World's first test site for autonomous vehicles opens

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We now witness a rapid development of the technology that is needed to create larger pilotless vessels that can transport cargo and maybe passengers. This is how unmanned ships can look in the future. Credit: Kongsberg Seatex

Norway's Trondheim Fjord will be the world's first technological playground for pilotless vehicles that move below, on and above the water's surface.

Snake robots, underwater drones, unmanned ships and flying drones are

craft you will soon be able to see on Trondheim Fjord, Norway's third-longest fjord located in the west-central part of the country. The area is being established as a test lab for autonomous technology – which could replace the crews on ships, among many other possibilities.

"As far as I know, this is the first test site of its kind in the world. In fact, I'm surprised at how fast the development is progressing. Now that the test site is being established, we have also received the blessing of the Norwegian authorities to try out technology that's going to amaze people," says Professor Asgeir Johan Sørensen, Director of the Norwegian University of Science and Technology's Centre for Autonomous Marine Operations and Systems (NTNU AMOS).

Good for the environment

Autonomous technology is being used to develop intelligent systems where human perception and intervention are automated. We find autonomous functions in advanced automated systems that have human operators – for example in a car's cruise control and collision avoidance systems or the autopilot on a passenger plane.

Autonomous functions are also found in unmanned systems where people are not physically present – such as on a pilotless vessel, or oil and gas installations. These often involve remote control of the vessel or installation with varying levels of autonomy, using for example satellite communications. Control is then moved from the bridge on the ship or the control room of the installation to a centre on land.

"If a fault or a delay occurs in the communication link, the systems must still be able to "think" for themselves and make decisions. In this area, we have so far made the most progress with autonomous underwater vehicles. Pilotless vessels do not necessarily mean that no people work on board, but the crew will have different functions," Sørensen says.

Today, autonomous unmanned vehicles are used to perform tasks in so-called unstructured environments with complex, unpredictable and sometimes dangerous areas, or for surveys and mapping of geographical areas. What is now happening with full force is the development of larger pilotless vessels that can transport cargo and maybe passengers. And the environment can actually benefit from that.

"Pilotless ships to carry cargoes can be built without cabins for the crew and without air conditioning systems that would otherwise be needed for the welfare of people on board. So they are both easier and cheaper to build. Pilotless freight traffic could also give us a far more differentiated pattern of transport," says Sørensen.

Vessels that sail slowly use less fuel. In the future, the speed of freight traffic could be adapted more precisely to the cargo on board. Some products must get there fast, but for others, speed is less important. This is better for the environment, and cuts operating costs.

"Unmanned vessels can also be built in ways that make them less vulnerable to attack – from pirates, for example. However, cyber security will be an issue," Sørensen adds.

New rules and standards needed

The Trondheim Fjord is highly suitable as a test site for autonomous vessels. The fjord is clear and open, large and wide, almost like a small sea – while it is demanding enough to create challenges for humans and technology to tackle. Another factor is that shipping traffic is relatively low.

Most important of all, however, is the cluster of expertise near the fjord, which includes research institutions, business and industry with long traditions of research and development in autonomous systems, vessel

concepts, aquaculture, mineral extraction and robotics. Now these players will have a test laboratory on their doorstep, but the test site will also be available for other players who need to test autonomous vessels.

Kongsberg Seatex, Marintek, and Maritime Robotics have joined forces with NTNU to launch the test site initiative. Other industrial players such as Rolls-Royce Marine are involved as well.

"This is an example of a unique collaboration between government agencies, industry, research and teaching, and it gives us a competitive edge. With the restructuring of the oil and gas sector, the stage is set for a quantum leap in the field. It is during downturns that radical innovation projects emerge," says Sørensen.

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Professor Ingrid Schjølberg is the Director of NTNU Oceans, one of NTNU's strategic areas of research. She points out that as a maritime nation, it is important for Norway to be at the forefront of maritime research and to ensure that the research infrastructure we need is in place.

"A wide range of expertise will be needed now that autonomous systems are being developed at record speed – because these systems relate to the environment, technology and operations, as well as human operators and operational safety," she says.

Difficult to predict what might go wrong

Sørensen also notes that the rapid development of autonomous systems creates completely new demands for dealing with risk and management of risk. Qualification of new technology and operations will call for an approach that focuses more on function and risk. The bottleneck for further development of the technology lies here, he believes.

"For the entire industry, it is demanding to keep up with developments. For government agencies and classification societies, it's going to be a major challenge to follow up standards and regulations, including adequate testing and verification in this area," he explains.

Ingrid Bouwer Utne, Professor at the Department of Marine Technology at NTNU, is conducting research in areas including risk assessment and maintenance management of marine systems.

She points out that new regulations are often developed after accidents have happened. Although automation is not a new phenomenon, the system complexity and dependencies are increasing. This makes it more

challenging to predict and allow for everything that might in fact go wrong.

"It's often a bit late before this risk management factor is included in the development of new technology – and this is not limited to autonomous systems," she said. "But when we get systems that are intended to run on their own, through monitoring and remote control, factors such as understanding the situation and the flow of information between the system and the operator immediately become more challenging."

"When you remove the operator from the vessel, the autonomous ship must be capable of understanding and handling challenges and adverse situations independently to a greater extent," says Bouwer Utne, who believes both government agencies and other parties see the importance of taking risk management seriously.

Provided by Norwegian University of Science and Technology

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