

Development of an advanced, efficient and green intermodal system with autonomous inland and short sea shipping – AEGIS

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Abstract

The development of an advanced, efficient, and green intermodal system is a substantial aspect for achieving sustainable growth and reducing road congestion and emissions. A major objective therefore is the transfer of more than 75% of road transport to rail and waterway until 2050 [1]. In line with this objective, the AEGIS project aims to create a new waterborne transport system for Europe, incorporating autonomous ships, shore support, and port infrastructure, while leveraging digital information exchange to streamline administrative processes across the entire supply chain [2].



Figure 1: AEGIS use cases [2]

In the AEGIS project concepts based on autonomous short sea shipping as well as inland shipping and hinterland transportation solutions were developed. A major aspect in the development of the vessel concepts was the reduction of greenhouse gas emissions in alignment with to the regulations of the European Union [3] and IMO [4]. New designs for autonomous ship types powered by low or zero emission propulsion systems operating on batteries or non-carbon fuels were developed. In addition to that feasible on-board cargo handling systems as well as automated ports and transshipment systems were developed. All developments were carried out on three selected use cases (see Figure 1) for short sea and inland waterway transportation in Europe.

The AEGIS use cases represent typical short sea transportation that needs to be linked efficient to local distribution systems, like hinterland transportation via fjord or inland waterways. An innovative system using a mother-daughter vessel concept (see Figure 2), linking coastal container ship from Rotterdam with loading capacity of about 1100 TEU to rural and urban destinations within the Trondheim Fjord was developed in **use case A**.



Figure 2: Mother–daughter vessel concept of use case A. 1100 TEU mother vessel, 100 TEU and 60 TEU- shuttles

In order to enhance the flexibility and resilience of the waterborne transport system, AEGIS focusses on a strategy of using smaller shuttle designs equipped with on-board handling systems and a cargo capacity ranging from 60 to 100 TEUs. This approach enables efficient distribution of cargo to terminals within the region. By leveraging these smaller shuttle vessels, the system enables flexible adaption to varying demands and operational conditions, contributing to increased flexibility and resilience. Those smaller zero-emission and autonomous ships can decongest roads and reduce pollution from noise and dust. Another approach is the implementation of zero emission pushed convoys, utilizing unmanned, self-propelled barges designed for transporting various types of cargo, such as containers or general/bulk cargo.

In Case B, innovative solutions for waterborne hinterland transportation in the inland waterways of the Netherlands, Belgium, and France were developed. The primary objective was to optimize cargo delivery by bringing it as close as possible to the final destination. This could be achieved through the utilization of smaller zero-emission RoRo vessels, with a capacity of approximately 10 to 70 trailers, and leveraging the advantages of increased automation in the conceptual designs (see Figure 3).



Figure 3: Use case B- class II, IV and VI RoRo vessels

In **case C** two different vessel concepts according to the port situation of two Danish ports were developed, in order to demonstrate how existing ports can use autonomous systems to facilitate the transfer of cargo from trucks and increase their shifted cargo. The development comprises a RoRo vessel with a capacity of about 55 trailers and combi-coaster with a capacity of 4250 DWT.



Figure 4: Use case C- coaster (left) and RoRo vessel (right)

The paper shows the developed vessel concepts as well as the corresponding KPI's [5] and the necessary legal recommendations [6-8] in order to implement the developed transport system in the future.

Literature

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