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Empowering the chain of operations in berth-to-berth sea transports by digitization

by

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The STM concept is born

A core shipping problem is a lack of means to share and communicate desired events and the times thereof due to problems in information exchange during sea passage. This has made sea transport an isolated and unique industry. Observe, almost 90% of world trade travels by sea. With today's technology, it is possible to increase efficiency by enabling sharing of critical data among stakeholders and at the same time increase safety & security. In the light of the data processing and connectivity efficiencies of digitization, sea transport can be more synchronized and transparent within the entire transportation system during an entire sea passage and its endpoints in port operations. Several initiatives for digitizing the maritime sector have been posited, both commercially and concept wise. Introducing digitization in the maritime sector will also bring opportunities for new business models and contracting models.

In 2009, the concept of Sea Traffic Management (STM), led by the Swedish Maritime Administration, started to take form in a EU-funded project (MONALISA). Then, STM aimed at enhanced safety by allowing ships to share their intentions and routes with shore side actors like VTS or Port Control. At the same time, ports were given the opportunity to receive real-time ETA data during the sea passage from departure berth to arrival berth. The need for standardisation and the potential of data sharing of voyage plan information, both spatial and temporal, past, present and intended was elaborated. Major logistical benefits were anticipated by sharing entire voyage plans and their contained data, instead of just the singularity of the ship. Sharing these data will also enhance safety and security aspects and enable completely new ways of monitoring and manage sea traffic.

MONALISA was successful and paved the way for another project MONALISA 2.0, which extended STM to embrace safe, efficient, and environmentally sustainable sea transport. To some extent, this project was inspired by the aviation sector's experiences and lessons from the SESAR program. During this effort, an IEC standard for voyage plans was developed and approved. During MONALISA 2.0, three

operational concepts were coined; voyage management, flow management, and port collaborative decision making. Furthermore, the scope of STM was set as berth-to-berth. Consequently, in STM this scope was to include both a ship-centric and a port-centric view tied together with an overall voyage-centric view covering the berth-to-berth process including the port call processes at each end. This also meant that STM undertook the challenge of integrating different practices on a new level; operations at sea and within ports, which had not been previously integrated at scale. By looking at the whole voyage berth to berth and its different operations at the endpoints on a new level a number of previous efficiency-inhibiting problems could be overcome. Efficiency cannot be pursued without taking into consideration both single and multiple instances of ship movements and a port's current conditions. Efficiency is tightly connected to environmental sustainability, such as with green steaming whereby a ship arrives and is served at a port just-in-time providing foundations for re-evaluating existing contractual models (such as charter parties). STM also creates means to increase safety of navigation by means of shared situational awareness and new efficient ways to organize traffic in dense areas and/or at port visits. At its core, STM connects port efficiency, navigational safety, and sustainability, and creates opportunities to enhance the mode of transport on all levels.

Opening up for validation of the STM concept

In June 2015, the EU commission granted funding for one of the largest sea transport project ever lasting from 2015 to 2018. The purpose was to validate the STM concept emanating from MONALISA 2.0 and prepare for its scaled implementation in the maritime industry. As digitization was also knocking on the door in the maritime sector, this made the introduction of STM very relevant because it relies heavily on digital data sharing and connectivity. Thus, it was appropriate that 2017 was deemed as the year when digitization came to the maritime sector.

Revisiting the foundations of digitization of ecosystems: Systems of framing and capital conversion

As Sea Traffic Management addresses an ecosystem, it becomes relevant to re-visit the foundations of such phenomenon:

- All organizations and ecosystems are in the business of capital creation[1] Typically, they pursue economic capital creation, but some pay prime attention to other forms, such universities on human capital. A shipping company creates economic

[1] The different types of capital are: natural, economic, human, organisational, social, and symbolic

capital by using its ships (economic capital) to move products from export to importer.

- Organizations can employ multiple combinations of systems of engagement, framing, inquiry, production, and record in their capital conversion repertoire. Shipping is a system of production because it follows routine practices in transporting goods. It also creates a system of record, as do all actors in the ecosystem.
- The goal of an organization or ecosystem is to create a competitive bundle of complementary capitals and capital conversion processes. *Digitization is an opportunity to change the competitiveness of a capital bundle.*

In the table below, these system types are depicted with example from the shipping sector.

Type	Intended focus	Example
Engagement	Collaboration & coordination	STM
Framing	The reason for behaving in particular ways	Shipping culture
Inquiry	Knowledge production	Data Analytics
Production	Products and services	Movement of goods
Record	Data	AIS, Time stamps

Some basic foundations of STM

STM has some key foundations. First, sea transport is a global phenomenon. This means that to extract the full efficiency gains of STM, there must be a high level of global adoption. Second, due to some culturally-determined drag on higher levels of collaboration, the introduction of digitization and greater connectivity to support higher levels of synchronization will challenge current practices and likely require a rewiring of systems of framing.

The STM concept aims at sustainability gains in systems of production, such as berth-to-berth times, to raise capital productivity, as well as providing stakeholders, external to the maritime sector, incentives to utilize shipping in their capital creation processes that require the movement of goods.

Standardized message formats need to be adopted among different stakeholders to enable capital conversion activities to seamlessly connect across organizations. Thus, general adoption of STM's Route Exchange Format (RTZ) and Port Call Message Format (PCMF) is essential. The Route Exchange Format provides both the geographical nature of the voyage and the schedule of the whole voyage including departure and arrival times, while the port call message provides a basis for sharing intentions and outcomes (in the form of time stamps), such as when a berth is available and needed, associated to movements, services, and status of agreement

processes. RTZ has the status of being accredited as an approved IEC standard and PCMF has the status of being proposed as an IALA S-2xx standard within the GI-registry.

The maritime sector is a distributed ecosystem with many competing and autonomous actors. This drives a need for establishing technical interfaces and operational procedures for episodic collaborations, and their facilitation becomes an important factor in enabling integrated systems of production. Hence, within the ecosystem there must be agreements of when, what, why, and how to share data. An important cornerstone of STM is that the information provider will control of which recipients (actors and/or cluster of actors) received shared data directly or indirectly.

Importantly, STM must also become concerned with facilitating the sharing of the systems of record for port call participants to provide a basis for port-level analytics (system of inquiry), as part of optimizing the ecosystem's performance. The same goes for providing a basis for optimization providers of voyage management services for voyage-level analytics. Without a holistic understanding of operations, neither a port nor a ship cannot achieve high levels of capital productivity. By the introduction of STM, a move is made from multiple systems of production for each player to an integrated system of production for sea transports berth-to-berth.

STM builds on three enablers;

- **Voyage management** with a focus on supporting a ship, shipping company or port to execute an efficient and safe sea passage berth-to-berth with for example reliable arrival times (estimated and desired) with high accuracy and in real time.
- **Flow management** with a concern for providing guidance to single or multiple ships in narrow and/or congested waters or waters with other constrains, temporary or permanent to achieve a safe and efficient passage.
- **Port collaborative decision making** with a focus on preparing and realizing port call operations for just-in-time operations and minimal turn-around time enabling that the port call process can be pursued with a high degree of predictability in its different events. It is important to achieve a high degree of predictability for the time of departure.

These concepts are bound holistically for STM and therefore interrelate in different ways, such as:

- **Voyage management and port collaborative decision making interaction**: port call synchronization is a common task to ensure that a ship arrives when a port is ready to serve it, as for instance, enabling the ship / shipping company to achieve an optimal speed profile for a voyage or to communicate port operational changes to upcoming operations on arrival.

- **Port collaborative decision making and flow management interaction**: port call coordination considering multiple ships' and ports' interfaces to a shore centre provider for enhanced situational awareness, safe passage, and for example, allocation of timeslots.
- **Voyage management and flow management interaction**: ships sharing voyage plans with shore centres to enable the provision of traffic synchronization and monitoring services by the combination of multiple data streams.

Besides these three operational enablers, STM also recommends a technical concept emphasizing inter-operability. This digital infrastructure, SeaSWIM, address the need for identity management and service discovery across the industry.

To summarize; STM address all systems type in the following way:

Type	How this is addressed in STM
Engagement	Technical and operational procedures for collaboration and coordination
Framing	STM is a new frame for raising the industry's efficiency and sustainability.
Inquiry	Foundation for optimization and safety services (such as route optimization, port call optimization, enhanced traffic monitoring and management of traffic flow) being established
Production	Integrated performance in sea transport berth-to-berth
Record	Essential records captured for optimization and integrated performance

Hold on to the vision for long-term gains

STM is a vision. It supersedes old frames that are no longer viable in the era of digital data processing and connectivity. Without new ways of thinking and acting, the industry will miss critical opportunities to raise its capital productivity and sustainability.

The realization of STM requires many actors' participation. Actors being part of the value chain need to ensure that their operations are pursued in an integrated manner and service providers need to be encouraged to provide holistic services. We will likely see movements by existing providers to develop proprietary solutions.

STM with its enabling concepts provides an arena for service innovation by providing means for third-party entrepreneurs to provide new services. As elaborated in this concept note, common message formats is a first step towards global harmonization. Data sharing through collaboration is an important means for achieving enhanced ecosystem performance. STM provides an arena to develop capabilities towards a

long-term vision where smaller pieces, such as a minimal set of state data, are shared in the beginning of paving the way for a system of records with enhanced state sharing, or fragmented routes are shared as a first step towards fully fledged route data sharing as the first step towards a more comprehensive data sharing system. We already see how third-party innovators enter the maritime sector to provide innovative services, as a contribution to capital conversion systems, based on data shared within the maritime sector.

The original data owner will control their data sharing. For example, a terminal operator might share time stamp data with actors within the port to support minimizing vessel turnaround, which should advantage the terminal operator. These data would not be shareable with others outside the port, unless permitted by the terminal operator.

STM provides new features for many actors, both for those responsible for the installed base, as well as for those desiring to become part of maritime ecosystem's service provisioning. Within the STM validation project, 300 ships, 5 shore centres, and 13 ports are engaged in validating STM. This is an important first step to encouraging continual investment in the industry. Up to this point technical interfaces have been established as a part of the systems of production, such as interfaces and procedures for sharing voyage plans, as well as providing a systems of records to support the distributed coordination of port call operations. Systems of inquiry have also been established with diverse analytic and optimization services.

We expect to see other initiatives based on the principles of STM that will enable a larger degree of integration across the ecosystem. The vision of STM is much larger than the immediate actions that we see today. There will likely be a balance between emergent vs. regulative standardization. A first step has been taken to elaborate on the necessary technical and operational standardization informed by industry practices.

Final words: STM changes the system of framing

A system of framing defines how an organization or industry justifies its role and establishes its mission. When Alfred Sloan took over GM in 1923, he set its frame as, "a car for every purse and purpose." Henry Ford stayed with his earlier frame, "any color, as long as it is black" and within a few years GM eclipsed Ford in terms of annual sales. Accepting the STM frame means that each player in shipping industry needs to rethink its systems of engagement, production, record, and inquiry. In particular, it needs to review how it digitizes them and how it shares data within the ecosystem. We urge each member of the shipping industry to take such a review of the impact of digitization on its framing of its purpose, and how digitization affects

each of its fundamental systems. STM proposes a holistic frame of sea transport for the multitude of members of the ecosystem. The framing for STM is set as "*sharing data and benefits*"

Ford was lucky, it failure to reframe was not fatal, but it never regained market leadership in automotive sales. Can your firm be so fortunate?

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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.

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