-2005 terminal congestion in many ports globally was rife. This led to huge investments in new terminal capacity to keep pace with demand, at naturally high capital expenditure. Since 2008 global demand growth has been closer to the 3-5% per annum range, and therefore capacity growth has slowed accordingly. Since 2010 however, a huge proliferation of container ships with in excess of 10,000 TEU have entered service, resulting in new (larger) quay equipment to be purchased and some existing assets up-sized, particular height and out-reach as the majority of ship capacity growth was achieved through wider beams and higher cargo profiles.

#### Today's challenges faced by container terminal operators

In sea transportation, careful cost/benefit assessments have to be made in order to identify the optimal port to use, but the market is not very transparent and this can limit effective decision making. Furthermore, decisions must often be taken without a reliable forecast of future demand. Using the three sub-ecosystems classification introduced in our Concept Note 14<sup>4</sup>: *the shipping line*, *the port* with its actors (with the port authority and terminal operator(s) as two core actors), and *the hinterland operators*, together with the Logistics Services Providers acting on behalf of shippers and consignees; the following types of influential factors can be identified for the different stakeholders:

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<sup>4</sup> Lind M., Bergmann M., Watson R.T., Andersen N-B., Haraldson S., Andersen T., Ward R., Rosemann M., Karlsson M., Zerem A., Skovbakke Juhl J., Sanricca M. (2018) Port Call Efficiency – the benefits of coordination and synchronization, Concept Note #14, STM Validation Project

- For shipping lines: Fees for using national waters, port call fees (including service provision) and container handling at the terminals – which can represent as much as 25% of total operating costs
- For terminal operators: Long-term planning enabling short-term berth planning, fees for renting land, the number of port calls
- For hinterland operators: The possibility of acquiring high-resolution information on planned loading / unloading operations, customs inspection and release, and other such necessary procedure can facilitate just-in-time delivery / pick-up of goods.
- For shippers and their agents: Predictability and throughput times

As indicated in the same Concept Note,<sup>7</sup> connected terminal operators are a potential key to enabling integration of a global supply chain and global trade generally.

Growth of vessel size and capacity has been faster than the development of terminals and supporting inland infrastructure development. As a consequence, the operational complexity of handling ships of increasing size is now significantly stretching the organizational capabilities and resources of many terminals.

Managing a port call for a 23,000 TEU vessel means using more and larger cranes, in order to be able to load and offload thousands of TEUs in a few hours. The main operational bottlenecks within a terminal area are chiefly caused by limited yard productivity and the shortage of yard equipment. Outside the terminal, trucking congestion and slow gate throughput can be influenced by limited road infrastructure; while the lack of on-dock rails can limit high-capacity intermodal activity in many ports.

While 23,000 TEU ships are already in operation, it is growing unlikely that we will witness a dramatic increase as global container growth slows. From a technology perspective, operational complexity will best be managed through data driven decision making, strongly supported by the wide adoption of the IoT (Internet of Things) and the embedding of predictive and prescriptive AI (Artificial Intelligence) methods. All this calls for the creation of nationwide or often region-wide data sharing among all the interested parties in the various transport ecosystems. This in turn will enhance transparency and data sharing among trucking and rail operators, customs, shippers, and consignees so as to optimize the flow of containers from ports to inland destinations. The next generation of TOS will be part of such ecosystems, thanks to enhanced digital connectivity between all of the supply chain's key stakeholders.

The requirements arising in the preceding analysis suggest that for some first tier ports, key actors will have to make major efficiency improvements to maintain the port's status. Where further investment is required, in some cases, it might make sense to forgo the large investment necessary as a first tier port and settle for becoming a highly efficient second tier port. This would, of course, be a major strategic decision for the central actors in a first tier port.

### **Why planning is essential for successful operations**

Enhanced information sharing, especially regarding the crucial parameter of estimated time of arrival (ETA), is necessary for any optimization effort before a vessel visits a port. This is absolutely key to all port actors, including terminal operators and shipping lines, and it is also relevant to hinterland operators and the eventual recipient of the cargo (the consignee).

Terminal operators are dependent upon both “internal collaboration” as well as upon “external collaboration” for the fine-tuning and delivery of optimized services. All too often, there are failures in ensuring that the necessary arrangements are in place during terminal operations at the time that they are needed, because of a lack of data sharing and collaboration between all the involved actors.

Successful data exchange between all the involved actors is necessary in order to coordinate planning and achieve benefits for all those involved. As described in several earlier Concept Notes,<sup>5</sup> shipping lines will not steam for longer than is necessary, previous ports will not have to release a ship from the terminal if the destination port is not ready, and hinterland operators would not need to hurry to get land transport assets to the terminal if a ship is not ready to release / receive goods / people and/or the ship is delayed in berthing. It is all about synchronization, where each actor needs to engage in a highly complex process of give and take.

As we have asserted in earlier Concept Notes, the successful coordination of port calls should be underpinned by the sharing of time stamped data which is a key to success for enabling optimal resource and infrastructure utilization. This can enable the actors, bi-directionally, to inform each other on their available capabilities and/or planned operations.

Being able to more reliably plan berth usage through information sharing and coordinated planning could actually lead to improvements in the berth charging regime. This could benefit both the port and the ship. To give an example, at the Port of Stavanger a visiting ship is currently charged per 24-hour slot. If better planning and deployment of the required resources and the completion of operations was improved, then the port could charge an hourly rate. This would most likely result in the ship leaving the berth immediately after work had completed. As a consequence, the number of berth visits possible in the port would increase and the cost for an individual shipping company to make a port call would fall. A reason for the port not to introduce this however is because the reliability in planning is currently too low, due to a lack of dependable and up-to-date information being exchanged between all the involved actors. To improve this situation requires that ships, ports

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<sup>5</sup> Lind M., Bergmann M. Watson R.T., Andersen N-B., Haraldson S., Andersen T., Ward R., Rosemann M., Karlsson M., Zerem A., Skovbakke Juhl J., Sancricca M., (2018) Port Call Efficiency – the benefits of coordination and synchronization, Concept Note #14, STM Validation Project



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(Concept Note #15)

from which the ship is coming from and going to, hinterland operators, and port internal operators share information about their plans, progress, and capabilities. This is exactly where the concept of Port Collaborative Decision Making (PortCDM) can help.

### **Supporting planning of port terminal operations through the PortCDM concept**

In support of the Sea Traffic Management (STM) concept, efficiency and environmental sustainability is reinforced by PortCDM. PortCDM is an organizational concept, not a product, aimed at enabling more predictable timings and operations in sea transport by building on unified and standardized data exchange among all actors. It addresses the need to ensure the continuous flow of intentions, outcomes, and possible disruptions related to movements and service provision among the involved actors in the berth-to-berth transportation process so as to arrive at a high degree of predictability in the planning and subsequent execution of all operations and activities.

An important driver for the optimization of port calls is that relevant information is shared in advance. This will enable better planning of such things as shifts, use of equipment, needs for human resources, as well as stowage planning. All terminal operators want to pursue just-in-time operations, enabling minimal waiting times, both for the external stakeholder and the operator providing services, enabling as fast turnaround process as possible. As described in earlier Concept Notes<sup>6, 7</sup>, PortCDM creates the possibility for enabling

- Situational awareness from multiple sources of spatial-temporal data to create a holistic view
- Collaboration (expressed as when to share data and what to share, related to different events of the port call process) to enable coordination and synchronization

### **Reflecting the situation as of today – providing validity to PortCDM**

Empowered by relationships established through the PortCDM testbeds in operation within the STM Validation Project, interviews were conducted with some core terminal operators in three different ports of the Mediterranean testbed: Limassol, Valencia and Barcelona. The goal was to gain a deeper understanding of the issues facing terminal operators in order to design supportive information systems.

The table below includes information on the terminals that participated.

Terminal	Port	Type	Used TOS
EUROGATE	Limassol	Private Container operator	COIN / TOPX
DP WORLD	Limassol	Private Cruise/General cargo operator	Comtrack & Navision

<sup>6</sup> Lind M., Bergmann M., Watson R.T., Haraldson S., Park J., Gimenez J., Andersen T., Voorspuij J. (2018) Towards Unified Communication – from a project format to a global standard, Concept Note #9, STM Validation Project

<sup>7</sup> Lind M., Watson R.T., Bergmann M., Ward R., Andersen N-B., Jensen T., Haraldson S., Zerem A., Rosemann M. (2018) Digitizing the maritime eco-system - Improving door-to-door coordination via a digitized transport chain, Concept Note #11, STM Validation Project



MSC Terminal Valencia	Valencia	Private Container operator	CATOS (Total Soft Bank)
NOATUM-COSCO	Valencia	Public Container operator	CATOS (Total Soft Bank)
APM	Barcelona	Private Container operator	ARGOS
BEST	Barcelona	Private Container operator	nGEN (developed in-house)

The main existing challenges for terminal operators

Terminal operators exist within a complex competitive and unpredictable environment. Their primary concern is to provide competitive tariffs to their customers - the shipping lines, especially in relation to other terminals in nearby ports. Our interviews with the terminal operators revealed the following main challenges:

1. *Inefficient equipment handling* (e.g., cranes & gangs). Unforeseen problems occur within a terminal such as faults or damage to cranes and other machinery that can cause a slowdown of container handling operations and prevent fast delivery to hinterland transport agents.
2. *Reduced availability of human resources* for serving a ship
3. *Reduced or excess berth availability* creating difficulties for terminal operators especially when there are situations such as the simultaneous arrival of multiple vessels.
4. *Reduced transparency or visibility of important planning data* among key stakeholders. A terminal berth planner, as part of their daily job, has to communicate several times throughout the day with the shipping agents, as well as with the other port actors, such as tug boats, pilots and mooring services.
5. *Lack of coordination and synchronization*, not only with the shipping companies/vessels, but also with the hinterland operators and most importantly with other stakeholders within the port. One main reason for this is that communication between terminals and other port call actors (agents, service providers, traffic control, pilots, etc.) is often still performed in a very basic way by point-2-point communication using telephone or email, due to their lack of better tools and/or common operational procedures.
6. *Missing information*. ETAs and ETDs are often missing or not properly updated in the Port Community System (PCS). Moreover, important documentation for a vessel (such as type of cargo and vessel type, length, beam, call sign and MMSI) is often wrong or not provided, which means the berth planner has to prepare without the necessary information for allocating a vessel to an appropriate berth with the necessary equipment and resources for loading or unloading. By providing information on which cargo needs to be loaded onto a ship ahead of time, the cargo operation estimates can become more accurate.
7. *Narrow time windows*. Another factor that can create problems for terminals is when time windows (the assigned time slots available for the ships to arrive at the port) are short. This is usually a condition observed in smaller ports with a single-entry point. It is a particularly





challenging condition for the terminal operators at ports serving ships coming from close neighbouring ports only a few hours away of steaming. This leaves very little time for responding and dealing with unexpected situations (see Concept Note #5 on Short Sea Shipping). Some respondents argue that that port-2-port communication is most essential to provide a viable solution to improving this situation.

8. *Confidentiality concerns.* The open sharing of data belonging to terminal customers might be difficult due to the reluctance of agents to share their data with competitors. Usually, there are strict rules in place regarding data confidentiality coming from the top management of the various companies. Data that could be used to infer the terminal's productivity (such as, waiting times) might assist potential competitors in nearby ports. For example, as was reported from the port of Limassol: *"If we provide how much time it takes for us to serve a ship and a ship-owner learns about it and compares it with another terminal in a nearby port (for example Ashdod) they may prefer to go there as the service might be faster"*. It is important to note here, however, that these privacy concerns do not apply for sharing non-sensitive data among particular port actors, if sufficient evidence is first provided that assures that the data will stay among the specific port actors.

#### ETAs, ETDs, and the need for better planning

The correct planning for receiving a vessel in terms of equipment, human resources, and stowage primarily depends upon the accuracy of the ETAs and ETDs reported by the agents, and of course on other factors such as the size and the type of the incoming vessel and the type and amount of cargo. However, as this is a highly dynamic process, this planning usually has to change several times as the arrival time approaches. This can cause difficulties for terminal operators. The following are some of the questions that must be answered by a terminal berth planner every time there is a change in schedule:

- ✓ Will the available equipment and human resources be sufficient to service the vessel according to the new plan?
- ✓ Will shifting the berth become necessary in order to rearrange the vessels in the berthing area?
- ✓ Will other incoming vessels have to wait outside the port area until a berth becomes available?
- ✓ Will the terminal have to coordinate with other stakeholders in the port, such as the marine services provider, in order to send a vessel to an anchorage to make room for other vessels?
- ✓ Will the terminal have to put other operations on hold?
- ✓ Will the operations for other vessels be impacted from this change?

The main problem identified by terminal operators is that in many cases the ETAs and ETDs reported by the shipping agents are either inaccurate or not properly updated when things change. In either case, this can cause a chain-reaction of cascaded problems in planning a ship's arrival, such as

- unavailability of a berth for the incoming vessel
- waiting times and inefficiencies for both the marine services providers and the terminals
- reduced availability of resources for serving the vessel (human resources may have been allocated elsewhere)
- unavailability of cranes or gangs because of the delay
- other processes already in progress

Moreover, other vessels that had been scheduled to use the specific berth and were arriving after the (delayed) vessel, will often need to use the berth first, as most terminals follow a first-come, first-served principle. As a result, the delayed vessel may now have to wait at the port (at the anchorage or another berth) before being properly served and berth shifting might become necessary for re-arranging the vessels. Under such conditions, a terminal may then incur even further delays by having to operate under stringent measures and pressure to properly manage the available resources and successfully orchestrate the multiple operations involved. A terminal berth planner has little time to change the original plan and decide not only how (and where) to berth the ship, but also how to reallocate the remaining resources. In the meantime, berth shifting might also become necessary for re-arranging the vessels; the continuing arrival of other ships further reduces the berth availability.

At this point, we should also emphasize that the cascaded problems resulting from an inaccurate or late notification of a changed ETA do not necessarily end at the particular port where the call is made. The aforementioned planning challenges continue for the next port as well. It is highly likely that any lack of clarity or detail on the ETA to the first port of call will result in an equally inaccurate or unreliable ETD that, in turn, will affect the reliability of the ETA for the vessel arriving to its next port. Note, that such changes in plans without appropriate warning can result in financial losses for the shipping company because of penalties when a vessel does not arrive at the planned time.

#### How can PortCDM help terminal operators?

Based on the responses from terminal operators, it appears that many benefits could be realised through implementing PortCDM and enabling real-time data sharing among the port actors. Following is a list of some of the most sought after benefits highlighted during the interviews:

- Fast vessel turnaround
- Decrease in time ships spend alongside
- Better utilization of berths
- Reductions in waiting times
- Reduction in average time needed to service a ship
- Better visibility of other operators' plans
- Improvements in predictability and resource planning
- Better understanding of the daily situation in a port

- Improvement in scheduling capacity
- Better port-2-port communication
- Common understanding and situational awareness regarding port call operations

#### PortCDM: Sharing data and benefits

For carrying out an optimal port call, all the core stakeholders involved in a vessel's arrival and departure from a port (including the terminals), need to have ETAs and ETDs reported and updated in real-time. This enables a common situational awareness of plans of the key timings and events to be shared among the port call actors. It is very important that all this critical information is aggregated in a standardised form and accessible from one place/system – for example, through the PortCDM data platform. This is essential, especially in the case where multiple operators co-exist within the port ecosystem (private companies, government, semi-government, etc.), and where the data exists across various operational systems that are not necessarily interconnected. In such a case, visibility and transparency is lost since changes on one system are not reflected and shared elsewhere. In the end, nobody has a complete picture of what is happening in the port, leading the actors to often make poorly informed and therefore sub-optimal decisions.

To address this, the core actors need to agree on ways to share critical timestamps – ETAs, ETDs, ATBs and ATUBs and to improve real time information exchange, collaboration and communication. Here PortCDM plays an important part.

PortCDM can help eliminate bottlenecks in the arrival/departure process. In this way, it will reduce the ship turnaround and waiting times and improve port productivity. PortCDM builds upon the idea that timestamps that are already being used by individual actors in port operations are collected, aggregated and shared within a common framework and made available to concerned actors in other contributing and concerned organizations. These timestamps cover various important aspects of the port call process, from the ship's intention to arrive until its departure for the next port after completing its scheduled operations.

In order to succeed, a common understanding among the actors involved must first be developed. If achieved, it will enable owner-controlled sharing<sup>8</sup> of intentions and critical information (timestamps) in real time using a standardized message format with all the involved actors. A shared situational port call awareness, as described in the PortCDM concept and transmitted in the standardised, internationally recognised message data format now being developed by IALA<sup>9</sup>, enables all actors involved to get the complete picture of the different port call events with time stamps for the different actors' intentions. This provides an enhanced basis for making better and

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<sup>8</sup> Lind M., Bergmann M., Haraldson S., Watson R.T., Park J., Gimenez J., Andersen T. (2018) Creating a mature data sharing regime – Thriving in the connected ecosystem, Concept Note #4, STM Validation Project

<sup>9</sup> Lind M., Bergmann M. Watson R.T., Haraldson S., Park J., Gimenez J., Andersen T., Voorspuij J. (2018) Towards Unified Port Communications – from a project format to a global standard, Concept Note #9, STM Validation Project

more accurate estimates. Sharing real-time data about a delay or the early completion of an event allows all the actors having a role in an event to re-plan their operations in accordance with the changed conditions. Within their specific constraints, they can make any necessary modifications, not only for that specific port call, but also for other related port calls and as such, improve the efficiency of their operations. Within the overall frame of STM, PortCDM is all about sharing data and benefits in port operations!<sup>10</sup>

### **Conclusions**

In this Concept Note we have looked into the role of terminal operators in relation to the part that they play in the development of ports as transshipment hubs. We have identified the challenges that they face – particularly in relation to operational planning and scheduling.

We note that a terminal operator cannot act alone in a port and pursue necessary operations. There needs to be collaborative arrangements among the maritime authorities (government), service providers, shipping lines, and other ports. Some major ports report that being the last port, in a chain of ports can cause severe problems in predicting the time of arrival for ships making a (transit) port call. This shortcoming is an opportunity for tier-2 ports to enhance their competitiveness through better management of the chains of visits associated with the hub. Data sharing creates the foundation for increasing the efficiency of voyages associated with a hub.

We have identified that the Port Collaborative Decision Making (PortCDM) concept, building on a standardized message format for sharing time stamps, is a very powerful enabler of more informed, efficient and reliable planning and execution of operations. It encompasses improved intra- and inter port collaboration including external collaboration with shipping lines and hinterland operators as well as improved information exchange between all the involved actors in the transport chain including terminal operators, shipping lines and hinterland operators.

Such improvements in the exchange of digital data will enable coordination and synchronization and help to optimize port call operations. However, this in itself will not necessarily create a port with competitive transshipment capabilities. As well as competitive fees and the infrastructure to support transshipment, it needs to invest in software and relationships that enable it to make its customers, shipping lines and hinterland transport businesses, more efficient. For example, it should be able to help its customers to minimize the effects of a delay in a network port or the hub.

Depending on the local situation terminal operators may be well situated to be hub orchestrators within the port. They have domain knowledge of cargo handling, they might have the capacity to reallocate resources to minimize current and future disruptions, and they have the potential to

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<sup>10</sup> Lind M., Karlsson F., Watson R., Bergmann M., Hägg M. (2018) Empowering the chain of operations in berth-to-berth sea transports by digitization, Concept Note #8, STM Validation Project



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create alliances, or outright purchases, of terminals in a transshipment system to attain the decision rights for more effective decision making.

We started this Concept Note, by observing that the shipping industry is a self-organizing ecosystem. This does not mean that it is a static collection of highly independent operators, but rather, that it is a dynamic cluster of continually changing alliance and ownership structures that emerge to generate higher levels of capital productivity. For instance, some shipping lines have purchased terminals because owning a combination of vessels and terminals provides a higher return on investment than purely operating ships.

Digitization creates opportunities for new structures for capital creation. It can enable alliances to achieve high levels of coordination through real-time data sharing. It can give early adopters an advantage that they can extend by acquiring laggards and giving them state-of-the-art information systems. This means shipping eco-system members need to be vigilant and continually search for opportunities to use digitization to bundle shipping services in new ways to provide superior customer service. In this Concept Note, we have identified the transshipment hub, and terminal operators specifically, as entities with an opportunity to use digital data sharing to gain a competitive advantage by adopting and extending the PortCDM concept. It is time to start conceptualising HubCDM as a new initiative for the shipping industry.

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