Why autonomy in waterborne transport? – A systematic review

Marco Molica Colella (Ph.D)
Senior Innovation Consultant at CiaoTech (PNO Consultants)
Project Coordinator

07 September 2022

The project has received funding from the European Union’s Horizon 2020 research and innovation program under Grant Agreement N°815012.
AUTOSHIP
AUTOSHIP aims at **speeding-up the Next Generation of Autonomous Ships**

Bridge the missing gap to **integrate and develop Key Enabling Technologies up to Demonstrating autonomous vessels in real environment** Short Sea Shipping and Inland Water Ways.

Actively **contributing to understand** business cases, regulations, standards, liabilities and **socio-economics of autonomous shipping**

---

**Achievement:**

Retrofit and operate 2 remote and autonomous vessels and their needed **shore control and operation infrastructure**, reaching and going over TRL7.

<table>
<thead>
<tr>
<th>Inland Water Way</th>
<th>Short Sea Shipping</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vessel type</td>
<td>Fish-feed carrier with a 1462 deadweight capacity-DWT and 74.7 m length</td>
</tr>
<tr>
<td>Operational focus</td>
<td>Transit, docking &amp; undocking, cargo operation, fish farm interaction, weather window</td>
</tr>
<tr>
<td>Autonomy level</td>
<td>3. Constrained autonomous &amp; Periodically unmanned bridge - high degree of automatic operations</td>
</tr>
<tr>
<td>Area of operation</td>
<td>Inland Waterways</td>
</tr>
<tr>
<td>Rules &amp; regulations</td>
<td>National Authorities and local governing bodies</td>
</tr>
<tr>
<td>Shore operation</td>
<td>Route planning, monitoring, remote controlled operations, exception handling, decision support</td>
</tr>
<tr>
<td>Infrastructure</td>
<td>RIS (River Information System), VTS, Lock interaction</td>
</tr>
<tr>
<td>Connectivity</td>
<td>Near land possible use of mobile networks and shorter range communication</td>
</tr>
</tbody>
</table>

---

The project has received funding from the European Union's Horizon 2020 research and innovation program under Grant Agreement N°815012.
WHY ARE WE DOING IT?
CHALLENGES IN THE MARITIME INDUSTRY

With less than 100,000 vessels worldwide, shipping represents over 90 percent of world trade.

10.6 % of transport emissions. Ca. 3 % of global emissions.

Shipping is co-responsible of ocean acidification.

Emissions of air pollutants like sulphur dioxide can travel long distances.

The number of seafarers quitting the industry increases every year (safety, unsettled life, hard-work)

Modal shift targets to decongestion EU roads

Keep EU technology leadership
Green shipping would be a massive leap in pollution reduction considering most ships burn fuel oil which inevitably seems to find a way into bilge waste which is routinely dumped in the open oceans without a care, but autonomous shipping with all the variables at sea just sounds like a disaster waiting to happen, however the proof is in the pudding as they say but if accidents did happen it's only with hindsight people would show animosity toward the practice.

This should be way easier than doing cars. Not much out there to hit when far from port and most places have a pilot that boards for docking.
The definition of an autonomous (or smart) ship is not universally shared among stakeholders.

At the moment, the closest scenario to reality can be described by "constrained autonomy" which is defined as uncrewed operation with limited but relatively advanced automation onboard and supported in complex situations by operators in a remote-control center (RCC) (Rodseth, 2021).
WHY AND HOW ARE FIRST MOVERS DOING IT?

“Yara Birkeland will be the world’s first fully electric and autonomous container ship, with zero emissions. With this vessel, Yara will reduce diesel-powered truck haulage by 40,000 journeys a year”.

“Grocery distributor ASKO Will replace 150 daily truck trips with two battery driven vessels...to develop a zero emissions logistics chain involving two autonomous vessels crossing the Oslo Fjord”

- Reduction of local truck transport through urban areas
- Completely green electric transport

Cargo-owners are the promoters  New routes changing the value-chain  Safe transition/learning from humans
HOW DO GREEN, COST EFFICIENT AND SAFE TRANSPORT RELATE TO AUTONOMY?
HOW DO GREEN, COST EFFICIENT AND SAFE TRANSPORT RELATE TO AUTONOMY?

More Cargo
Operate 24/7
Reduced crew
No accommodation
Full automation

More competitive business and new operation profiles
Smaller Ships

The smaller the better: changing the economy of scale paradigm
HOW DO GREEN, COST EFFICIENT AND SAFE TRANSPORT RELATE TO AUTONOMY?

The project has received funding from the European Union’s Horizon 2020 research and innovation program under Grant Agreement N°815012.

The smaller the better: changing the economy of scale paradigm
Increased flexibility with less infrastructure needed for smaller vessels
HOW DO GREEN, COST EFFICIENT AND SAFE TRANSPORT RELATE TO AUTONOMY?

More competitive business and new operation profiles
- More Cargo
- Smaller Ships
- Operate 24/7

A better waterborne infrastructure
- Infrastructure
+ Reliability
+ Resilience

Increased societal benefits
- Energy
+ Modal shift
- Accidents

The smaller the better: changing the economy of scale paradigm
Increased flexibility with less infrastructure needed for smaller vessels
Operational and design characteristics make electrification easier
### IN SHORT: AUTONOMY IS NOT A GOAL BY ITSELF BUT CAN BE A GAMECHANGER

#### SAFETY, RENEWAL, DECARBONISATION, ROAD DECONGESTION

<table>
<thead>
<tr>
<th>Preventing Human Mistake</th>
<th>Not a Goal by Itself</th>
</tr>
</thead>
<tbody>
<tr>
<td>Optimizing crew and energy requirements, reducing OPEX</td>
<td></td>
</tr>
<tr>
<td>Increasing safety and resilience of the transport system</td>
<td></td>
</tr>
<tr>
<td>Fostering moving more goods and people from road to sea</td>
<td></td>
</tr>
<tr>
<td>Reducing emission (reducing vessels speed and improving control)</td>
<td></td>
</tr>
<tr>
<td>Improving working conditions and safety</td>
<td></td>
</tr>
<tr>
<td>Create standardised vessels concepts</td>
<td></td>
</tr>
<tr>
<td>Impacting on the whole value-chain enabling new business concepts</td>
<td></td>
</tr>
<tr>
<td>Improving reliability and resilience</td>
<td></td>
</tr>
</tbody>
</table>

#### More Cargo and Profitability

- Smaller and more flexible vessels

#### Better Energy Performances

- New control centers on the shore
SOME OPEN POINTS

• **KPIs shall be measured** in metrics that investors should understand. **Need for cost benefit analysis**

• Additional costs related to new sensor systems and automation – **business models are key**

• Integrate into the logistic value-chain to build **shared value and acceptance**
Marco MOLICA COLELLA (CiaoTech, Italian branch of PNO Consultants) is a Mechanical Engineer and PhD in Aeronautics with further executive education in IPR, open innovation, business and finance. He is a + 15 years’ experienced researcher (see here for publications), innovation consultant and manager in EU funded projects. Since 2014 in PNO, he is a Team manager and Heads of the Innovation Analysts unit. He works as Project Manager and expert in specific cleantech engineering domains, focussing on Industrial, Energy and Transport sectors. As of 2019 he is the Coordinator of the H2020 AUTOSHIP project. E-mail: m.molicacolella@cioatech.com
Thank you

7 September 2022