Autonomous and interconnected technologies for the container supply chain: The MOSES Concept

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Introduction & Concept

The maritime branch of the EU container supply chain is configured as hub-and-spoke networks where large containerships transport cargo to Deep-Sea Shipping (DSS) ports and a limited number of Short Sea Shipping (SSS) feeder lines and container trucks on RoPax vessels distribute cargo to smaller ports for further transhipment. However, economically, environmentally, and socially unsustainable land-based transportation still covers most of the cargo transhipment from Hub ports. MOSES aims to significantly improve the modal shift to SSS by creating sustainable feeder services to small ports that have limited or no infrastructure (Figure 1). This will be achieved by developing the following highly automated/autonomous technologies and integrating them in existing operational processes: i) a digital collaboration and matchmaking platform (**MOSES platform**), ii) an **innovative, green feeder vessel** with a **robotic container handling system**, iii) a manoeuvring and docking scheme where **autonomous tugboats** collaborate with an automated mooring system.

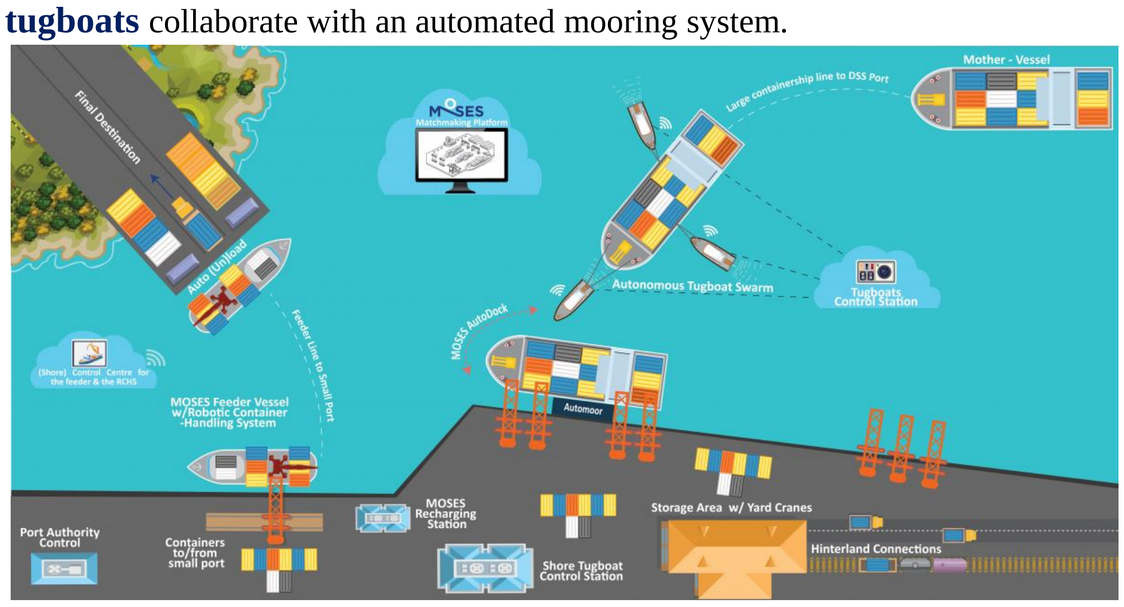

Figure 1: MOSES Concept and innovations

MOSES Matchmaking platform proposes a solution where data feeds from various sources allow logistics stakeholders to optimise and adjust routing plans, bringing the PI one step closer to the targets set for 2030 and 2040.

Objectives

- Create sustainable, efficient SSS services that are competitive to land-based transportation (road/truck and rail) by enabling interconnected and horizontal collaboration between shippers and port operators, as well as other logistics stakeholders.
- Stimulate synchromodality by exploiting the interoperability and interconnectedness of Physical Internet systems, which provide efficient and more environmentally friendly cargo transport and induce a positive modal shift to SSS.
- Improved efficiency and end-to-end delivery times of SSS mode, by balancing the backhaul traffic through sustainable feeder services and automated tugboats that will reduce lead and waiting times for large containerships in DSS ports.

MOSES Matchmaking Platform

MOSES matchmaking platform is an advanced digital collaboration platform, that aims to foster the multidisciplinary horizontal collaboration (Figure 2) and interaction between key actors of the maritime supply chain by offering scenario–building capabilities that consider as-is and to-be costs, energy efficiency, and environmental footprint. The platform will also encompass a specific module for sharing information on empty containers.

The platform will get as an input relevant cargo data offers and respective flows in both parts of the SSS route from the respective stakeholders' systems, besides a comprehensive map of alternative transport modes' traditional flows. Using a Machine Learning matchmaking logic and data driven-based analytics for the best cargo allocation, the platform will aggregate the information over multiple shippers and make the data visible to logistics service providers by capitalising on both sea & hinterland transport modes (road/truck, rail and inland waterways).

The MOSES platform will be supported by suitable governance models and will enable shippers and carriers to consolidate flows for both directions, addressing planned deliveries/spot capacity, whilst triggering inter-firm collaboration, which is critical in the innovation process.

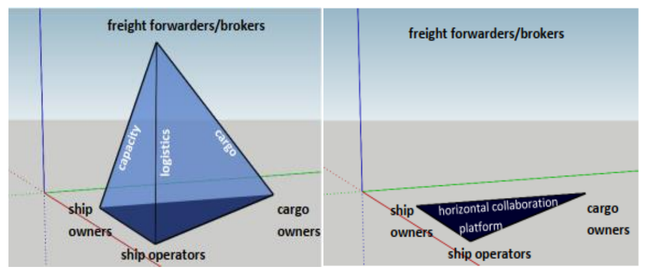

Figure 2: Left: the current status of collaboration, Right: The expected level of collaboration

Innovative Feeder Vessel with the Robotic container-handling system

MOSES innovative feeder will be a new automated ship design with reduced environmental footprint that will enable optimized and automated/autonomous operation during sea passage between large and small ports and will be designed with the outlook of fully autonomous navigation in the future. The innovative feeder services will be supported by the capabilities of the MOSES matchmaking platform in terms of the available and required cargo flows. MOSES innovative feeder will be outfitted with an autonomous system for cargo handling (Figures 3 & 4). The **MOSES robotic container-handling system (RCHS)** will be designed as a fully self-supporting system, without requiring human intervention, and it will be capable of safely (un)loading containers from the innovative feeder to the quay side. To detect containers, their relative position, and other relevant operational parameters, an advanced sensor suite is necessary for building an accurate 3D-world model of the operating environment. This 3D-world model will also detect people and objects other than containers (e.g., trucks) for maintaining safety. The RCHS will be coupled with a human operator, who will supervise the operation from a Shore Control Station (SCS).

Figure 3: Graphical representation of MOSES feeder with the RCHS

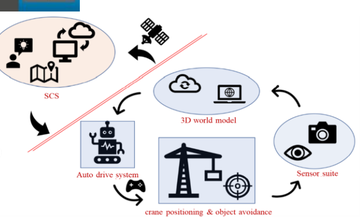

Figure 4: Concept map of MOSES RCHS

MOSES Autonomous Tugboats

The **MOSES Autonomous tugboats swarm** will assist a large containership approaching the DSS port with the manoeuvring process. MOSES will develop technologies that can be retrofitted to existing tugboats that include hardware units, AI and navigational control software, and sensors. These will enable them to work cooperatively in a swarm formation. The MOSES autonomous tugboats automate the docking process of a large mother vessel by collaborating with a re-engineered version of the Trelleborg's AutoMoor system (MOSES AutoDock). The tugboats swarm is monitored through a remote-control station located at the DSS port (MOSES Shore Tugboat Control Station), which continuously monitors and gathers information about the process until the vessel is safely docked and communicates with the Terminal Operation System (TOS) to initiate stevedoring operations. The container owners can subsequently use the MOSES matchmaking platform to determine the best connection (i.e., hinterland or SSS**)** based on parameters such as Turn around time (TAT), cost, and environmental footprint.

Conclusions & Ambitions

MOSES automation technologies will minimise safety risk in manoeuvring, berthing, and cargo handling in seaports. The modal shift and optimisation of MOSES will also reduce the environmental footprint per transported TEU through optimisation of next-leg deliveries and modal shift to SSS and rail. MOSES innovations include the deployment of multiple data producing devices that will contribute to the development of logistics applications and an automated, interconnected, multimodal transportation system, in line with the ALICE Physical Internet Roadmap.

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