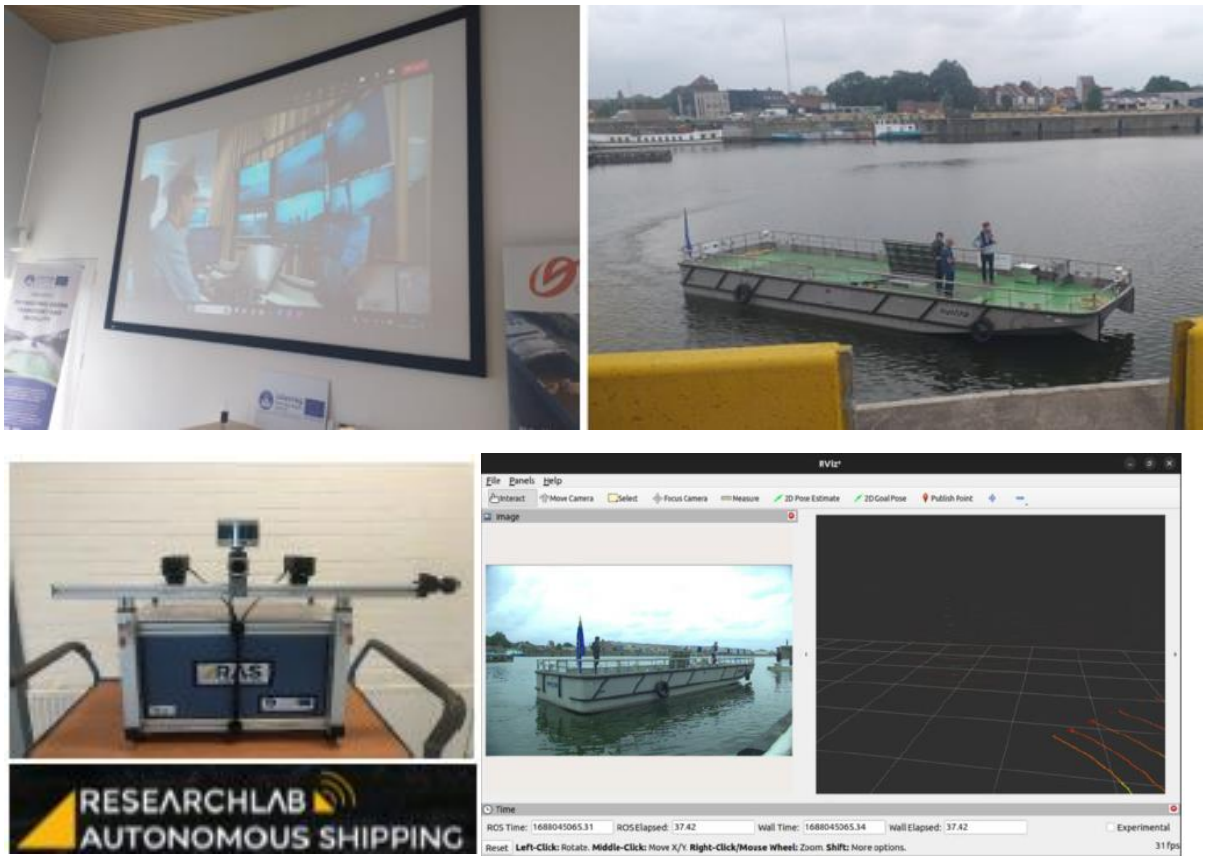

Best practice manual

Within the framework of the Interreg NSR project AVATAR work package 2

AVATAR is a project co-funded by the
Interreg North Sea Region programme 2014-2020

Colophon

- *"Best practice manual" within the framework of the Interreg NSR project AVATAR work package 6.*
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See also: AVATAR website and Linkedin

Project partners AVATAR:

1. Introduction

The massive under-exploitation of inland waterways (IWW) in the North Sea Region (NSR), especially in and around urban environments, provides opportunities for technological innovations. The AVATAR project aims to deploy (highly) zero-emission automated vessels that can do regular trips between the urban consolidation centers outside of a city and inner city hubs.

The original AVATAR project ("call 11") aimed to tackle challenges of city freight distribution by developing, testing and assessing adequate technologies and business models for urban (highly) autonomous zero-emission Inland waterway transport (IWT) solutions. Through this, the project unlocks the economic potential of urban vessels and corresponding waterways, increases available solutions for full-cycle automation and sets up a sustainable supply chain model for urban goods distribution and waste return.

The goal of the AVATAR extension ("call 12") is to set up the market-proof foundation of an autonomous open source fleet to be used for city freight distribution (inland waterways). The current AVATAR project served as a basis and has been extended with the needed building stones (topics). Therefore, additional topics have been introduced as well as new project partners are involved.

In this report, focus is on:

⇨ Key learnings reported by AVATAR project partners.

2. Key learnings reported by AVATAR project partners

- AVATAR has shown that city freight distribution via inland waterways is possible, if cities and municipalities support it.
- We are very happy that several transport use cases defined in AVATAR will now be piloted in Hamburg and Ghent through follow up projects such as InnoWaTr 2.0 and DECARBOMILE.
- AVATAR project succeeded in showing realizations. Very satisfied with the cooperation with all partners to arrive at a remote-controlled vessel that can be used for further testing and economic use.
- An exceptional result of the project is the collaboration with various research institutions in the context of autonomous sailing, use of Galileo and testing lab results. From this project, the test and expertise center has grown that makes ships, hardware and software available to R & D organizations to carry out all kinds of tests.
- In a remote-control setup, the communication layer between ship and shore is the most important component. It is used to secure the connection, to make sure that the commands

arrive and to enable a low latency communication. At the same time, connection failures show that the fallback routines for the remote control must also exist.

- When a vessel is remotely controlled, a remote operator must always have a complete overview of the situation. This enables him to intervene immediately in a critical situation. At the same time, the remote operator must be familiar with the interface and the control system, so the functionality must be abstracted, and a single interface must be used for different vessels. Technical details such as thrusters, rudders or maneuvering thrusters must be combined and represented in a uniform way in order to standardize the overall behavior of different ships under the same remote-control commands.
- Energy use case. CO2 reduction of 97.528 kilograms per year compared to a diesel truck equivalent of CO2 absorption of 8,13-hectare forest surface. 8,13-hectare forest surface is than again the equivalent of 12,5 soccer fields. Imagine what a fleet of autonomous AVATAR vessels can do !
- The benefits of implementing the AVATAR vessels go beyond the significant CO2 reduction, it also leads to reduced traffic, reduced noise and more safety in the city center.
- Urban waterway logistics has the potential to become a solution for sustainable logistics when we are prepared to revive our urban waterway infrastructure.
- Based on the business model developed by the partners, companies operating in the logistics sector, dealing with investment cycles and OPEX and CAPEX (operating costs/capital costs) data, can decide to invest in new green urban vessels, knowing that there is an adequate return on investment.
- Our experience, after carrying out the tests, is that the use of autonomous sailing via remote control from a shore control center is not yet an obvious solution. On a theoretical level, this is a great opportunity in response to the lack of helmsmen, but there are still many technical obstacles to overcome with regard to autonomous navigation in an urban environment.
- In conclusion, while the idea of providing open access to remotely operated vessels for external entities may hold certain benefits, it introduces a plethora of security risks and financial implications that must not be underestimated. To ensure the safe, secure, and sustainable utilization of these innovative maritime technologies, stakeholders must carefully weigh the advantages against the potential drawbacks. Prioritizing robust cybersecurity measures, staying alongside of evolving threats, and building long-term financial strategies are imperative for the successful integration of remotely operated vessels into modern industry practices.
- It turns out that, from a commercial and regulatory point of view, risks will occur when a SEAFAR controlled AVATAR vessel would be controlled by other operators. On the other hand, that doesn't mean it is not possible. During the AVATAR project, it has been shown that the KUL Maverick vessel and the TUD vessels (each with their own remote control system) has been integrated with another UOL remote control system. This has been demonstrated in AVATAR WP3 and WP5-activities.

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