Autonomous in the Arctic – fortune or folly?

Arctic shipping is hot, but the climate is definitely not. Does that make it a good idea or a bad one to send ships to the far north without crew?

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Martin Bergström is a postdoctoral researcher at Aalto University in Finland, currently focusing his work on Arctic and autonomous shipping. Rather than seeing harsh Arctic conditions as an obstacle to autonomous shipping, he sees the climactic challenges a prime reason to take a closer look at the unmanned option.

“So far, there has not been much discussion specifically on Arctic applications. In any case, because I am convinced that the Arctic is well suited for autonomous shipping, perhaps even more so than non-Arctic areas, I think it is good we start the discussion.”

To Martin’s mind, the current main barrier is probably legal: “Because most rules and regulations were developed before anyone had seriously considered the concept of autonomous ships, references to specific crew tasks like the human lookout are lacking.” In order to overcome these issues, he believes the IMO will need to develop a new, goal-based regulatory framework specifically for autonomous ships.

Typically, development of any new IMO regulatory framework is a slow process, and the approval of any autonomous ship solution will require extensive real-life evidence of its safety. “Also, we need to consider that most Arctic shipping will occur in waters regulated by the Russian Federation. Because of these complicating factors, I expect that autonomous shipping will start small in territorial waters, for instance in the coastal waters of Norway and Finland, which would also mean that autonomous shipping from the very start would be adapted to semi-Arctic conditions.”

To crew or not to crew?
Sending a ship and crew on a solo voyage through a passage with virtually no infrastructure, and days away from rescue, would seem a fool’s game. Is this the primary reason for thinking autonomous in the High North?

“The fact that ships in the Arctic often are days away from rescue is a good reason for thinking autonomous. Safety risks, or immediate risk to humans, exist only where there are people. By eliminating the onboard crew, crew safety issues are eliminated as well.”

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At the same time, Arctic waters are often poorly charted, and ice poses a constantly shifting threat. Can a machine deal with such unpredictable complexities?

“Arctic ship operations are indeed complex and associated with many uncertainties. An autonomous ship would be controlled and monitored from a shore control centre, or from a mothership. Whoever is in charge would have access to the

same information as an onboard crew, and therefore I do not see why any Arctic-specific uncertainties would be significantly more challenging for an autonomous ship than for a manned one."

Certain functions, such as active measures by the helmsman to minimise the ice exposure of a ship, would likely be less efficient when performed by an autonomous system. Here Bergström has a novel solution: "For improved autonomous safety and efficiency, methods should be developed to allow autonomous systems to learn from experienced Arctic shipmasters and officers."

When mind meets machine

In considering the sharing of the seas between human and machine-controlled vessels, many are sceptical. What happens when a human pilot and a computer "captain" find themselves on a collision course?

"I am confident that autonomous and manned ships can and will coexist. To enable a safe coexistence, I think autonomous ships need to be clearly identifiable as such, so that manned ships, when operating in their proximity, can take appropriate precautions if necessary."

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He also believes that division of labour will be a factor: "Autonomous ships will surely replace some manned ships, but they might not be efficient for all types of operations, especially those requiring a high degree of flexibility and situational awareness, like icebreaking services or special cargo transport."

The level of automation of manned ships will gradually increase as well, he believes, potentially reducing crew sizes. But with even one crewmember onboard, the argument of eliminating risk to crew falls flat. Will there ever be truly autonomous ships, or is the future hybrid? "At least for the foreseeable future, I suppose we are talking about a hybrid solution, with a gradual transfer towards increased autonomy."

Even with no crew on board, Bergström is certain that humans will have a role to play. "For better or worse, humans will remain in control and continue to play an active role. Exactly what will be controlled remotely, and what will be autonomous, will be determined based on cost efficiency and regulations. Autonomous or not, all engineering systems are made by humans, and in essence autonomy is about predetermining appropriate actions for various situations. That means humans need to teach autonomous systems how to behave."

The risks

"Concerning risks to humans, the replacement of manned ships with autonomous ones could have an adverse effect on the available search and rescue capabilities. The ability to identify small objects in the water, such as a lifeboat or a person, as well as the ability to assist persons or ships in distress, could be reduced, resulting in an increased safety risk for any remaining people in the Arctic."

Regarding risks to nature, Bergström sees at least three possible adverse effects: "First, the ability to carry out immediate oil spill response measures like deploying booms, would be limited. Second, due to the absence of a human lookout, a vessel's ability to detect any oil discharges would be reduced, potentially increasing the amount of illegal discharges. Third, if autonomous Arctic shipping turns out to be profitable, an overall increase in Arctic shipping is expected, resulting in an increased environmental load from exhaust and noise emissions, which would have an adverse effect on sensitive Arctic wildlife."

The rewards

"The most obvious safety benefit would be the elimination of crew safety risks. In addition, by going autonomous, a reduction in trivial human errors, which are behind most accidents, can be expected. The most common type of accident in winter navigation is collision between ships and icebreakers." Bergström points out that fatigue, at least partially caused by extreme Arctic conditions, is often is a contributing factor to such accidents. "A well-rested shore based crew that is able to make objective decisions could reduce the risk of accidents."

As to the environmental benefits of autonomy, Bergström believes the main effect would be higher energy efficiency and consequently lower exhaust emissions. Improved energy efficiency could be achieved by removing the superstructure housing crew facilities, resulting in lower air resistance, lighter ships, and reduced onboard energy consumption. "In addition, by removing the crew, related environmental loads such as grey water and garbage, especially problematic in the sensitive Arctic environment, would be eliminated."

"In terms of economics, the most obvious gain would be the elimination of onboard crew-related costs," Bergström says. "In any case," he concludes, "the biggest potential economic benefit lies in new business models and markets, resulting in an overall increase in Arctic shipping. The winners will be those that are able to make the most of this disruptive development."