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Proven systems still backbone of innovation

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THERE is no shortage of grand futuristic ship designs intended to meet all sorts of potential economic and technical scenarios. The history of shipping is full of such concepts, most of which never hit the water. Real innovation more often involves incremental, practical and cost-effective solutions to meet current or imminent regulatory, technical or economic challenges. These solutions might not be so eye catching as radical design concepts and often involve adaptations of existing concepts and technology.

Proven systems still backbone of innovation

The most obvious challenge demanding innovation is the need to reduce fuel consumption and harmful greenhouse gas and sulphur emissions. The International Maritime Organization's adoption of the Energy Efficiency Design Index for newbuildings should accelerate this process and encourage owners to invest in technical and design innovations.

AP Moller-Maersk has been moving in this direction for some time, developing and applying a number of design modifications to its latest newbuilding orders, including hull forms, propeller designs and to propulsion machinery and exhaust emissions. Cumulatively, these changes can make a big difference.

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UK-based shipping services group Graig has recently developed a new design concept for a container feeder vessel in collaboration with Wärtsilä and DNV. The design includes changes intended to optimise efficiency, but also includes more radical options such as a dual-fuel version using liquefied natural gas.

Its decision to put the accommodation forward is hardly new, although it is a break with recent convention. Its main intention is to maximise container capacity. The design involved a trade off between crew comfort, reducing emissions and the most economic design.

"We could have had a higher intake of full containers but we compromised by refining the hull form further to reduce fuel consumption and emissions," says technical director Philip Atkinson.

Asked about the LNG option, he says: "Shipping is at a crucial juncture with a lot of emissions legislation emerging now and in the future and fuel will become more expensive, so our design is intended to be forward thinking with these trends in mind, though owners might not want to make that commitment yet and it might be a step too far at this stage".

Mr Atkinson compares it with earlier historic changes when dual-fuel vessels involved ships powered by both wind and coal, before coal finally became dominant.

Wärtsilä project development and naval architecture team leader Claudio Nikito points out that dual-fuel technology is already proven in ship and shore-based applications so the decision is down to owners.

DNV business development manager Andy Westwood says that there is always an economic dimension to design changes. "Designs are always constrained by price and some new designs are ruled out for that reason."

Other solutions are more radical, such as the use of solar power, which still has significant problems to overcome. Japanese owner NYK recently fitted a hybrid power supply system using solar power onboard its car carrier, Auriga Leader. Tests of the power generation and endurance capabilities of the photovoltaic panels showed that it was difficult to provide a stable power supply during weather changes, thus limiting how much reliance can be placed on that source of power. In an effort to stabilise the supply, large nickel hydrogen batteries are being developed and tested on the ship to see whether larger capacity solar power systems are feasible.

A solar-powered catamaran, Turanor Planetsolar, is currently circumnavigating the globe, powered only by the sun. Such a radical solution might make good publicity for clean energy onboard ships, but there is no imminent prospect of its exclusive application to commercial vessels.

In an adaptation of older technology, Mitsubishi Heavy Industries, in a new design of a LNG carrier called LNG Extrem, is including a steam turbine main propulsion system, called the Ultra Steam Turbine System. It uses reheated steam to achieve higher thermal efficiency. Together with other innovations including an adapted design of the Moss-type LNG containment system and changes to hull design, it estimates fuel consumption will be 20% lower than on existing designs.

An apparently innovative solution being put forward is the use of air cavity and air lubrication systems using air bubbles released from the ship to reduce hull friction in the water and thereby cut fuel consumption. Once again, this concept is not new and various trials have been conducted using the same principle as far back as the 19th century.

Most recent tests using air as lubrication have focused on high-speed craft with significant reductions in resistance found on catamarans at high speeds. Indeed, a hull design incorporating this technology recently won the 2011 European Power Boat of the Year Innovation Award, achieving a 50% reduction in fuel consumption at 30 knots compared with a conventional monohull design.

However, the potential application to large, slower speed conventional vessels remains debatable. Swedish owner Stena has carried out tests using a 15 m demonstrator scale model of a tanker, Stena Airmax, studying the impact on performance and sea-keeping as well as fuel consumption.

Another company DK Group is pushing its air cavity design solution, using air bubbles to reduce friction, to commercial shipowners.

DK Group's Katia Kardash says that in 2007 it bought its own 83 m mini-bulker to test the system along with extensive tank testing. Unfortunately an initial contract for four vessels was with doomed operator Britannia Bulk and the project was discontinued. But Ms Kardash says new research has led to a revised version of the technology focusing on the potential for retrofits, requiring no major structural alterations. This features smaller cavities in the forward part of the vessel, instead of along the full length. She says that tests showed a potential fuel saving of at least 10%, and DK is looking to carry out full-scale tests on a 120 m vessel. The payback period is estimated at 18-36 months.

"More shipowners are becoming interested in innovative solutions and some are setting up their own departments for innovation," says Ms Kardash.

"There are increasing incentives for shipowners to make investments in new systems, not just to save fuel costs and meet new regulations but due to the advantages from an image point of view and to differentiate themselves."

Class society DNV suggests a number of straightforward changes can achieve significant improvements in performance, using existing technology. For example it developed the Ecore large ore carrier design, featuring a V-shaped hull, tri-fuel engines and an innovative self-loading cargo handling system developed by Cargotec to facilitate a wide beam design. Business director Michael Aasland says: "These concepts are based on existing technology but shows that they can be used in innovative ways."

He lists other modifications that can save up to 10% of fuel consumption on existing ships, which are relatively cheap and with short payback times. They include fitting various devices to the propeller, such as a boss cap, costing less than $50,000 and paying for itself within six months. Other propeller installations include propeller nozzles and the Mewis Duct. "These options are real and now and not just concepts," Mr Aasland says.

Again, the propeller boss cap is not new, originating more than 20 years ago, but the increased need to cut fuel consumption and emissions has prompted interest among owners.

In reality, technical innovation in shipping is more likely to involve adaptations or new applications of existing technology rather than completely new radical concepts. The need for innovation to save fuel and emissions is becoming more urgent. Combinations of relatively modest innovations based on proven technology are most likely to yield outcomes for which owners will be willing to invest.

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