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Autonomous ships

For the past 30 years, the best way to watch the transformation of London's docklands has been to board a semi-autonomous light railway train and sit in the front seat, where you might have expected to see the train operator. Look down at the roads below and, in years to come, you'll probably notice a few driverless cars. But cast your eyes up to the far horizon and it may not be much longer before you see fleets of captainless ships.

Small, remotely-controlled craft are already being used for military purposes and in marine scientific research. But the real challenge is to build and operate unmanned ocean-going ships.

The first such vessels will be remotely piloted from a control centre on land. Imagine the bridge of a ship transplanted to a secure location on land. Instead of setting sail, the ship's master will control the vessel remotely from what's been called a "shore-based bridge".

The ultimate prize, though, is a fully autonomous ship — navigating the seas without human intervention.

But there will be intermediate stages. Lloyds Register, for example, has identified not just two but six levels of autonomy — ranging from local on-board support to entirely unsupervised operation.

Shipping law

Autonomous and remotely-controlled vessels have clear commercial advantages over manned shipping. But they don't sit easily within the existing legal framework. Some people have even suggested they shouldn't be classified as ships at all — which might deny them rights of innocent passage through foreign territorial waters.

What does the law say? Shipping law can be divided into two types. The first covers relations between states. That includes the law of the sea — part of customary international law — as well treaty rights and obligations under UNCLOS, the United Nations Convention on the Law of the Sea.

The second type of shipping law is created by individual states. An example would be the Merchant Shipping Act 1995, a law passed by the UK parliament. That applies to foreign-flagged ships in British territorial waters. But so too does the law of each ship's own flag state. So there could be conflicts between the law of the littoral state — where the ship happens to be docked — and the law of the state where it's registered.

In practice, much of the law applied by flag and littoral states can be found in the treaties and conventions they've all signed. These include International Maritime Organisation instruments such as SOLAS — the International Convention for the Safety of Life at Sea — and the International Regulations for Prevention of Collision at Sea: the COLREGS. That's fine for conventional shipping but a glance at these instruments shows how inadequate they are to deal with autonomous or even remotely-controlled vessels.

For example, the COLREGS say that “every vessel shall at all times maintain a proper look-out by sight and hearing”. Can that requirement be met by television cameras, radar and microphones? Is it sufficient for the ship’s master to maintain a proper look-out from a shore-based bridge? And could a computer comply if it has been programmed to change a ship’s speed or course — or indeed maintain it — when it detects another vessel?

What about casualties? Mariners always seek to do all they can to help others in peril. And if the master of a ship “in a position to provide assistance” learns that people are in distress at sea, the SOLAS convention requires that ship to proceed at speed to the rescue. But does that apply to a vessel without a crew? Is the equivalent duty to steam towards a marooned ship and send back information? Might the autonomous vessel need to be equipped with life-rafts that can be launched remotely?

We could answer questions such as these by drawing up a completely new legal regime for autonomous vessels. But that would be a huge undertaking. It would also lead to arguments about whether individual craft were covered by it at any given time: I’m thinking of a ship that would normally operate autonomously but might carry a small crew for maintenance. And the existing instruments should surely apply to issues such as hull construction and sea-worthiness, regardless of how a vessel is controlled.

I don’t detect any support for the view that an autonomous or remotely-controlled vessel isn’t really a ship at all. The common law works by adapting established principles to new concepts: as it did, for example, after the invention of the submarine.

And that seems to be what’s happening at the moment. The starting-point should be to look at the objectives of shipping law — which I suppose are to protect life and preserve the environment while supporting navigation — and decide how those aims can best be applied to unmanned vessels.

At its most recent meeting in June, the IMO’s Maritime Safety Committee agreed on the need for a new regulatory framework. It ordered a scoping exercise to decide “how the safe, secure and environmentally sound operation” of what it called maritime autonomous surface ships “may be introduced in IMO instruments”. As well as adapting the COLREGS and SOLAS, I expect the International Maritime Organisation will need to amend other instruments, including the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers— STCW — as well as the International Convention for the Prevention of Pollution from Ships, MARPOL. But the IMO scoping exercise is expected to take up to four years and it could be another three years after that before changes to these instruments take effect.

A UK-devised code of practice

Autonomous ships are likely to deliver commercial advantages for developers in Western Europe and other advanced countries. But states that are not so technologically advanced will have little incentive to approve new regulations; indeed, it may be in their interests to block them. Rather than wait for the IMO to take action, the UK Marine Industries Alliance has drawn up a voluntary code of its own.

In 2014, the industry established a Maritime Autonomous Systems Regulatory Working Group (MASRWG). Last year, the working group issued a code of conduct for the design, manufacture and operation of surface-based maritime autonomous systems. Under the code, autonomous ships have to be registered and marked on each side with the operator’s name and contact details. There are also provisions to ensure safe operation and to protect the environment.

But that's only the start. The working group has now compiled a much more detailed voluntary code of practice, which it plans to launch at its conference in November. I've not seen the new code and so I can't comment on the solutions it proposes. But it's said to cover operations; product design and manufacturing standards; situational awareness; communications; training and competences; base station operation; certification and maintenance; security; prevention of pollution; carriage of goods; and ship management. Let's explore a few of those topics.

Who are the masters now?

"We are the masters now," is a phrase attributed to Labour's post-war attorney general, Sir Hartley Shawcross. But who is the master of an unmanned vessel? We need to agree on that before we can revise the instruments I've been talking about.

If the vessel is remotely controlled, its master would presumably be the person in ultimate command at any given time. That could be the person actually controlling the ship's movements. Or it could be a more senior officer who has delegated his authority to the commander on duty.

If the ship is fully autonomous, the master could be the person who initially programmed its voyage. But even the most sophisticated hands-off ship will presumably be monitored by a shore-based team with power to override the programmed instructions in unexpected circumstances. Perhaps we should designate the officer of the watch — or the most senior member of the monitoring team — as the master.

If something goes seriously wrong, a ship's master faces arrest by a coastal state when his vessel enters territorial waters. That's a useful sanction; but would unmanned ships be immune from it? In a recent paper, Robert Veal and Michael Tsimplis from the University of Southampton suggest ship owners could keep a representative in every country who would be criminally liable for the ship's actions — a bit like sailors having a sweetheart in every port, I suppose.

I prefer their alternative suggestion, which is that a master and crew would be required to join an autonomous vessel, perhaps with a pilot, every time it comes into port. Although I can imagine autonomous cargo ships travelling back and forth between fixed berths and docking without the need for any on-board crew, I find it hard to believe that busy ports will ever allow an entirely unmanned foreign ocean-going vessel to approach or leave harbour.

Manning

Let's move on to crewing. The SOLAS annexe (Chapter V, regulation 14) requires flag states to ensure that, "from the point of view of safety of life at sea, all ships shall be sufficiently and efficiently manned". Does that prohibit unmanned ships? Or can we argue that an autonomous ship *is* sufficiently manned if it has systems that are designed to ensure the safety of life at sea?

That may be a good question for law students but it probably doesn't need to worry us today. In reality, SOLAS will need to be amended before autonomous or remotely-controlled ships set sail for the first time. There might have to be additional requirements, though others would no longer be needed: an unmanned ship is inherently safer because it doesn't have to support life at sea.

Training

The STCW convention, dealing with standards of training, applies specifically to “seafarers serving on board seagoing ships”. That suggests it has no application to shore-based controllers. Indeed, the convention allows states to adopt “other educational and training arrangements... provided that the level of seagoing service, knowledge and efficiency [is]... at least equivalent to the requirements of the convention”.

That sounds promising. But who’s to say whether a state’s educational and training arrangements will provide an equivalent degree of safety at sea? The wisest course of action would be to draw up amendments to the STCW convention, setting standards of training and watchkeeping for crews who operate unmanned vessels. Without such protection, it would be difficult to obtain insurance cover. What’s more, the owner or master of a UK ship — or a foreign ship in a UK port — would risk prosecution and imprisonment under the Merchant Shipping Act (section 98) if it was found to be “dangerously unsafe”.

A new legal order?

Why *are* offences like the one I’ve just mentioned confined to UK-flagged ships and other ships in UK ports? Because, of course, the courts of the United Kingdom have no jurisdiction over non-UK ships in international waters.

But for how much longer? If you were going to construct a command and control centre for your remotely-controlled ship, where would you build it? In Panama, where your ship is registered? Or just outside Southampton, whose university supports an internationally recognised inter-disciplinary Marine and Maritime Institute? I suspect you’d chose a state with good communications which has taken steps to train operators of semi-autonomous ships.

But whichever state you choose, you’ll surely be bound by its legal requirements. Nobody is suggesting that a shore-based bridge would be like a foreign embassy, with staff who can ignore the host country’s laws. You might have to satisfy the safety and environmental standards of the state from which your ships are controlled even if they never enter that country’s territorial waters.

As a ship operator, you could face civil litigation or even criminal prosecution in the country where your staff work — regardless of the flag your vessel flies. Those laws might be more stringent than the laws of your ship’s flag state or the laws of the state where your ship has docked. Treaties would have to establish which laws take priority.

And ships in your fleet might be controlled from different countries at different times. Command might be handed from one country to the next as the ship travels the world. Or control might follow the sun so that your operators would always be working daytime shifts.

For that to work, the IMO will need to establish a global operations centre to ensure that other vessels — and national authorities — can always locate and contact the base from which every autonomous or semi-autonomous ship is controlled at any given time.

Insurance

The development of autonomous vessels is also likely to have major implications for the insurance industry. The International Group of Protection & Indemnity Clubs, representing the 13 principal underwriting associations that provide P&I cover for approximately 90% of the world's ocean-going tonnage, says that legal and regulatory issues must be addressed before marine insurers can assess the risks of remotely-operated and autonomous ships. And it predicts that issues will arise under the civil liability conventions "of what would constitute conduct barring rights to limit".

So ship owners will need to know what's required of them and insurers will need to know what risks they are taking on. But once these new navigational systems have been tried and tested, they should be less vulnerable to human error and therefore safer.

And the risk of piracy will change. Crucially, there will be no crew for pirates to take hostage. On the other hand, there will be nobody to repel intruders. Unmanned ships will certainly be designed so that they are more difficult to board at sea — although there will have to be provision for maintenance crews to be winched aboard in mid-voyage.

But just as thieves have learned to clone electronic car-keys, pirates will attempt to seize control of computer-operated shipping. Thieves have already hacked into electronic bills of lading so that they can find out which containers are carrying high-value cargoes. There are now reports that computer-controlled steering systems on US Navy warships have been "spoofed", leading to serious collisions and loss of life.

P&I club members who own and operate autonomous ships will expect their vessels to be covered in the same way as conventional shipping. But other members might argue that autonomous ships carry higher risks, at least to begin with. Because this type of insurance is funded by calls rather than by premiums, a separate P&I club may be needed for owners and operators of autonomous shipping.

And there may be a shift to something more like a product liability policy. You'll no longer need to insure your crew against death or injury at sea. But you will have to insure against the risks that your autonomous ship will pose to other shipping, which may be greater than before. And by "you" I don't just mean ship owners and controllers. "You" might be a ship builder, the designer of an electronic component or even a programmer. If you're at risk of being found negligent, you'll need insurance.

Artificial intelligence

The development of autonomous shipping is an example of artificial intelligence; and I've been asked to end with a few words about that too. AI, as it's usually called, can be defined as the ability of machines to mimic cognitive functions — such as learning and problem-solving — that humans associate with other human minds. Computers can detect problems and work round them. Except, of course, when they don't — as happened in 2016 when a Tesla car being driven in Florida failed to detect a lorry crossing its path, crashing and killing its human driver. He was partly to blame; but so was Tesla.

AI is becoming more widely used by law firms, particularly in document review. Computers can sift through what may be many thousands of pages of documents, identifying and marking those that meet specified criteria. The more documents the systems examine, the more adept they become at

learning what's needed. And, provided they have been correctly programmed, the machines are less likely to miss relevant documents than the trainee lawyers who used to do this tedious work.

In shipping, the concept of machine learning will be equally important. Ships are already required to carry voyage data recorders. Operators should be required to share data from these recorders across the industry, not only in the event of a collision but also whenever there is a systems failure that could have consequences for other shipping.

The seafarer and the consumer

If remotely-controlled and autonomous ships prove to be commercially viable, they will be operated by smaller and better-educated crews. For the time being, at least, experience will still be indispensable, but computer skills will be more important than familiarity with ropes and knots. Far from seeing the world, mariners will go home and see their families every night.

Although there may be some resistance to unmanned passenger ferries, consumers will take all this in their stride. Their concern is to ensure that goods manufactured in places such as the Far East reach them on time, as cheaply as possible and with minimum damage to the environment. The law will evolve, as it always has, to meet the needs of traders, shippers, mariners and the public as a whole.

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