The marine revolution

Smart shipping is set to provide operators with the ability to better manage vessels and to do so more efficiently, effectively and safely. By **Neil Tyler**

The global shipping industry has witnessed a series of revolutions over the past 150 years, including the transition from sail to steam and the advent of containerisation in the 1960s.

Today, the shipping industry is confronted by another one – the smart shipping revolution. But what does that actually mean for the industry?

Each revolution has, by its very nature, been different and smart shipping is unlikely to change this. In the case of containerisation, for example, the industry was reluctant to accept it because of the changes and difficulties it faced by its adoption – while the industry saw the benefits, it was perturbed by the scale of the changes that would be required. It wasn't going to be possible to adopt containerisation gradually because it required a radical reorganisation of the whole shipping industry.

Will today's shipping industry respond to the smart shipping era in the same way and, if so, what kind of revolution will it be? Will we see smart ships 'talk' using nanotechnology in paints, coatings and materials and will data from a ship's structure, components and machinery be collated and used to enhance performance, productivity and safety? And will data analytics be employed to support more effective maintenance, planning and deployment?

At the heart of the smart shipping concept is communications and connectivity. The marine industry has seen dramatic changes over the past 20 years, with global communications transforming the business of shipping completely, creating a truly integrated industry.

Satellite communications, Cloud computing, the Internet of Things and smartphone technology have all combined to provide real time data and voice communications, all of which is continuous, cheap and reliable.

The Cloud means that data can now be stored in vast quantities and used for operational, management and research purposes, while the Internet of Things enables that data to be generated and acted upon without the need for human intervention.

Sensors are being deployed throughout vessels and can now monitor almost anything and provide data to automate almost everything.

Smart phone 'apps' have demonstrated that it is possible to design applications to do specific jobs, but without the need for massive computer systems.

"New sensor technologies, object detection, advances in satellite communication technology – especially broadband connectivity – the Internet of Things, Cloud computing and 'big data' have all combined to increase automation and robotics technology. This presents opportunities for ship owners and operators to manage their ships more efficiently, effectively and safely, saving them time and money," says Iiro Lindborg, vice president, Remote and Autonomous Operations, Ship Intelligence, at Rolls Royce.

Above: One of many remote controlled ship concepts from Rolls Royce

Ship builders and fleet owners are starting to recognise the role that digitalisation can play in transforming their business models, as well as how it can provide new and innovative value-producing opportunities.

However, according to Andy McKeran, marine executive, GE's Marine Solutions, there are clear challenges ahead.

"The speed of adoption is an

issue. The digital transformation is a long journey that still needs to be figured out and that will need industry-wide collaboration to demonstrate its value. Data access is another challenge. Traditional methods have created data silos and islands of automation, making it difficult to optimise operations across a vessel or systemise across a fleet."

In response, GE has taken an open approach to data management and created Predix, a cloud-based platform that is able to consolidate data to inform all aspects of vessel management, as well as digital software solutions that are equipment agnostic.

Asset performance management software, such as GE's SeaStream Insight, helps to de-risk decisions, providing practical, actionable insights into a ship's or a fleet's performance and provide opportunities to optimise operations in a sustainable way.

"SeaStream connects data collected from all vessel assets, providing operators with a holistic view of a vessel's status. By comparing real-time data with its normal operational profile – the Digital Twin – we can now anticipate and address problems before they cause an operational disruption. This predictivity will enable condition-based maintenance to enhance a vessel's operational efficiency through reduced downtime and increased productivity," McKeran suggests.

"We are proactively working with our partners to embrace this new way of working looking at the marine industry as an ecosystem, rather than dealing with individual vessels as isolated assets. As such, understanding that everything you do, every decision you make, is interconnected and will affect something else is key to identifying opportunities for efficiency.

"Finally, and crucially, we need to take into account the issue of cyber security to help us develop digital solutions that not only improve the safety of assets but also ensure they are reliable and safe," he says.

Self piloting

In Japan, shipping companies are now working with shipbuilders to develop self-piloting cargo ships using artificial intelligence (AI) to plot the safest, shortest, most fuel-efficient routes.

Mitsui OSK Lines and Nippon Yusen are working with shipbuilders including Japan Marine United and looking to use AI to predict malfunctions and other problems, which could help reduce the number of maritime incidents.

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Iiro Lindborg

Below: The Stril Luna Rolls-Royce unified bridge

Safety plays an important role in smart shipping. Up to 80% of the accidents at sea are a result of human mistakes and this could be reduced with new smart vessels. Not only that, the capacity of waterways could also be increased because of autonomous ships.

In Europe, Rolls-Royce announced plans last year to develop unmanned cargo ships, starting with remote-controlled vessels that could be operational as soon as 2020.

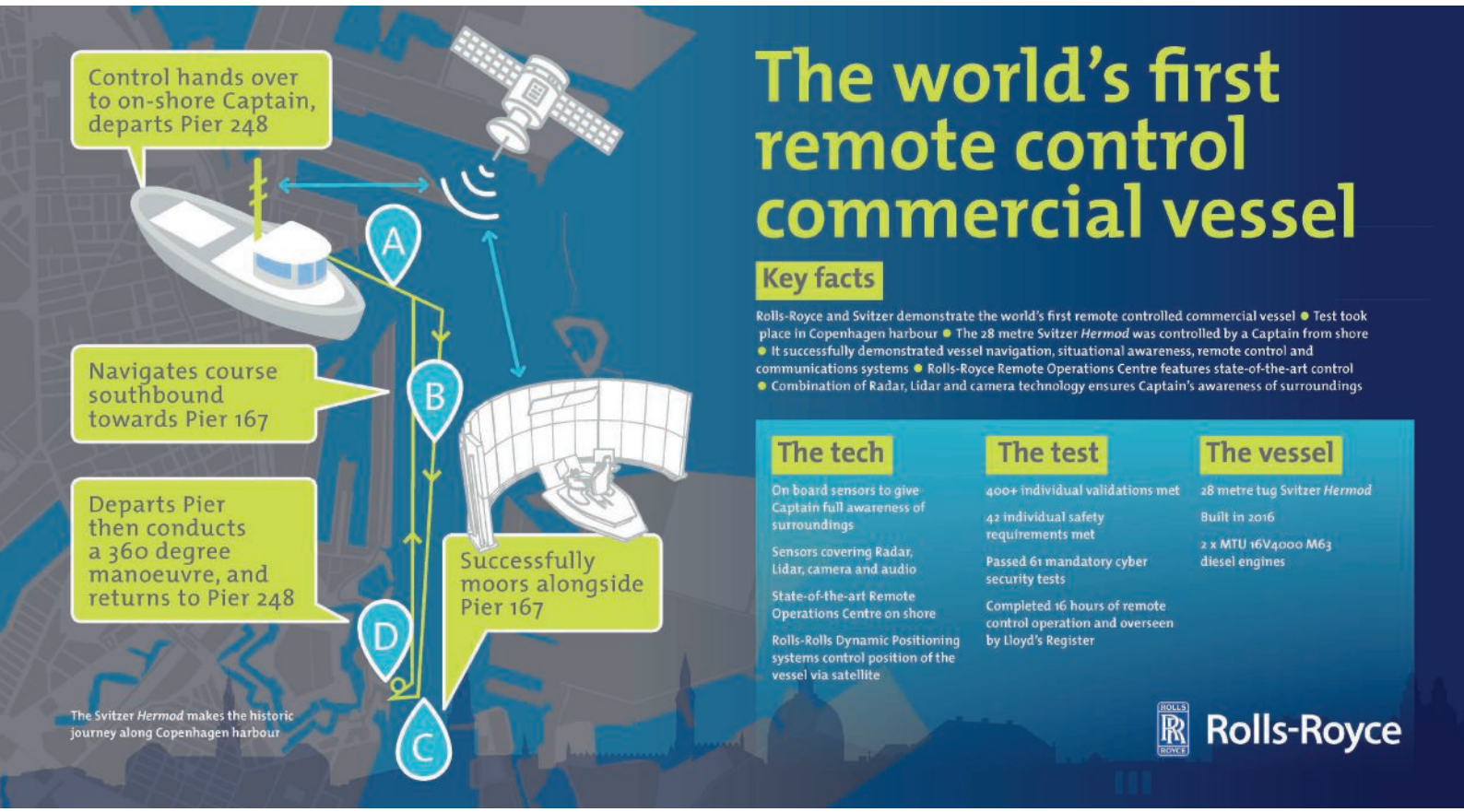
Working with the global towage operator Svitzer, Rolls-Royce was able to successfully demonstrate a remotely operated commercial vessel in Copenhagen's harbour.

According to Kristian Brauner, Svitzer's chief technology officer: "Disruption through innovation is happening in almost every industry and technology will also be transforming the maritime industry. Svitzer is engaging in projects that will allow us to explore innovative ways to improve the safety and efficiency of towage operations to benefit our customers and our crews."

From the quayside, the vessel's captain, stationed at the vessel's remote base at Svitzer headquarters, berthed the ship alongside the quay, undocked, turned 360° and piloted it to the Svitzer HQ, before docking again.

"An autonomous vessel has to be capable of performing a specific operation for a business – in this case a tug which can be operated from somewhere other than the vessel's bridge; for example, a shore control centre," explains Lindborg.

"There are number of different definitions of autonomy and machine intelligence and levels of autonomy (LOA) are often used to describe to what degree the machine can act on



its own. This ranges from a machine being completely controlled by a human (teleoperated) through to the machine being fully autonomous and not requiring any input from the human before taking actions."

While there is talk of autonomous vessels going into operation by 2025, Lindborg suggests it is unlikely that there will be a single autonomous solution applicable to all vessel types; rather, there will be a blend of autonomous and remote control.

"Sailing autonomously will be possible in open water, where the ship will be able to pick the best route and speed independently, but there will be remote control where more advanced manoeuvres are required; for example, navigating in congested waters and entering and leaving port," he suggests.

Rolls Royce and Svitzer have signed an agreement to work together to test remote and autonomous operations for vessels. The primary systems involved will be autonomous navigation, situational awareness, remote control and communication.

It is likely that we will see remote-controlled shipping in commercial use by the end of the decade, where navigation and basic operations will be automated, with a human 'captain' based on shore looking after critical decision-making.

"We envisage a remotely operated vessel in local waters as the first stage and in operation by 2020. By 2025, we hope to have a remotely operated vessel at open sea and five years after that, we expect unmanned ocean going vessels to be a common sight," says Lindborg.

"Tugs, along with road ferries, are likely to be one of the first places we will see the commercial use of remotely operated and autonomous vessels. Tugs and road ferries are most likely to fall under the control of individual flag states. These have the capacity to make special dispensation for their operation."

The technology to enable this is already available, explains Lindborg pointing to sensor technology, such as high definition and infra-red cameras, lidar and radar. "All of this is available commercially," he says.

"The vessel tested last year in Copenhagen featured a range of sensors which combine different data inputs using advanced software to give the captain an enhanced understanding of the vessel and its surroundings. We were able to transmit the data reliably and securely to a purpose designed remote operating centre (ROC), which was designed to redefine the way in which vessels are controlled.

"Instead of copying existing wheelhouse designs, the ROC used input from experienced captains to place the different system components in the optimum place to give the Master confidence and control. The aim was to create a

future proof standard for the control of vessels remotely."

The captain was able to control the vessel by making use of the purpose designed Rolls-Royce Dynamic Positioning System.

According to McKeran: "More and more assets and operations are automated as we see the smart vessels we are building today becoming less dependent on operators and becoming more efficient through automated decisions and operations."

This has gradually led to reduced manning on ships as automation allows one person to be fully in charge, looking at a screen to make sure the vessel is performing to expectations, while making corrective actions through software.

A reduction in personnel costs is a key driver behind the deployment of the smart shipping concept. With around 15 to 20 crew members on a cargo ship, such as a captain, a few steersmen, technical engineers, sailors and a cook, these crew members are unnecessary on a smart ship. Since there won't be any crew, staff facilities will also be irrelevant. This means that new ships can transport extra loads because there will be additional space on the vessel.

"Autonomous ships are technically challenging, but within our grasp," says Lindberg. "The current big challenge is to gain the consensus of key stakeholders, such as national and global regulators, maritime administrations, insurers and a whole range of other interested parties."

Regulations and standards

"For remote and autonomous shipping to become a reality, we need efforts at all regulatory levels," argues Lindborg. "The legal challenges of constructing and operating a demonstration vessel at a national level need to be explored. Questions of liability for autonomous ships are subject to national variations, but generally it seems that there is a less urgent need for regulatory change in this field. What needs to be explored is to what extent other liability rules, such as product liability, would affect traditional rules of maritime liability and insurance. These questions are being studied."

The International Maritime Organisation's 98th Maritime Safety Committee's adoption of a joint proposal from Norway, the UK, Estonia, South Korea, Denmark, Finland, Japan, the Netherlands and the US on Maritime Autonomous Surface Ships has kick-started work within the IMO which will ultimately lead to the development of future regulations for autonomous ships.

"There is still a long way to go before we see the regulatory framework in place," says Lindborg.

Crucially, if autonomous ships are to be realised, more standardised and reliable ships will be essential if they are to operate at sea for several weeks without engineers on board.

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"The standardisation of ship systems, the collection and analysis of significant quantities of operating data and the development of enhanced analytical capabilities (through equipment health monitoring) will be crucial to the development of remote and autonomous ships by providing a massive set of historic statistical data from which robust trends can be drawn and valid predictions of ship reliability made," Lindborg concludes.