



Autonomous technologies also extend to the subsea environment, image courtesy of TNO

# On course for autonomy

## Taking a glimpse at the (not too distant) future

The moment when we finally see unmanned ships in our harbours and seas is still some way off. Yet, the technologies behind autonomous shipping are forging ahead at a blistering pace. With commercial shipping and naval projects kicking off around the world, the maritime sector is hot on the heels of the more advanced automotive industry. Here, Maritime Holland takes a closer look at the subject of autonomous vessels: Answering key questions about the various aspects of autonomy, the research currently being performed in the Netherlands and what the future holds.

We have seen the futuristic computer renderings picturing unmanned vessels sailing our oceans. Devoid of any sign of human presence, these hyper-modern designs are undoubtedly a vision of the future. Before we reach that future-moment though, there are a number of significant phases that the sector has to pass through first. Explaining the various levels of autonomy, Dan Veen, director of We4Sea, brings us up to speed: "The lowest level is no autonomy - this is where the captain has full responsibility for his ship. He makes all the decisions and has ultimate legal responsibility."

### Approaching the end stage

The next step is monitoring at a distance. "This is the stage where many ships are moving to at the moment. Personnel in a control room away from the vessel can assist in decision-making processes. For example, looking at the state of maintenance - how many operational hours the engine has had or analysing data from on-board sensors. This information helps the crew do their work better, but the captain still has ultimate responsibility. This is where the work of We4Sea comes in. At the moment, we are concentrating on the monitoring phase for ship owners and operators. There are a lot of gains to be made by focusing on optimising energy use and fuel efficiency."

The next advance in autonomous shipping is cooperative autonomy: "This involves sharing data between vessels. This can include information about sailing speed or course changes. This is already happening in the automotive industry. Finally, full autonomy takes the human aspect out of the loop - this is the end stage. Ship systems will make decisions themselves: There's a ship approaching, and I have to change my course in order to avoid a collision, for instance."

### Limiting factors

With the automotive industry striding ahead in the field of autonomy, it is difficult not to make comparisons between the two sectors. So what is inhibiting the progress of autonomy in the maritime sector? "Data exchange between ships is a limiting factor - there is no 4G network or Wi-Fi at sea", explains Veen. "This is the major reason why autonomy is developing slower in the maritime industry. Another limiting factor is that the shipping industry is an international industry. Data transfer needs internationally defined standards. Are you measuring distances in metres or inches? Are you using GMT or UTC time? These standards would be determined by the IMO - meaning that around 160 member countries need to agree. This would be a long process."

"The legal aspects are also very important - the automotive industry is currently experiencing the same issues. Who is responsible if something goes wrong? The trends we are seeing from the automotive industry is that systems themselves will be made liable." These legal questions are intrinsically linked to safety concerns. "The ship has to be resilient. Whatever happens, the ship has to stay afloat. In the future we are aiming for systems that technically cannot get out-of-control. They should be intrinsically safe, and as such, failures cannot result in a disaster."

### Dutch research

Bringing a considerable amount of social and technical knowledge to the table is independent Dutch research organisation TNO. Cooperating with renowned research institutes such as MARIN and Delft Technical University, TNO also works with top sector commercial maritime companies and governmental departments.

When discussing the numerous benefits of autonomy, safety is an important issue for TNO business director maritime & offshore Pieter Boersma. "The safety of complex processes in the shipping industry is often determined by humans. Errors caused by tiredness or loss of concentration can be prevented by increased autonomy. Another factor is efficiency - improving insight in the use of a ship and its infrastructure and also optimising communications between ships themselves. And it's also about reducing costs - we have invested in research towards optimisation of crew usage for many years, looking at what the minimum amount of crew is necessary to perform the essential functions of a ship."

### Looking at the specifics

Active in a broad range of industries, TNO has already gained considerable experience in the subject of autonomy from its work in the automotive sector. "We are not starting from scratch so we have a head start on this subject. All of the dilemmas and questions that have been placed in the automotive industry can be applied to the multi-disciplinary questions surrounding the issue of autonomous sailing."

"We have a number of large programmes currently happening. These include the sensor and monitoring systems that are necessary for autonomous vessels. At the moment humans are the eyes and ears on a vessel but this will change as the levels of automation slowly increase. We have also looked at shore support - what happens if you don't have people on board but have teams of experts in a shore-based



The US Defense Advanced Research Projects Agency DARPA christened the US Navy's first unmanned surface vehicle, photo courtesy DARPA

support centre instead. There will be a lot of data transfer involved - this data has to be transferred safely and presented properly to ensure that the operators can make decisions quickly and accurately. What's more, the ergonomics is also an important factor. TNO has done a lot of experimentation and has learned a lot by looking at this subject."

### Subsea too

The subject of autonomous vessels also includes underwater activities: an arena that brings with it very specific challenges. "There is no Wi-Fi, and therefore no data transfer, underwater", states Maurits Huisman, Business Developer for TNO Maritime & Offshore. "TNO is very active on this subject and we will be performing our first sea trials this year. Data transfer is accomplished acoustically - making it possible to

take on various subsea operations such as minesweeping, cleaning hulls or of cleaning oil tanks. For all these operations it is good to ask whether you need to use people for these activities or is it better to use autonomous drones."

Looking to the future, what developments are most likely to be seen? Veen: "For the time being I think this will be more of a local industry. A discussion needs to begin within the shipping sector to discuss what the industry needs and what the industry wants. For example, in an individual harbour, an autonomous vessel moving containers from a container terminal to a feeder terminal. There are no international issues and no legal issues. Such local initiatives will take place in less than five years."

### What about workboats?

Container vessel transfer is just one aspect of the goings-on in an individual harbour. Typically involving multiple vessels requiring effective communication, towing operations could also benefit from emerging technologies. Here, though, the economics of the situation will also need to be looked at. "The business model has to be feasible," continues Veen. "In the case of a tug operator, there are not that many people on board so it wouldn't deliver the financial advantages sufficient to set up a fully autonomous system. Cooperative autonomy would be better. There are numerous communication steps during the process of escorting a container vessel - all of it involving humans. A system where vessels communicate between themselves has the potential for considerable efficiency gains."

Beyond the confines of the harbour walls, the first steps made by the maritime sector into autonomous shipping could involve neighbouring countries. "Look at the amount of seagoing vessels between the Netherlands and Germany", Veen goes on to say. "If these two countries cooperated then you could have the first autonomous system set up within 10 to 15 years."

### Statements for the future

The maritime industry is admittedly a few steps behind the automotive sector. The April 2016 signing of the Declaration of Amsterdam by transport ministers from the 28 member states of the EU, European Automobile Manufacturers' Association and the European Commission goes to show the progress being made on our roads. This pan-European agreement involving deployment of connected and automated driving technologies across Europe could be used as for a blueprint for future developments in the maritime sector.

The maritime industry, both commercial and governmental, is readying itself: April 2016 saw two separate events showing this. Firstly, the US Defense Advanced Research Projects



The Finferries-owned Stella will assist the Rolls-Royce led AAWA project by carrying out sensor array tests, photo courtesy Rolls-Royce

Agency DARPA christened the US Navy's first unmanned surface vehicle Sea Hunter - a 40-metre long trimaran. The US Navy hopes to mobilise the vessel for anti-submarine warfare by 2018.

Secondly, the Advanced Autonomous Waterborne Applications Initiative (AAWA) project, led by Rolls-Royce, introduced the project's first commercial ship operators: ferry operator Finferries and dry bulk cargo carriers ESL Shipping Oy. Concluding a recent conference presenting the findings of the project's first year, Oskar Levander, VP of Innovation, Rolls-Royce Marine concluded: "This is happening. It's not if, it's when. We will see a remote controlled ship in commercial use by the end of the decade."

Tom Scott



The Advanced Autonomous Waterborne Applications Initiative project, led by Rolls-Royce, has just completed its first year, photo courtesy Rolls-Royce



TNO's research extends to shore-based control centres, photo cp

