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Editor Nick Savvides
Editorial Assistant Robert Grisbrook
Design/Production Manager Sandy Defraine
Group Sales Director John Payten
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Advertisement Production Manager Stephen Bell
Subscriptions & Publications Manager Jim-Ray Semanhyia
Publisher Mark J Staunton-Lambert

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Editorial & Advertisement Office:
8-9 Northumberland Street
London, WC2N 5DA, UK
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Telefax: +44 (0) 20 7245 6959
E-mail editorial editorial@rina.org.uk
E-mail advertising advertising@rina.org.uk
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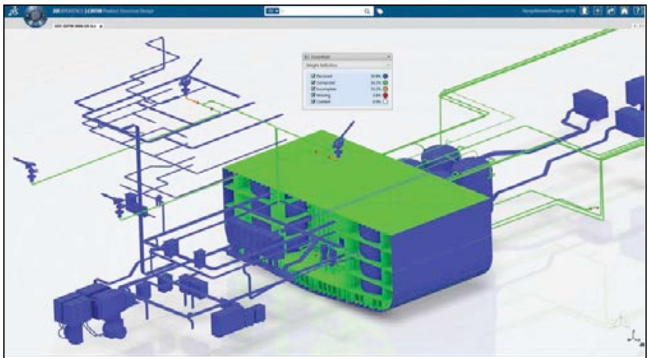

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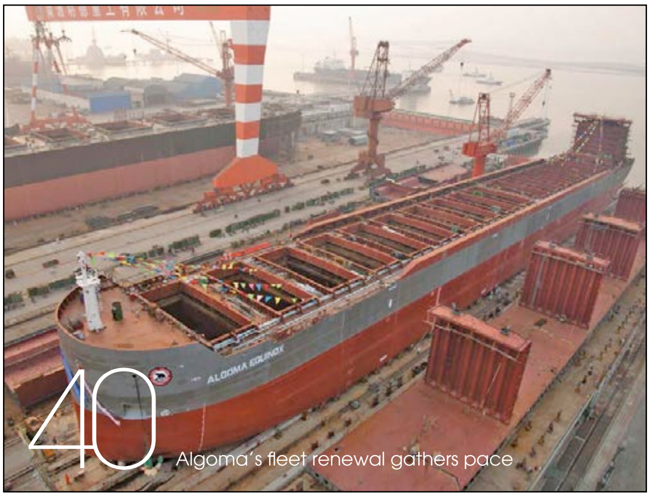

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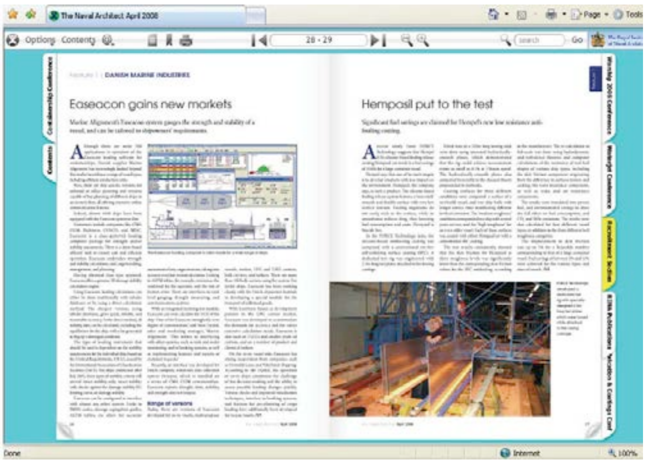


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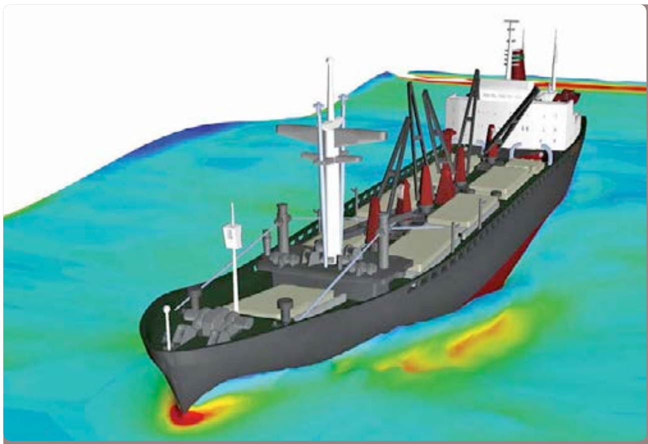


Technological evolution in the maritime industry

Technological development in the maritime industry will surge forward as the power of computers is put to good use

The pace of change is quickening. Moore's Law states that computer processing power will double approximately every two years. Such exponential growth in computing power is fuelling the technological development which many industries are currently experiencing.

However, while the exponential growth in computing power is providing the fuel, the drive for technological innovation in the maritime industry comes principally from economic necessity and the determination of regulatory bodies to meet climate change targets.

In the first instance, the global economy has deteriorated substantially, as has the offshore market following the collapse in oil price. Demand for shipping of all types has fallen as a result and owners have sought to cut costs in order to minimise losses. This has mainly meant owners have conserved fuel by sailing at reduced speeds.

A knock-on effect of the economic crisis has been that, with the fall in demand for capacity, newbuilding orders have suffered, with many Chinese and South Korean yards failing to register a single new order last year. As a result, the price of a newbuilding ship has reduced substantially. Again, the knock-on effect of this is that the yards, which during the boom years before 2007/8 refused to build anything other than their standard design ships unless owners were prepared to pay very high premiums, will now accept owners' demands in a bid to secure orders.

Owners are now faced with a barrage of new regulations and increasing demands to eliminate NOx, SOx and particulate matter. The need to treat ballast water will also be a requirement when the Ballast Water Management Convention is ratified within a year, and new regulations on managing other waste water and stern tube lubrication oil are already either in place or will be enforced in the near future.

Pressure for the regulation of carbon emissions is also growing, particularly since the COP 21 meeting in Paris late last year. Some IMO rules on cutting carbon emissions are in place, such as the Energy Efficiency Design Index (EEDI), but there is an expectation that if the IMO does not introduce a market-based measure to further cut emissions, then local regulators, such as the EU, may force the issue.

> "the next 15 years are expected to produce much greater savings as designers and their customers continue to harness the increasing power of computers"

All of these changes to regulation and economics have occurred in the relatively short space of about 15 years. In this time vessel design has also begun to change, with owners designing ships, not to a single design point as they had done in the past, but to the specific vessel's operational requirements.

Electronic aids on engines have cut emissions further and a multitude of sensors, up to 10,000 on modern vessels, feed information to owners eager to analyse the data to find more ways in which to reduce costs, fuel consumption and ultimately emissions.

Many of the new fuel and emission saving developments over the past 15 years have been possible due to the increase in computing power, and the next 15 years are expected to produce much greater savings as designers and their customers continue to harness the increasing power of computers to design and operate ships with even greater efficiency.

It is no accident that last month's China Ship News focused on technological developments in China, this month Volker Bertram previews COMPIT 2016, which looks at the new designs, including CFD developments, that will help mitigate the worst excesses of the maritime industry, and next month a green shipping feature along with a feature on Smart Ships (the follow up to *The Naval Architect*'s Smart Ships supplement published in January) will be included.

All in all there is an expectation from some parts of the industry that more change will follow and that, as Moore's Law predicts, the change will gather pace and will make the technological advancements of the 20th century look pedestrian by comparison, not simply because the technology will amaze, but because the speed of the evolution of technology will be faster than at any other time in history. This change seems something we can all look forward to. *NA*

BWMC

Ratifications edge upwards

Belgium and Fiji edged the ratification process for the Ballast Water Management Convention (BWMC) tantalisingly close as they became the 48th and 49th countries to ratify the rule.

Ratification by both Belgium and Fiji means that the percentage of world tonnage represented by those that have ratified the regulation now stands at 34.82%, 0.18% below the magic 35% figure that would trigger the enforcement of the rule. The regulation will come into force one year after the 35% figure is achieved.

In the meantime, more than 140 experts gathered in Montreal, Canada, in mid-March to debate the BWMC and its implementation. The Globallast research & development conference also had the GloBal TestNet meeting with testing organisations debating the issues around verification of ballast water cleansing and the testing systems.

In a statement the IMO said: "The forum, which brings together scientific experts and academia with the maritime industry and leaders in technology development for ships' ballast water management, was launched by Marc Garneau, Minister of Transport, Canada. IMO's Stefan Micallef, Director, Marine Environment Division, delivered an opening speech. Mr Micallef stated that the Ballast Water Management Convention needed to enter into force for effective implementation of its provisions. But he highlighted the huge amount of collaborative work which had been undertaken since the first GEF-UNDP-IMO GloBallast R&D forum 15 years ago, leading to a great deal of progress in the BWM field in terms of testing and approval of ballast water management systems, ballast water sampling and analysis, and the availability of ballast water management systems."

Cybersecurity

Maritime's cyberspace lag

Cybersecurity experts believe that the shipping industry is lagging other industries in terms of its cyber-development by about 10 years.

Steve Williams, a partner at consultants Moore Stephens said: "The maritime industry's cybersecurity awareness is currently low to non-existent." However, he added that as shipping is "not well connected" the incidence of cybercrime in the industry remained low.

Williams believes that the maritime industry is currently at the early stages of realising that cyberattacks can happen and will be costly. "I feel that the shipping industry is at the point that the banking industry was at in 2006," he told *The Naval Architect*.

He said the industry was catching up, particularly over the last six to nine months, but added that as the industry increases connectivity, an increase in cyberattacks will also take place.

"All systems are hackable," said Williams, "that's because they are designed for access and use, nothing is secure, but the world keeps on turning, we must keep the issue in perspective."

Even so, Williams urged shipping companies to take the issue of cybersecurity seriously and to have a plan on how to deal with breaches of their systems.

Personnel

ClassNK appoints new chairman

Koichi Fujiwara has been appointed as chairman and president as well as a representative director of Japanese classification society ClassNK, after Noboru Ueda stepped down from these positions last month.

Naval architect Koichi Fujiwara took the helm at ClassNK in March as the class society reshuffles its senior team in challenging times

Fujiwara was an executive vice president along with Yasushi Nakamura and Tetsuya Kinoshita who will continue in their present roles, but they have been joined by Junichiro Iida who has taken the position of

managing director. Another executive vice president, Tetsushi Agata, has been appointed executive auditor as ClassNK aims to strengthen its auditing system.

Koichi Fujiwara, who holds a master's degree in naval architecture from the University of Tokyo, said: "Following the recent downturn of the shipping and shipbuilding markets, the business environment surrounding ClassNK has become even more challenging. Under our new executive team, we will work to ensure stable operations and further enhance our corporate governance as required of an independent third-party organisation so that the society can continue contributing to the development of the maritime industry in the long term."

Fujiwara previously served in Japan's Ministry of Transportation (now Ministry of Land, Infrastructure, Transport and Tourism) and assumed the role of Director-General of the Maritime Bureau in 2006. He joined ClassNK in 2007, and was appointed managing director in 2010, before taking the position of executive vice president in 2011.

Ship design

Chinese collaborations grow

Shanghai's high profile naval architect the Shanghai Merchant Ship Design & Research Institute (SDARI) has entered into a collaborative deal with Finland's Wärtsilä Ship Design unit.

Signed in December 2015, Wärtsilä says the deal "provides a means for the two companies to combine their strengths in order to provide customers with a better value proposition. The joint collaboration will give customers access to the industry's most extensive ship design portfolio combining both the Wärtsilä and SDARI offerings. The cooperation will also enable the same supplier to manage the interface risk between the basic and detail design, which has traditionally been handled by two separate companies."

As a further benefit the two companies expect that their cooperation will strengthen their relationships with Chinese shipyards, which is of particular interest to Wärtsilä, and will ultimately lead to shorter design and development times.

"Wärtsilä has a strong position as a technology and innovative ship design leader, particularly for the offshore and special vessel markets. This agreement will enable us to provide our customers with the world's most efficient and environmentally sustainable ship designs and technologies," said Hu Jintao, President of SDARI.

In addition, Wärtsilä is making further inroads into China with a signed letter of intent for its fourth joint venture company in partnership with SDARI's parent company, China State Shipbuilding Corporation (CSSC). The new company will focus on electrical and automation solutions for marine applications and comes in response to growth in the market.

Sustainability

It's time for a roadmap

The maritime industry does not have a roadmap for the disruptive innovation it needs to meet sustainability challenges, and must look beyond its traditional well of expertise for actionable strategies, according to Kirsi Tikka, executive vice president, global marine, ABS, speaking at IMMEDIASEA's disruptive sustainability forum on 29 February.

Tikka says that a myriad of problems face the maritime industry as it looks to innovate, including financial instability, an industry driven by short term market fundamentals, shortages in research and dwindling academic interest in marine technology, as well as fragmentation:

"Perhaps the reality is that shipping is too fragmented – in ownership profile, in supplier base, in service providers, for the take-up of disruptive ideas. There are only two major civilian aircraft manufacturers, but here it appears to encourage innovation. We have dozens of shipyards and hundreds of OEMs and service providers but we seem to be suffering from a lack of genuine inspiration."

Automation, Big Data and autonomous ships are mentioned as disruptive entities in the speech, but Tikka questions the demand for such vessels and believes Big Data usage needs improvement: "Big Data as a concept is happening, but I think collectively we still need to figure out how to use it. There are plenty of stories of increasing volumes of data collected from the ships without a clear strategy of how to manage and act on the results."

She adds that class societies have a "fundamental role to play" that will enable the industry to move towards an industry that is smarter and safer and has been arrived at sustainably. However, while class societies will need to adapt to changes in the industry and adopt new technologies, she insists that "to make safety decisions based on data we need to be confident on the quality and the reliability of the data". *NA*

Correction

In the March issue of *The Naval Architect* in a news story entitled "Tor Svensen leaves DNV GL" we stated that Knut Ørbeck-Nilssen will "move up to the Group EVP role" following Tor Svensen's departure. This is incorrect. Nilssen, who succeeded Svensen as chief executive officer of DNV GL's maritime business, will remain in this role. We would like to apologise for the error and for causing any embarrassment to DNV GL and its staff.

Cyber age spawns virtual security industry

There has been a lot of discussion about data smart ships, digital ships and cybershipping, not least on how to protect the ship against a cyberattack, *writes Sandra Speares*.

As ships' technology becomes ever more complex and vessels' internet connectivity improves a new approach to the day to day operation of ships will be needed as they enter the cyber age.

As classification society Lloyd's Register (LR) says in new guidance on the issue: "Because a cyber-enabled ship consists of multiple, interconnected systems, and because of the rapid pace of technological development, assuring that a cyber-enabled ship will be safe cannot be prescriptive, and cannot rely on knowledge gained from previous systems.

"Instead, it requires a 'total systems' approach – one that takes account of all the different systems onboard and onshore, how they are designed and installed, how they connect and how they will be managed. This is the approach that LR takes, applying a non-prescriptive, risk-based process from the earliest concept stage, through onboard integration, to operation".

According to Luis Benito, marine marketing director at LR, the key to understanding what is happening as far as ships, and more particularly cyberships, are concerned, is the issue of connectivity. The increase in connectivity and its affordability have driven the development of the cybership, he says.

Connectivity has two major angles, the first being that today's ship is becoming a "system of systems," he says. "The ship itself is a group of systems working together with a very high level of connectivity. People call it 'integration', but it is actually systems talking to each other". Systems are becoming more available but also more affordable."

As far as cybersecurity is concerned, different aspects need to be considered including protecting the asset from attack by incoming signals, while the second level of protection would be preventing signals attacking the ship from being re-transmitted from the ship again. In short, ships need to look at different levels of protection depending on the level of connectivity.

Benito outlines three areas on which LR has been working. The first is design, and designing a safe and compliant cybership presents new challenges, he says. LR has recently released a document outlining some of the issues that need to be addressed as far as design is concerned, some of which are not new concepts, but which need to be addressed to ensure the ship is safe. These include systems, human interaction with systems, software, data assurance and its veracity and security.

There is a "new human role for shipping," he explains.

Aspects of this include the extent to which the ship is operated at sea and to what extent it is operated remotely from the shore. The relationship between the two needs to be considered alongside accountability issues from both perspectives.

With the highly-geared cybership, it may not be managed entirely at sea unless there are crew members capable of dealing with software issues for example. How much management is shore-based and sea-based will depend on the operating model. There are a wide range of operating models being developed which also present a challenge, he says.

The third aspect to consider is that a new supply chain for shipping is being developed, he believes. If you consider traditional members of the shipping supply chain these include designers, manufacturers, owners, operators and classification societies, for example. Now, to make the ship commercially viable, software suppliers, companies providing equipment which is software-driven, software integrators and cybersecurity providers will be needed as well as different maintenance sub-contractors. In short, more parties in the supply chain are necessary.

Another point Benito makes is on the issue of remoteness and control. Ships can be remotely controlled in niche areas, for example in areas where traffic is restricted. Some ports for example might ask for a ship to be remotely controlled when entering a very congested port area. Is it necessary to send a pilot or could the ship be controlled from a port office? Some trials of remotely controlled ships have already taken place.

Another issue is whether the new supply chain can work together to agree on a way to maintain the ship based on data that monitors the performance and reliability of equipment and systems on an on-going basis as opposed to the time-based testing at given intervals currently required of owners and operators. On-going monitoring could mean opening up a system before the due date in order to correct a problem. Overall, he believes this preventative approach will increase safety.

New competencies on ships will also need to be considered, particularly where problems arise from software issues for example. "The jobs of seafarers and shore staff need to be re-designed to take account of new or changed responsibilities, including support and maintenance of software-intensive systems. The cumulative effect of all changes on the safe and effective performance of seafarers and shore staff needs to be considered, in terms of situational awareness and training," the LR guidance states. *NA*

Welding

The mechanised weld

Kemppi, a Finnish welding solutions company, has announced two new mechanised welding systems that aim to improve on the quality and productivity of manual welding.

The A3 MIG System is a straight rail solution that mechanises the longitudinal welding and cutting process, and is powered from a reachable battery.

The A5 MIG System can be used for straight rail or orbital MIG welding, offering an integrated welding carriage solution. The system is digitally integrated with Kemppi's FastMig welding equipment to ensure increased welding arc control.

Operators can choose from a variety of welding settings on the remote control unit, including from pre-set memory channels.

www.kemppi.com

Power systems

Engine power-saver

A new powering concept that optimises engine speed can save up to 6% on annual fuel consumption for large cruiseships, according to its developer, ABB.

The Dynamic AC (DAC) concept adjusts the rotational speed of a vessel's diesel generating set. This allows the system frequency to vary within a specified range, preventing the creation of surplus energy. It utilises the medium voltage power system in the ship, which is specifically engineered for variable frequency, and distributes the auxiliary and hotel loads by frequency converters or directly from the variable frequency systems.

While ABB's Onboard DC Grid aims to improve the efficiency of vessels with a lower power requirement, DAC aims to improve the efficiency of vessels with power demands of 20MW or more.

According to ABB, many ships still run with their generators at a set speed regardless of the power requirement, creating a surplus of wasted energy. The DAC tool will help to manage this problem, aiding cruise companies to build more efficient and environmentally friendly fleets, says Juha Koskela, managing director of ABB's marine and ports business.

www.abb.com

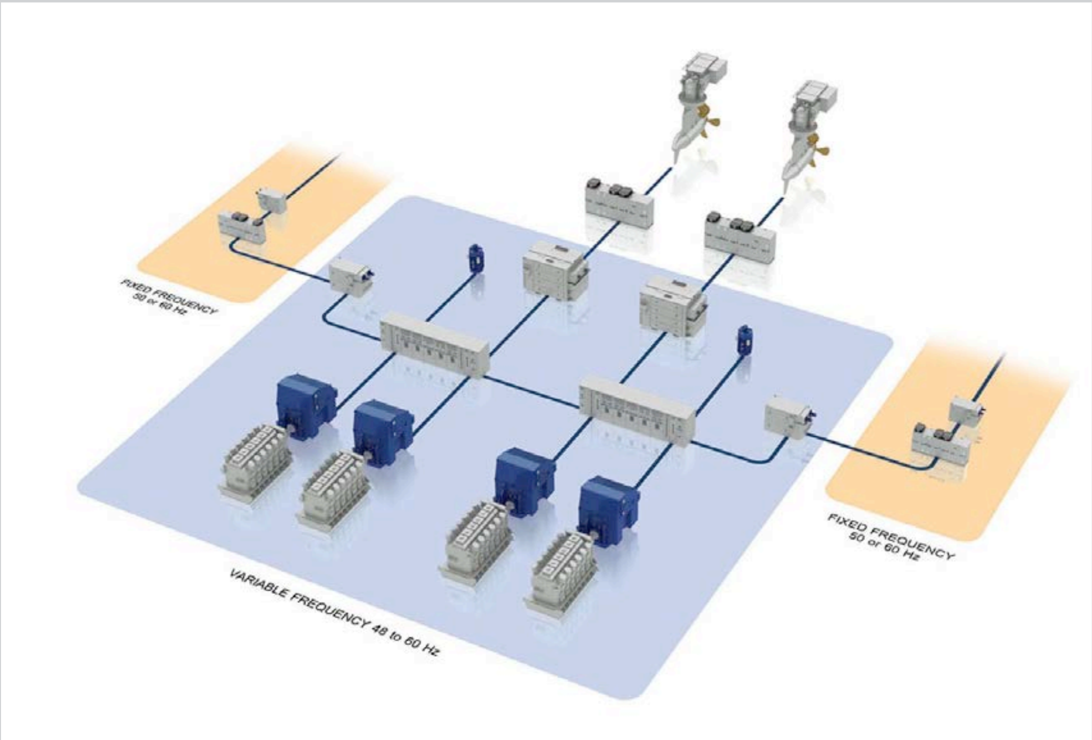
Engines

Performance deviation discovered

An internal audit by Wärtsilä has discovered deviations in fuel consumption tests for its marine engines, potentially affecting 2% of the company's engine deliveries.

Wärtsilä's Delivery Centre Trieste, Italy, is at the heart of the controversy as it appears personnel from

The Dynamic AC (DAC) concept will help vessels with high power demands operate more efficiently



the facility are responsible for acting against work instructions and the company's code of conduct, influencing test results.

The effects of this influence are estimated to have led to an average deviation of 1% of fuel consumption, which equates to an annual loss of approximately US$50,000 for ship owners and operators when extrapolated using the current average bunker costs at the time of writing, US$170 per tonne HFO at 150tonnes/day for 200days/year.

The company states that it has reviewed all test procedures, and taken immediate corrective actions where deviations have been found.

"Wärtsilä requires all its employees to act in accordance with internal guidelines as well as laws and regulations. We deeply apologise for any loss in trust caused by this violation to our policies and corporate values, and we will immediately start reaching out to our customers," says Jaako Eskola, CEO, Wärtsilä Corporation.

www.wartsila.com

Software solutions

Reefers turn green

Maersk Container Industry (MCI) has collaborated with fruit multinational Dole in the design of a new software solution for the transportation of reefer containers, cutting energy consumption in half.

The solution, StarConomy, will manage the refrigeration of cargoes in MCI's Star Cool units by its simultaneous control of compressor and fan speeds. This allows precise temperature control inside reefers while matching the airflow to the varying requirements of specific cargoes, matching air circulation to cooling demands. "The StarConomy software begins by rapidly cooling the produce with the fans at full speed. When the temperature set point is reached, fan speed is reduced and energy optimisation can begin," says Morten Nylykke, general manager, Refrigeration Technology, MCI.

The company points out that the solution will substantially cut operating costs and help to reduce CO_2 emissions for reefer containerships:

"If a typical fruit multinational operating their own fleet of four vessels with 500 reefers each were to upgrade to the software, the annual financial savings on a single route, such as Ecuador to the UK, would be over US$2million. For a container line with a six-vessel service from Ecuador to Russia, also with 500 plugs, the annual saving would be an estimated US$3.2million."

www.mcicontainers.com

Valves

ECAs drive LNG equipment growth

Parker Bestobell Marine, a manufacturer of LNG cryogenic valves, has developed a new range of marine-approved high pressure cryogenic valves in anticipation of a rise in LNG powered vessels due to increasingly stringent environmental regulation.

The new range includes manual, gearbox operation, single actuator, tandem actuator, and high pressure check valves. Each valve has been designed for the ME-GI engine fuel gas system, ranges from 0.5inches to 3inches in size, and can withstand pressures of up to 625bar.

Market development manager for Parker Bestobell Marine, Duncan Gaskin, says: "We developed these valves in collaboration with a number of shipping companies which required them for the MAN ME-GI fuel gas," and adds: "As worldwide markets look to reduce air pollutants and with the introduction of Emission Control Areas (ECA), we expect to see demand increase for high pressure valves that are marine approved."

Previous orders for the company include the supply of high pressure valves for five Teekay LNG carriers, two LNG carriers for Knutsen OAS Shipping and three LEG (Liquefied Ethylene Gas) carriers for Ocean Yield of Norway.

www.bestobellvalves.com

Fuels

Space for change

Alfa Laval announces the expansion of its test and training centre in Aalborg, Denmark, to prepare the way for LNG and other alternative fuels. The company expects 7,000 vessels will be sailing with LNG in 15 years, a substantial rise on the current 500.

The 250m^2 testing space will expand with an additional 1,100m^2 to be used for the study of environmental and combustion technology in burners and heating systems for vessels using LNG and alternative fuels.

Such expansion highlights the industry's course for becoming more environmentally friendly and meeting growing environmental regulation. Bodil Nielsen, test and training centre manager, Alfa Laval, says the predicted growth in LNG vessels is "a remarkable change, driven in part by the successive tightening of NOx and SOx regulations by IMO."

However, LNG demands advanced technology, which in turn requires more research and testing space, something Alfa Laval is keen to be prepared for. "There are key processes that become significantly more complex when LNG is involved, which means the technologies onboard must be even more advanced," says Lars Skytte Jørgensen, vice president, product centre boilers at Alfa Laval. The company believes the gas revolution is here and intends to be at the cutting edge of technological development.

www.alfalaval.com

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Paints & coatings

Cruise vessels in the fold

International Paints has announced that cruise vessels can now be analysed using its Big Data tool, Intertrac Vision.

The tool predicts potential fuel and CO_2 savings of different fouling control coatings and will now, following further research, help the cruise sector make more informed coatings decisions based on a more transparent method for measuring performance.

Project lead for Intertrac Vision, Michael Hindmarsh, says: "Hull coatings play a key role in the profitability and sustainability of [cruise vessels] due to the fuel and CO_2 savings that can be delivered. Through Intertrac Vision, we can provide cruise vessel owners with tangible proof of the ROI from the comparison of fouling control coatings prior to application."

Hindmarsh adds that the company expects to add LNG vessels to the tool in the near future as part of its continuing mission to meet the needs of customers and the changing dynamics of the market.

Intertrac Vision is the first Big Data solution for the accurate prediction of a coating technology's performance prior to application, according to it developers.

www.international-marine.com

Business

PALFINGER lifts marine offering

The hydraulic lifting, loading and handling solutions manufacturer, PALFINGER, has integrated a number of its sub-brands for marine products into PALFINGER MARINE in order to better establish itself in the industry as a complete supplier.

PALFINGER DREGGEN, PALFINGER NED-DECK and Norwegian Deck Machinery (NDM) are now housed within the new umbrella brand, incorporating the company's wide product portfolio of cranes, offshore cranes, davit systems, wind cranes and equipment for boats, winches and offshore.

The company states that all product areas, services and office locations will remain the same despite the change.

www.palfingermarine.com

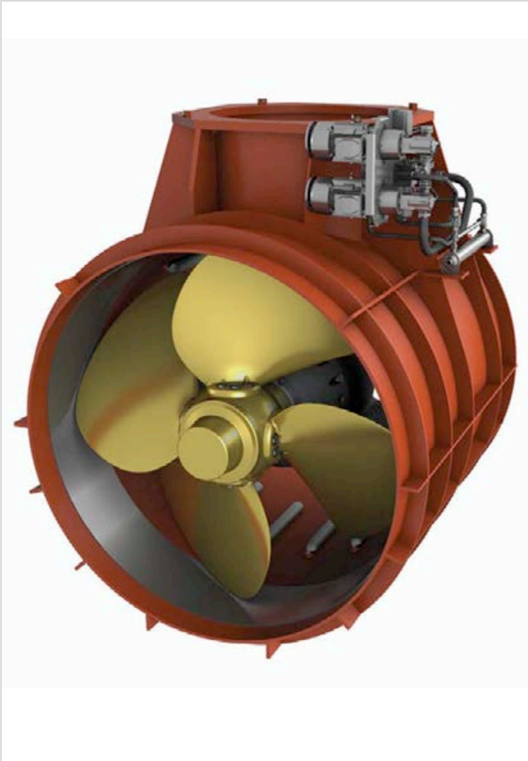
Thrusters

New high power transverse thruster

Wärtsilä have launched a high power transverse thruster that will help optimise cruiseship designs and provide enhanced harbour manoeuvring and docking for large ships, and for the dynamic positioning of offshore vessels.

The company's WTT-40 transverse thruster is intended for cruiseships, large offshore support vessels and offshore construction vessels, and features a 4,000kW power level and a 3,400mm diameter controllable pitch propeller that aims to address customers' needs for high power transverse thrusters for bow and stern applications.

Wärtsilä says: "Because of its maximum power of 4,000kW, shipyards and cruise vessel designers can often utilise three WTT-40 thrusters instead of four smaller ones. This creates a more efficient vessel design with less space required for the transverse thrusters. It also allows them to be located closer to the bow where they are more effective."

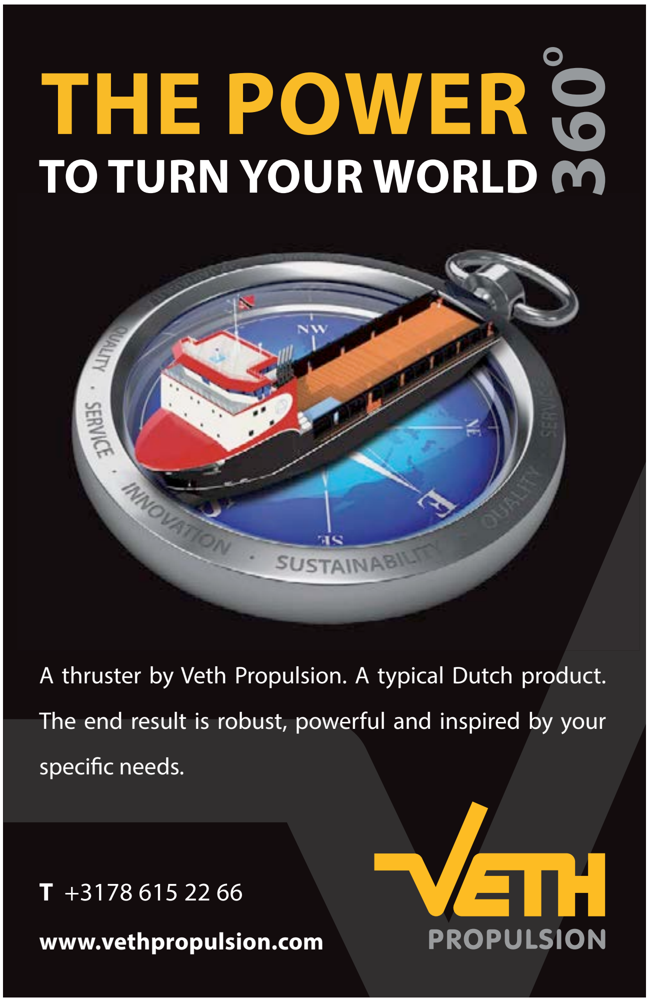


The WTT-40 thruster addresses demand for high power transverse thrusters for bow and stern applications

In addition, the thruster features integrated hydraulics, which saves machinery room space and installation and commissioning time in the shipyard.

Development of the WTT-40 began in 2015 and the first thrusters have been scheduled for delivery during 2016.

www.wartsila.com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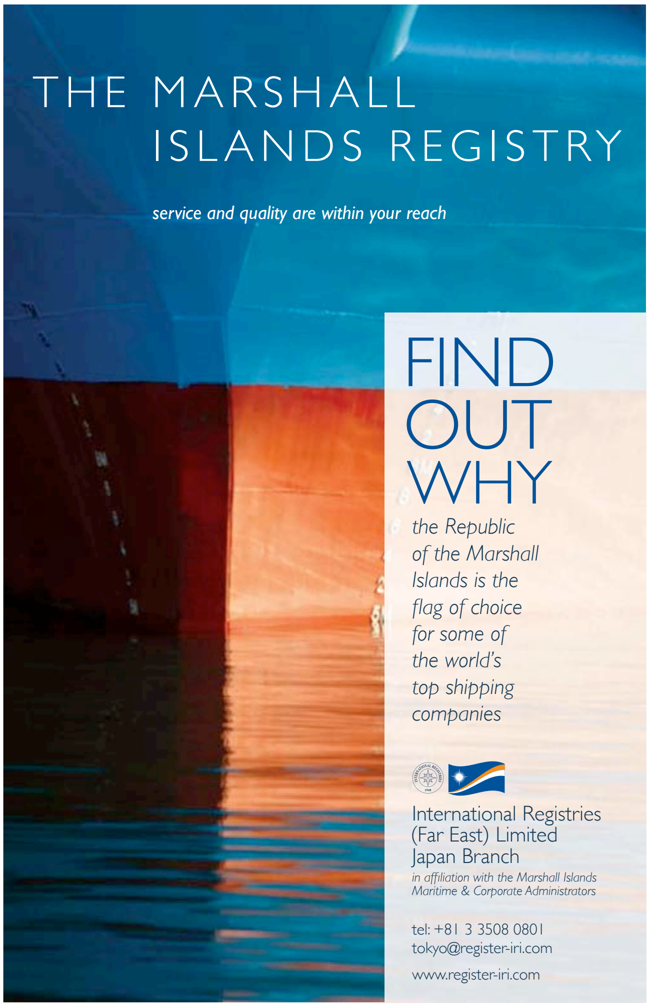
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EEDI dialogue on ro-ro ships only makes IMO margins

Discussions on the ro-ro ship correction factor with regards to the Energy Efficiency Design Index have reached the margins of MEPC 69, but a formal debate has not been tabled, it has emerged, despite some technical consultants pushing for change to the exponent that is said to be limiting the design of new vessels

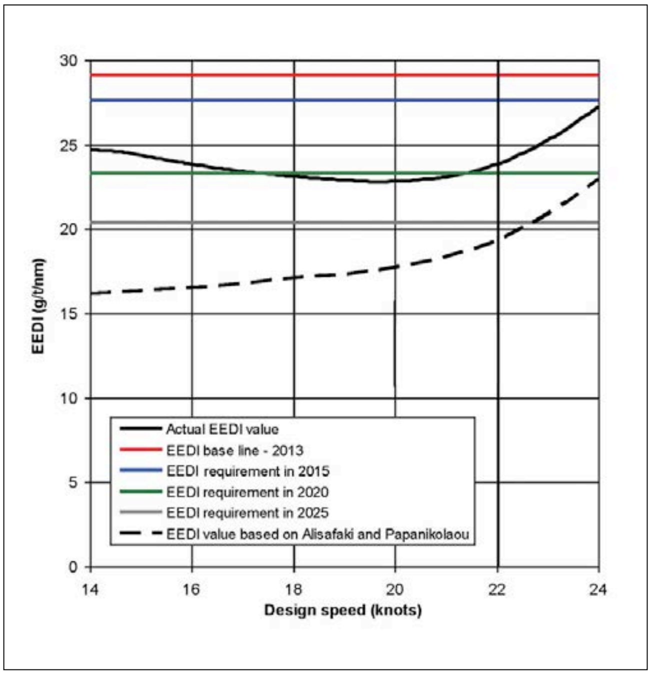
According to a prominent ro-ro ship operator, the current Energy Efficiency Design Index (EEDI) correction factor for ro-ro ships of all types "lacks clarity".

The EEDI was introduced for newbuildings in 2011 as a method of improving the design of vessels. In the initial Phase 0 reduction CO_2 emissions were minimal, but with Phase 1 the base levels for emissions for new vessels have been lowered and they will continue to decrease every five years.

Meeting the demands for EEDI has been comparatively straight forward for cargo ships such as tankers, bulk carriers and containerships, as the formula works by measuring fuel consumption compared to the level of cargo moved; so by reducing speed the cargo vessels of the types above have been able to meet the EEDI standard.

However, this formula is not so easily applied to vessels such as ro-ro cargo ships and ro-pax vessels where cargo is carried in large open spaces and the cargo is often passengers. In this situation, many ferries operate in competition with air, road and rail transport and so slowing down the vessels could mean they lose out to other modes of transport because the ships will not meet their schedules.

Alberto Portolano, a naval architect in the energy saving department of Grimaldi Group, told *The Naval Architect* that the "Second target of 5-10% of EEDI reduction is very strict." He said tanker operators and others may find this easier, "but with ferries and ro-ro ships it's very difficult to meet the EEDI second phase without reducing the speed that will tremendously affect the service of this kind of vessel."



EEDI values for a ro-pax vessel of 5,000dwt Source: DTU

As a result, when the EEDI Phase 1 rules were applied in 2013 the IMO introduced an exemption of ro-ro ships of all types, car carriers, cargo ro-ro and ro-pax vessels until a correction factor was created to allow the rule to be fairly applied to ro-ro ships.

"it will be very difficult to meet the second phase target of 10%"

A debate in 2013 between a number of countries ensued and the Swedish/German correction factor based on the Froude number was agreed at IMO. However, a number of experts are now claiming that this correction factor is unworkable, giving designers and owners too slim a margin to design a vessel in order for that ship to comply with the EEDI regulation.

"I'm not sure if a new coefficient will be better or worse," said Portolano, "but it will be very difficult to meet the second phase target of 10%". He went on to say that the hull, propeller and the propulsion systems of newbuilding ro-ro vessels and ferries are optimised for the vessel to operate at a commercially requested speed, making it difficult to meet the EEDI requirements by simply slowing ro-ro ships down.

Hans Otto Holmegaard Kristensen, head of maritime DTU at the Technical University of Denmark has told *The Naval*

Architect that no maritime authority will formally raise the issue of the ro-ro correction factor for the EEDI at this month's MEPC 69, even though technical discussions between some consultants concerning the current exponents have shown that the correction factors will limit the design scope and could prevent owners building new vessels.

Kristensen says that it is difficult for "some countries to admit that they agreed to the wrong rules and that they made mistakes". He believes, therefore, that the discussion must, in the first instance, start with the owners.

Changes to the exponent are required and there have been discussions between interested parties in Denmark and Sweden, but no formal issue has been raised.

Kristensen says that the issue may be raised during the review process at MEPC 69 when discussions around the trends for EEDI will be discussed, but adds there is only one ro-ro vessel that can be debated at the review process and this is a car carrier which, he says, is "not representative" of the ro-ro ship industry.

Last month's In-depth article on EEDI (*The Naval Architect*, March issue, p.18) highlighted that the current exponent factors for ro-ro and ro-pax vessels are unsuitable according to research from Aimilia Alisafaki and professor Apostolos Papanikolau of the National Technical University of Athens, and Kristensen, and that they can instead be replaced with more suitable exponent factors as proposed by Alisafaki and Papanikolau. These new factors draw a more feasible line of EEDI requirement according to the research, lowering EEDI by 15-27% for ro-pax and by 12-19% for ro-ro, which in turn makes it easier for architects to balance concerns for economic viability and regulatory compliance in their designs.

Now, further parties are coming forward to comment on their experiences with EEDI and the problems they have encountered. Christian Damsgaard, head of Naval Architecture at Knud E. Hansen A/S, echoes the findings mentioned above, as he states the current calculation of EEDI makes the design of compliant vessels potentially too difficult to achieve: "vessels are already fairly optimised, so to find a further 5-10% is almost impossible".

Damsgaard clarifies: "I'm not saying the idea is wrong, we all want green ships and to put in the extra effort," but the present relationship between the industry's carbon footprint and cargo transported is not really connected to the EEDI as it stands for ro-ro vessels. This almost suggests a scenario in which vessels are designed and optimised to meet EEDI, but not to get the best vessel in relation to speed and power.

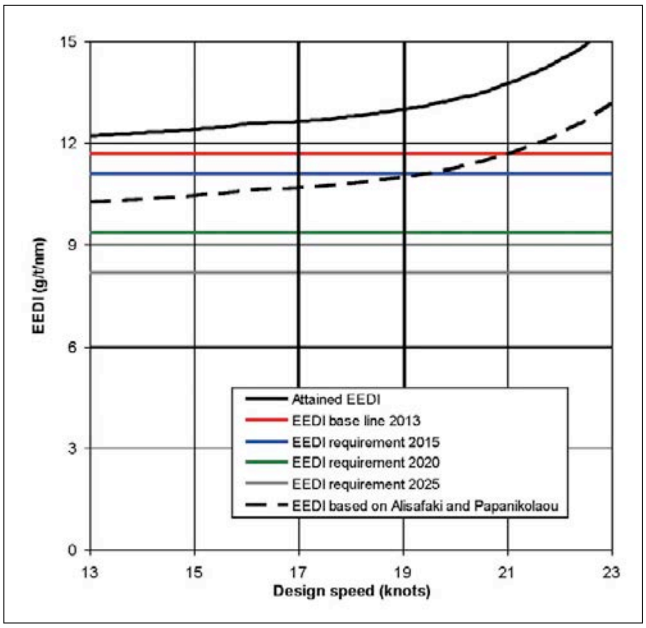
The most difficulty has been found with the design of large ro-ro vessels, says Damsgaard, and the fact that designs are either just above or just below the relevant EEDI line.

At present, EEDI fails to take into account that a good margin is needed at the early design stage in order to secure orders from shipowners who do not want a ship that may not remain compliant, and another issue lies with the fact that a good starting point in relation to main dimensions means even more must be accomplished, according to Damsgaard. Owners' wishes, in response to tailoring the main dimensions of a vessel to a particular route, may be compromised for the sake of good hydrodynamic performance, but then in the case of a more slender vessel, the 'ro-ro factor' is increased by relatively more than the gain in power reduction by optimising main dimensions. This ends up with a higher attained EEDI and a design that is further away from the required EEDI. As a result, Damsgaard's experience suggests that changing the main dimensions of a large ro-ro to improve the hull resistance is not the solution.

Interferry has also given comment. Its regulatory affairs director, Johan Roos, says: "As so few ferries have been built to the new EEDI-requirements, we have too little to go on to assess any general impacts. What we have noted, however, is a mismatch between the EEDI reference lines and the way the actual EEDI for a design is calculated. This is due to using a generic auxiliary power load for the reference line, but real auxiliary load as per the design. The generic load may be far too low, unintentionally raising the improvement requirements for new designs. Interferry is currently canvassing its members in order to assess whether this issue needs to be brought to the attention of the IMO."

However, the IMO itself will not comment on the issue ahead of MEPC 69, although there is a discussion on the "technical and operational measures for enhancing energy efficiency of international shipping" scheduled for the morning of 19 April, according to the MEPC 69 agenda.

The Naval Architect will continue to follow the debate and contents of the MEPC 69 discussion in the May issue. *NA*



EEDI values for a ro-ro cargo vessel of 15,000dwt
Source: DTU

Smart, connected & bigger - IT for ships

Volker Bertram from the Department of Mechanical and Mechatronic Engineering, Stellenbosch University and DNV GL, previews the 15th International Conference on Computer and IT Applications in the Maritime Industries (COMPIT) which will be held from 9–11 May in Lecce, Italy

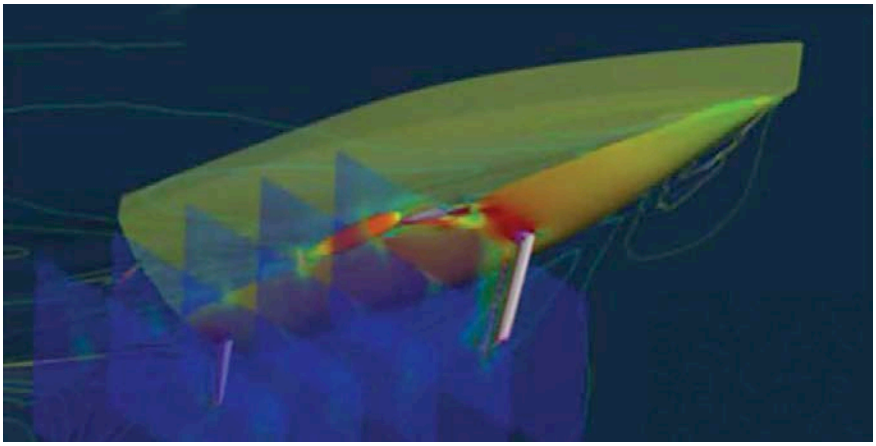
A selection of papers for the upcoming COMPIT conference shows the range of the discussions that are now taking place at the conference and they reflect the general trends in IT for the maritime industries.

In the 'We get smart & cooperative' section, communication and cooperation make for smarter solutions – in business, in design and in operation. Smart & connected is a recurrent theme in diverse forms. Key players cooperate to create new solutions for customers, not unlike airlines with their alliances and code-sharing. Robots and autonomous systems cooperate with each other and with humans – giving us a glimpse into future cybershipping.

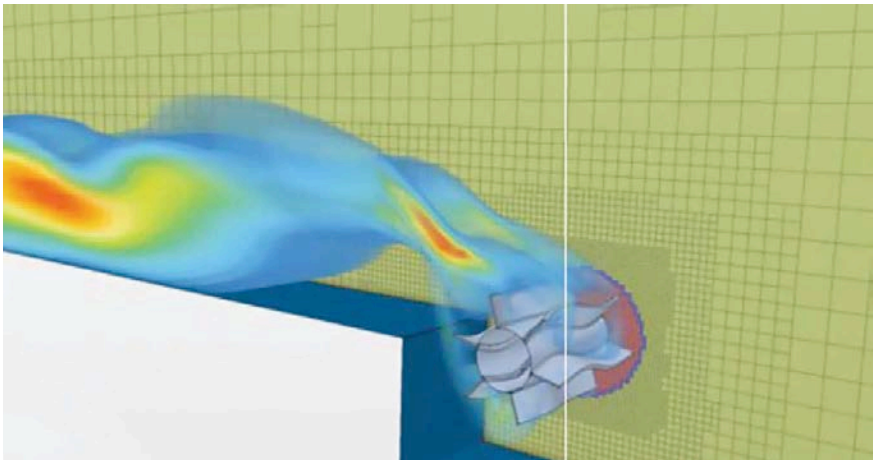
Cybershipping will require information to be fed to operators ashore and as such Big Data will be a key component in the future. Big Data uses relatively simple algorithms, but huge amounts of data, fuelled by AIS and onboard sensors. Collecting and storing all this data is easy. The challenge lies in turning the data into useful information. The business field is developing very rapidly – there seems to be almost a "gold rush" spirit in the industry as Big Data mining may produce some real nuggets.

By way of contrast, Virtual Reality is a different game now. We have to thank our kids – the video game industry has provided cost-effective software and hardware solutions for Virtual Reality and Augmented Reality. The maritime industries are adapting the options and putting them to good use whenever the human needs to be involved in simulations. And for user-friendly bridges or training on surveys the answer is now clearly based on Virtual Reality.

While Virtual Reality is an important aspect for IT in the maritime industry it is Big Data and the Smart & Connected themes that are the dominant trends, accounting for two dedicated sessions each, and also making guest appearances in other sessions.



For competitive sailing CFD has already replaced the towing tank (source: Numeca)



CFD is the perfect tool to design appendages – here is a device for wind assisted propulsion (source: CD-adapco)

Smart & cooperative – both software and people

Despite numerous attempts, there is no single monolithic software programme that is optimal for all tasks. Coupling dedicated software packages is a better strategy than trying to develop the "one code to solve all problems". In short: cooperation beats integration. This is demonstrated in a variety of papers, many coming from joint industry projects.

Key enablers in this context are open software architectures and open-source codes. Morais & Waldie (SSI) describe "Open Architecture Applications: The Key to Best-of-Breed Solutions", where the key is open-architecture software which supports easy "plug-and-play" interfaces to other software. There is a general trend to be "open", i.e. not using proprietary data formats and sometimes even disclosing the source code allowing others to modify and expand the software. Mannarini et al. (Centro Euro-Mediterraneo sui Cambiamenti Climatici) present "VISIR: A Free and Open-Source Model for Ship Route Optimisation". The paper fits in with the open spirit of COMPIT (with its freely downloadable proceedings) perfectly. The authors offer a GPLv3 (General Public License) licensing of the source code and detailed model documentation on open-access journals.

In this way, numerical methods, approximations used, and their range of application are documented and made available to research and business applications. In a similar vein, Chaves & Gaspar (Ålesund University College) give us an "Open Source and Web Based Ship 3D Virtual Simulator" for nautical training applications. The key advantage of their approach consists in adapting the simulation tool requirements to a common user platform (web browser), instead of forcing the user to comply with the tool requirements of common commercial nautical simulators (operational system, file format or commercial tool).

Simulation – the engineer's best friend (if he's got nothing else)

Smart and cooperative also aptly describes the trends in simulation-based design. A "plug-and-play" culture is developing where software codes and companies learn to work smoothly together to provide better or new solutions. A typical example comes in the recent cooperation of Hydrocomp and Friendship Systems (since COMPIT 2014), which resulted in "Real Cost Savings for a Waterjet-driven Patrol Craft Design Using a CAESES-NavCad Coupled Solution" by MacPherson & Harries. Arguably the most interesting aspect here is the cost reduction achieved in this industry project, looking both at the hull and the propulsion.

In "Cloud Computing for CFD based on Novel CAE Software Containers", Gentzsch et al. (UberCloud, Numeca and CPU 24/7) show how, for example, Glosten Associates use cloud computing for CFD predictions of ship resistance. Cannavacciuolo (CD-adapco) looks at more mundane, but not less interesting applications of wind propulsion, in "A Novel Way to Harness Wind Energy on Ships: How CFD Helps Foster Innovation". The paper describes an optimisation study for a novel wind-assistance concept. The study takes different wind speeds and directions into account, striving for the best compromise between variables to optimise fuel consumption over realistic operational profiles. In "Design Optimisation using Fluid-Structure Interaction and Kinematics Analyses", Korbetis et al. (BETA CAE Systems) combine CFD and structural analysis in the design of a free-fall lifeboat. The short-term extreme loads during water impact require a strong coupling between these two classical simulation disciplines.

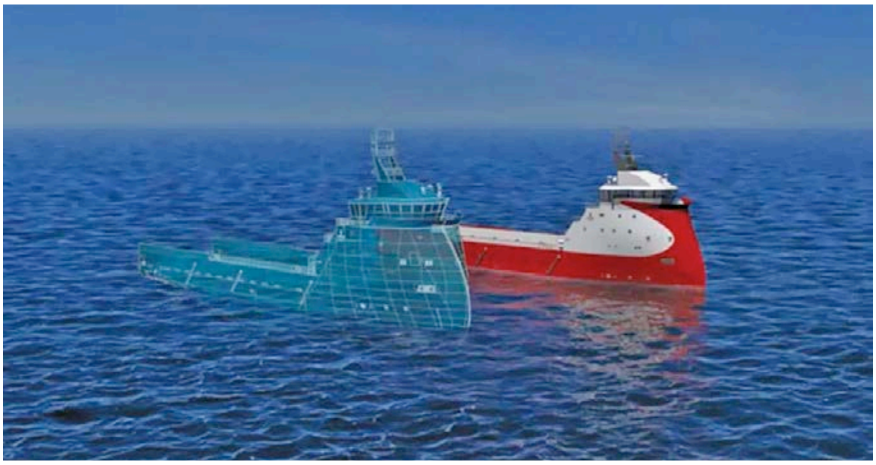
Simulation-based design continues to grow, both in terms of extent and variety. Besides established methods such as finite-element methods and CFD, new design approaches are being adopted from other industries, such as from the financial industry for the treatment of risk and uncertainty as Erikstad et al. (NTNU) with "Real Options Analysis for Air Emission Regulations Compliance under Uncertainty". Here, instruments of corporate finance for decision making under uncertainty are applied to maritime engineering applications.

But as simulations become more realistic and more accurate, they also become more time-consuming. For optimisation projects, the solution seems to be meta-models, otherwise known as surrogate models. Literally building models on top of models, it means in simple parlance using trend predictions fitted to "hard" points coming from expensive simulations.

During the optimisation the trend predictions are updated as more hard points come in. There are various ways to get such trend predictions, differing in required effort, robustness, and accuracy. The power of meta-models is demonstrated in "Bulbous Bow Optimisation through a Complete Open-Source Framework" by Bailardi et al. (DLTM, Wolfdynamics, Optimad) for hull optimisation or "Evaluation of Surrogate Models of Internal Energy Absorbed by Oil Tanker Structure during Collision and/or Grounding" by Prebeg et al. (University of Zagreb) for structural optimisation. The latter evaluate various meta-model approaches for their application.

Virtual Reality – it's a different game now!

In some applications, we are not only interested in the physical behaviour of objects, but focus on human behaviour in maritime environments. In these cases, Virtual Reality (VR) is the magic word. But… "Real Men don't do Virtual Reality. This is something for teenage kids and granola-eating programmers." Wrong! The gaming industry is bigger than the



A Digital Twin: Product data models and simulation models will follow the real ship through its lifetime (source: DNV GL) maritime industry and offers some great solutions for us 'real engineers', both in terms of software and hardware. Several leading companies use these options for pioneering applications. 2016 is widely expected to be a breakthrough year for VR applications as such, due to the launch of affordable headsets such as Oculus (owned by Facebook).

The diversity of applications is as fascinating as the level of realism achieved by CGI (computer generated imagery). Zrodowski & Feiner (DNV GL) present a perfect example with the "SurveySimulator [SuSi] – A Virtual Reality Training Tool for Ship Surveys". SuSi offers virtual environments for ships and offshore structures. Trainees can practice in VR finding various deficiencies (technical and safety-related) simulated in the virtual environment.

Jamt et al. (Marine Cybernetics – A DNV GL company) take the concept of asset modelling a step further, envisioning "Digital Twins for Design, Testing and Verification throughout a Vessel's Life Cycle". A digital twin of a vessel consists of simulation models that are continuously updated to mirror the condition of its real-life twin. The prototype simulation platform is an open architecture allowing integration of external and internal simulation models. The idea is to collect simulation models from design and re-use not only data, but also complex models, throughout the lifetime of the ship, for retrofits, emergency response, performance monitoring, etc. The idea is not new, but seeing the digital twin finally coming to (test) life is noteworthy.

What do performance monitoring, cooperative schemes between ports and ships, condition-based maintenance and asset management have in common? They all need frequent and smooth data exchange, which in turn benefits from standards providing "a common language". The industry should thus welcome Vatteroni's "Shipdex – A Standard to Exchange Technical Data between Owners and Suppliers" as it offers an independent, non-proprietary and free-of-charge standard protocol. Shipdex intends to decrease the traditional effort in importing technical data into corporate IT systems like ERP (Enterprise Resource Planning) or CMMS (Computerised Maintenance Management System). Based on xml and a neutral data exchange format (in layman's terms: it is easy to import and export the data on any computer). The paper briefly introduces the history of Shipdex, its main business rules, and key advantages for assorted stakeholders. A standard Shipdex dataset is given for illustration.

Big Data has gotten bigger

One of the most revolutionary IT developments is Big Data, affecting transport efficiency and maintenance schemes. Much of this data is provided by the growing number of robots and automation processes discussed above. How can we avoid being swamped by this data?

Essentially only computers can cope with the data flow coming from other computers, using repeated filtering and processing, separating "gold dust" from rubbish. The key is generally to turn Big Data into meaningful small data, simple trends or even single numbers that we can use to make good decisions. The applications seen so far fall largely into two categories: smarter maintenance schemes and smarter operation schemes. Some of the maritime Big Data pioneers are already presenting second-generation applications which combine multiple data sources with intelligent data fusion and integration with other maritime software.

In "*Big Data in Shipping - Challenges and Opportunities*", Rødseth et al. (Marintek) give some examples of successful applications, but also discuss current constraints of using Big Data in the shipping industry: low bandwidth, costly satellite communication links, issues of data ownership, etc. They also look at an organization's ability to absorb and make use of the collected information.

Etienne & Sayers (Dell) see "*The Internet of Things and Connected Ships*" as a game-changer for the maritime industry, helping customers to integrate operations, reduce production costs, improve safety, and effectively implement and manage large-scale change. They address challenges, similar to Rødseth et al., but present a pragmatic approach to getting started today. De Masi et al. (Saipem) show an interesting application to "*Corrosion Prediction by Hierarchical Neural Networks*". The specific application in this paper is for pipes. Corrosion prediction models so far have been based on linear or parabolic approximations of data clouds. Neural nets can approximate arbitrary patterns and it is that little progress that sometimes make for much more useful information. Ramsden (Akzonobel) presents in "*AIS, Antifouling and Big Data*" an application for hull performance monitoring. Gunnsteinsson (Marorka) examines in "*Enhancing Performance through Continuous Monitoring*" how sampling method and frequency impact data-based business decisions. Results show the superiority of continuous monitoring over noon-reporting.

Everything is connected

Manno et al. (DNV GL) present in "*Asset and Operations Management in the Era of Connectivity and Big Data: A Maritime Industry Focus*" a framework for a maritime Big Data ecosystem considering the whole lifecycle of a marine asset and its digital twin, from design to scrapping. Abbasian et al. (Ålesund University, Ulstein International) close the circle with a paper going in the opposite direction: "*Improving Early OSV Design Robustness by Applying Adaptive Distributed Clustering in Ship Lifecycle Big Data*". They focus on how Big Data (from operational monitoring) can improve further design competitiveness and reduce design uncertainty.

This pretty much sums it up. Gone are the days where it was simple to cluster papers on "design", "production" and "operation". Papers at COMPIT 2016 connect in multiple dimensions, sharing numerical techniques, applications or industry segments. The product life-cycle idea becomes reality and it is reflected in the best-of-practice IT solutions that we see at COMPIT. The conference promises to be a highlight in this year's calendar for anyone interested in how IT is transforming the maritime industries.

First held in the year 2000, COMPIT has established itself as a key conference in information technology (IT) for the maritime industries. *NA*

Trailer CAT takes shape

As the three year project to develop a highly efficient, low emission catamaran trailer ferry enters its second year, *The Naval Architect* gets a running report on the developments of the vessel and the challenges yet to be overcome

Trailer CAT project manager Claus Kruse, an independent maritime consultant and naval architect, says that the design of the trailer carrier is merely a part of the project and the ship itself must be allied with port and logistics designs that will support the vessel and offer its customers a cheaper and more efficient route for cargo transportation.

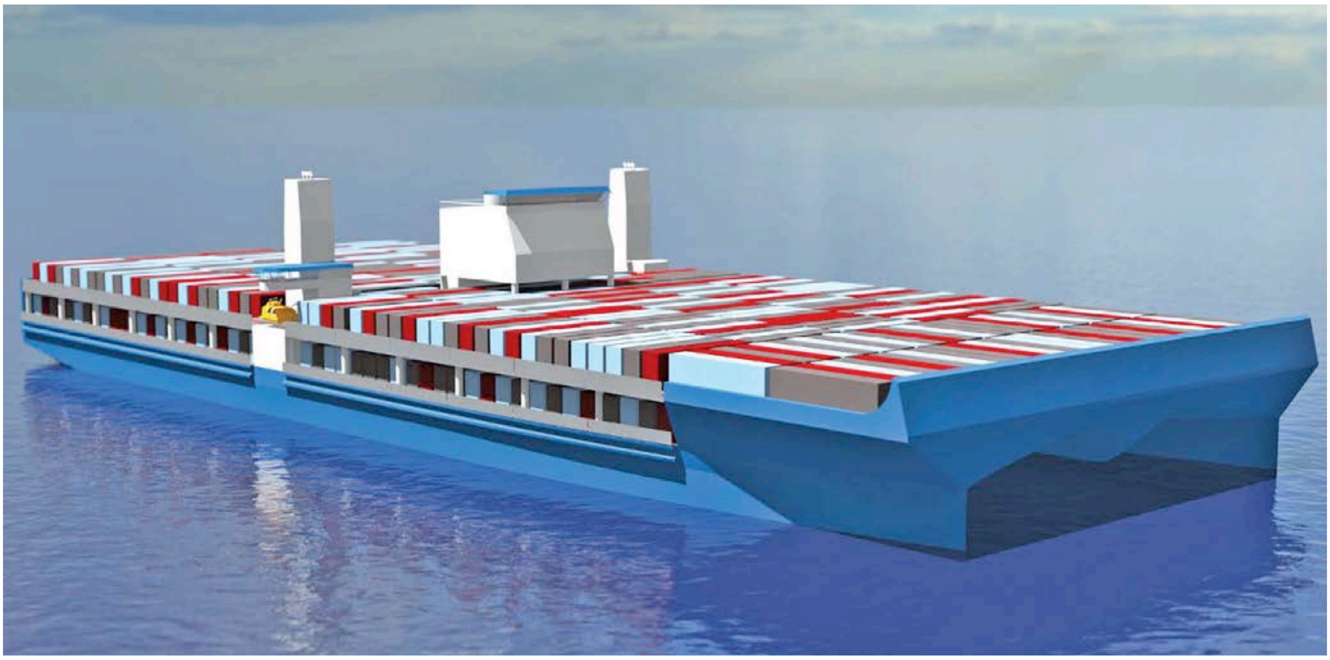
The Trailer CAT has been initiated by naval architects OSK Shiptech, transport planning company Transmar, and Claus Kruse. The challenge for the team, which now also includes the Danish Technical University (DTU), class society Bureau Veritas (BV), cargo handling equipment supplier MacGregor, transport planning companies Tetraplan and Copenhagen Business School, is to develop a trailer ferry that meets modern requirements in terms of new regulations, including emissions regulations and the need to reduce unit costs as competition from road and rail services increases.

	3,800 lm vessel		8,100 lm Trailer CAT	
Voyage, quay to quay	120 NM		120 NM	
Voyages per year each vessel	600 voyages		600 voyages	
Capacity of the vessel	240 units		539 units	
Turn around in harbour	5 hours		3 hours	
Time at sea and maneuver.	7 hours		9 hours	
Speed at sea	21,5 kn		16 kn	
	Annually	Per. trailer	Annually	Per. trailer
Capital costs (2 vessels) (Interest and depreciations)	8.2 million euro	28.4 euro	11.1 million euro	17.1 euro
Manning, maintenance etc.	2.5 million euro	17.3 euro	2.5 million euro	7.7 euro
Fuel per voyage 350 EURO/t		27.1 euro		8.8 euro
Loading and discharging excluding terminal operation		28 euro		18 euro
Costs per trailer excl port fee etc.		101 euro		51 euro

First estimate of a comparison between a traditional ro-ro vessel and the Trailer CAT over a distance of 120 nautical miles

Currently, the ro-ro industry operates with a design concept that has been around for more than 40 years. Conventionally designed larger ro-ro vessels are very time consuming

The Trailer CAT is wider than conventional ferries, but cargo is handled transversely, halving the loading and unloading time



TECHNICAL PARTICULARS		
Trailer CAT		
Two designs:	**Euro units:**	**US units:**
Length (overall)	189m	182m
Breadth	75m	68m
Draught, max	8.0m	8.0m
Depth to main deck	13.2m	13.2m
Depth to upper deck	18.6m	18.85m
Deadweight	16,000t	13,200t
Trailer lane meters	8,100m	6,900m
Number of trailers	539trailers	408trailers
Max service speed	21.5kn	21.5kn
Scheduled service speed	18 – 19kn	18 - 19kn
Pontoon		
Length:	156.9m	
Breadth, moulded:	24m	
Draught:	5.82m	
Depth to main deck:	10.56m	

to load and discharge via a stern ramp into the main deck and via internal ramps to the other decks.

In effect, an 8,000 lane metre (lm) ferry can take six or more hours to turnaround in port so the Trailer CAT team have designed a vessel which halves the loading time, allowing the vessel to reduce speed when it is at sea and thereby reduce emissions and save fuel at the same time.

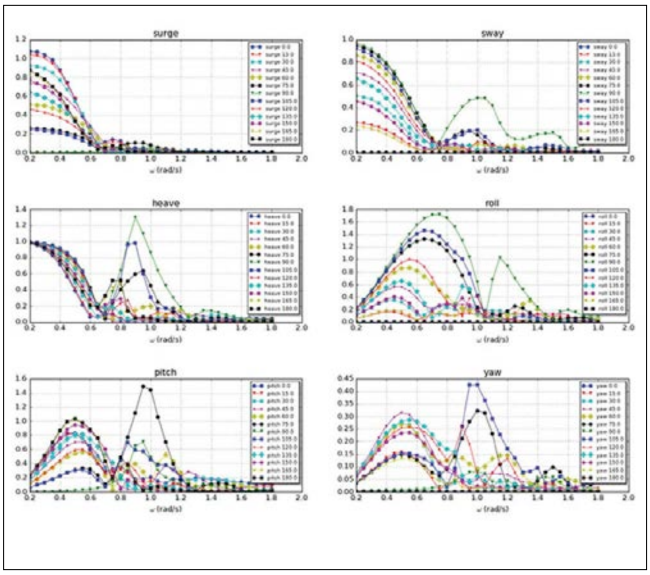
The project is looking at two possible routes for the vessel design, one on the North Sea and the other between Texas, US, and the State of Veracruz, Mexico. The routes are chosen for the development of two sample business cases for the Trailer CAT Concept.

In both cases, the ports will need to build a linkspan that will be long enough to handle the Trailer CAT as well as have a two tier unloading system that will allow the vessel to load and discharge cargo rapidly from the side of the vessel. Transverse loading and a lack of internal ramps allows more truck masters to operate and significantly reduces their waiting times, effectively doubling the speed of cargo handling.

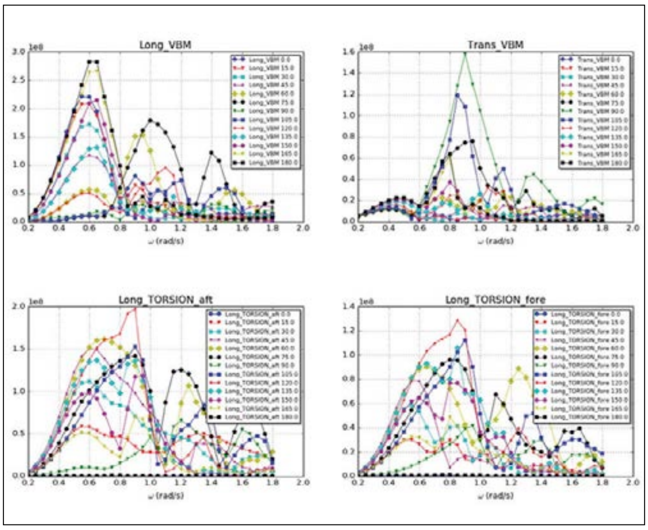
There is an additional need to move to unmanned lashing of cargo trailers in order to further speed up the loading process, and the team are looking at this possibility too. As more time is shaved off the loading process the slower the vessel can operate, reducing the unit costs further.

"The goal for the concept is to make 50% cost savings per trailer," says Kruse, "but the reduced price of oil will make that a challenge," he admits. Though he still believes that the emissions will be significantly reduced, 70% per cargo unit, compared to a conventional vessel.

"This vessel is bigger so there will be lower emissions per unit [of cargo transported] together with the lower service speed and LNG powered propulsion," he explains. The



Motion transfer function (Source Bureau Veritas)



Internal loads transfer function (Source Bureau Veritas)

	4,500 lm vessel		8,100 lm Trailer CAT	
Voyage, quay to quay	500 NM		500 NM	
Voyages per year each vessel	230 voyages		230 voyages	
Capacity of the vessel	285 units		539 units	
Turn around in harbour	6 hours		3 hours	
Time at sea and maneuver.	26 hours		29 hours	
Speed at sea	20 kn		18 kn	
	Annually	**Per. trailer**	**Annually**	**Per. trailer**
Capital costs (2 vessels) (Interest and depreciations)	8.5 million euro	65.1 euro	11.1 million euro	44.6 euro
Manning, maintenance etc.	2.5 million euro	38.1 euro	2.5 million euro	20.2 euro
Fuel per voyage 350 EURO/t		83 euro		43 euro
Loading and discharging excluding terminal operation		28 euro		18 euro
Costs per trailer excl port fee etc.		214 euro		125 euro

First estimate of a comparison between a traditional ro-ro vessel and the Trailer CAT over a distance of 500 nautical miles

vessel is a simplified design without internal hydraulic ramps, hatch covers etc. The steel weight of the vessel is very important for the fuel consumption and the price for the vessel, and so an optimisation of the steel structure is an essential part of the development project.

Kruse admitted that "these ships will require a significant investment in the terminals to accommodate them, there are no existing terminals at which these ships can currently call without essential modifications".

Although, he also added that the ports that they were in discussions with had recently given the Trailer CAT project a boost: "One of the concerns from operators that we talked to was that the vessel was too wide and that this could cause a problem getting the ship into the harbour or through the channel. But the port operators said that the draught [at 8m] was fine and the manoeuvrability with the propellers on both hulls meant that it was fine at passing other vessels too without other restrictions for other traditional vessels of that size," explained Kruse.

Investment in the port infrastructure is, however, crucial with the major efficiency savings to be made through the transverse super-fast loading and unloading. That means that there will need to be a longer linkspan at the port to support the loading operations and this is being looked at by MacGregor.

Designing the vessel has also posed some challenges for BV, who have had to make original calculations of loads on the steel structure of the vessel. "There are no existing rules for this type of vessel," explained Kruse, so BV especially needed to make the calculations to check the torsion on the structure between the two hulls and to look at slamming of the hulls.

The preliminary results have shown that there is no serious torsion problem between the hulls. The vessel will be completely designed in steel, but as an alternative the team is also looking to reduce the overall weight/price of the vessel by using light concrete or composites in the construction of the decks. Students from DTU will be studying this problem. *NA*

Pitch perfect

Testing propellers has taken a new turn as Nikolaj Peter Lemb Larsen, senior naval architect of FORCE Technology describes the development of the successful Kappel propeller from MAN Diesel & Turbo

For decades, model tests of propeller designs have been carried out in certain progressive steps. Starting with the simple resistance test, followed by a self-propulsion test with a stock propeller and then a self-propulsion test with the final propeller designed for the specific vessel.

Today, several propeller vendors compete for the same contract with the object of delivering the best-performing propeller and thereby securing the contract. All propeller designs are tailor made to each application in order to optimise the propeller to the individual flow pattern and wakefield of the specific hull design. This leads to development of comparative model test studies in which the best-performing propeller is identified. In commercial projects, however, there is typically only time for one model test series with the final propellers before production has to be initiated. This leads to the question: could any of the vendors design an even better propeller based on the results from the first test?

Design evaluation

At FORCE Technology we carried out six iterations for the model test study with Kappel propellers designed by the Danish propeller vendor MAN Diesel & Turbo (MD&T). The Kappel propeller is characterised by having its propeller tips slightly bent towards the suction/forward side in order to reduce the losses associated with the tip vortex flow.

The model test series was carried out over more than a year with the tests of a new propeller every third month. Each propeller was designed based on an evaluation of the previous propeller. This made it possible to track even minor changes in the propeller design and quantify the effect on the propulsive power and propulsive coefficients.

With the final propeller, MD&T showed that they were able to improve the performance of the propeller by approximately 4% and additionally 1.5% by adding a rudder-bulb to the setup. The savings may sound modest for a large study like this, but it should be noted that the reference propeller already showed a good performance and in this light the gain is impressive. The extra savings in fuel consumption will be significant for the vessel in question over its lifetime.

FORCE Technology made six iterations of the Kappel propeller during the study, said senior naval architect Nikolaj Peter Lemb Larson

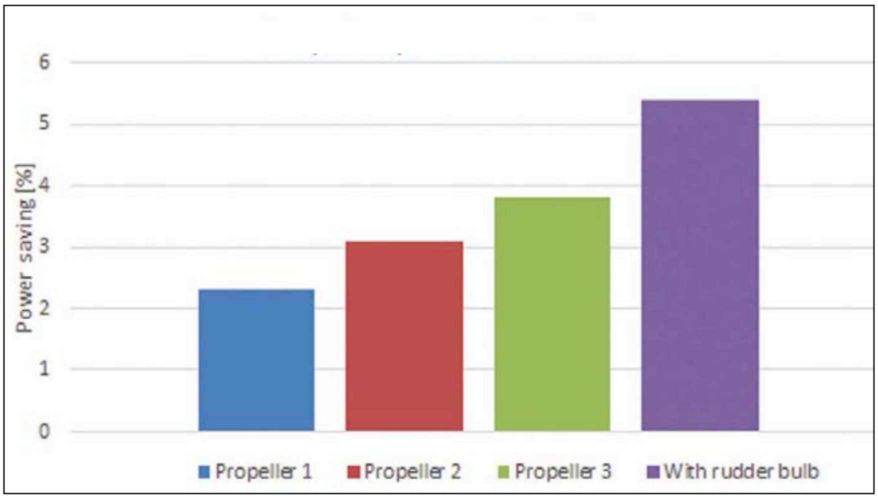
Model test of seven propellers

A total of seven different Kappel propellers were tested. The propeller tested in the first iteration had comparable particulars and outline to the reference propeller, but, of course, with the Kappel design feature in the blade. At the design point, an improvement of approx. 2% in the propulsive performance was identified.

The next iteration was a test with two propellers. One with a smaller diameter and similar outline - impressively the performance was only slightly reduced. According to propeller theory, the efficiency decreases if the diameter is reduced – hence the only slight reduction was impressive. For the second propeller, iteration two, the original diameter was kept but with one propeller blade less.

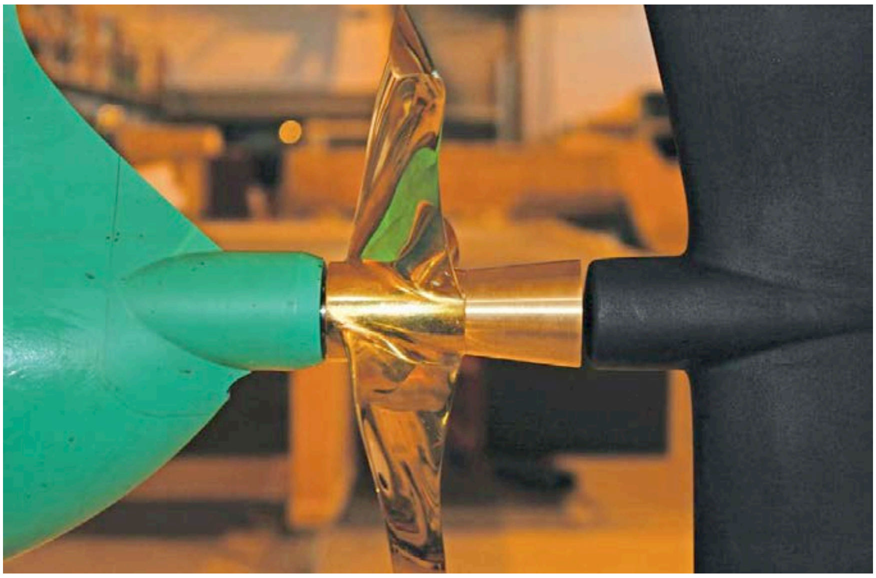
Due to cavitation considerations, the area ratio was kept so each blade was made larger. A 3.1% improvement in the propulsive performance was detected. This propeller showed a higher propulsive efficiency and, in particular, the relative rotative efficiency was improved. Relative

Propeller power reduction



made larger. A 3.1% improvement in the propulsive performance was detected. This propeller showed a higher propulsive efficiency and, in particular, the relative rotative efficiency was improved. Relative rotative performance is a coefficient describing how well the propeller works when mounted on the vessel as compared to an artificial test in uniform flow.

From then on, the focus was on the propellers with one blade less. In the light of a traditional, commercial propeller study, it was important to observe that the optimum design was found in the next iteration with an additional 0.7% improvement of perfor¬mance. The last three propellers tested were all variants of the ones with one blade less. Some quite experimental and others with reduced pitch and thereby reduced efficiency; as expected and in accordance with propeller theory.



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The overall conclusion of the project is that propellers can be designed for a high efficiency in one iteration. However, another one or two iterations might add that one percentage of higher efficiency that everyone is looking for.

Full scale testing – comment from MAN Diesel & Turbo

Regarding full scale testing of Kappel propellers on different ship types constant efforts to improve the concept and deliver better propellers with higher efficiencies will continue. The concept of the Kappel design has, however, already been tested on various ship sizes and types – container vessels, tankers, bulk carriers, car carriers, ro-ro vessels and even offshore and fishing vessels – and full scale propellers have also been installed in all these segments of the shipping industry.

Almost all fixed pitch propellers are tested in model scale and this is also the case for most fixed pitch Kappel propellers. When it comes to controllable pitch propellers not all propellers are tested – at least not when delivered from MD&T. One reason for this is that MD&T holds more than 100 years' experience with designing and producing controllable pitch propellers and minor adjustments are, in the rare event it is needed easier to implement due to the nature of the controllable pitch propeller type.

MD&T gave us good feedback on the on the propulsion efficiency regarding the full scale propellers. They tell us, that there is a tendency towards the full scale efficiency being better than observed in most tank tests which is most likely due to the scaling methods that many model test facilities apply – however not FORCE Technology. With the scaling method for transforming measured model scale figures to full scale predictions used by FORCE Technology the Kappel propeller concept is not unfavourable. As the Kappel propeller design concept is treated as neutral/equal compared to conventional propeller designs in the scaling calculations a more realistic comparison can be made which is also why MD&T considers FORCE Technology as a preferred partner for propeller testing. *NA*

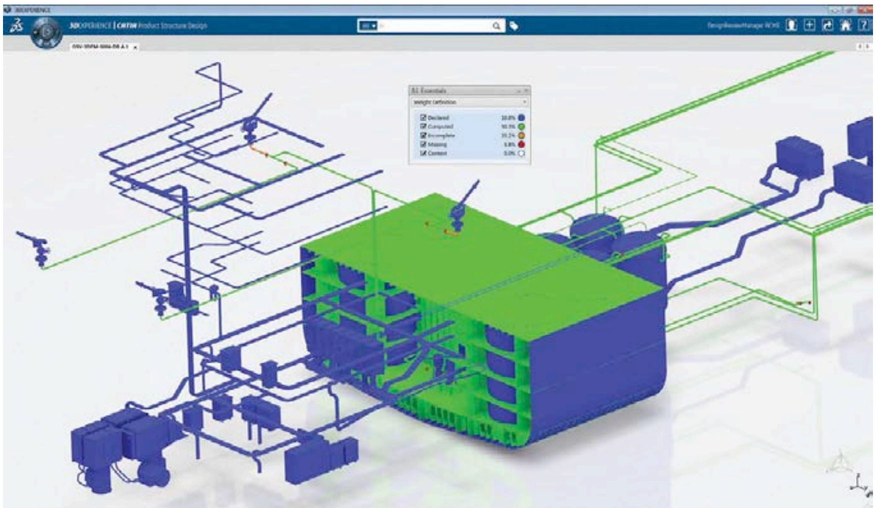
Collaboration not competition is the new 3D reality

Competition is changing in the maritime industry as more companies collaborate. Designers, class societies, shipyards and owners are teaming up to beat the recession with new software and processes that will cut design time and costs

Inter-company collaboration is occurring because of the need to develop complex systems which cannot be the domain of a single entity. This does not mean that all competition has ceased but that more companies are recognising the need to create strategic partnerships.

It is essentially this requirement that has brought together companies like software specialist Dassault Systèmes, class society Bureau Veritas (BV), both of France, and Chinese ship designer the Shanghai Merchant Ship Design & Research Institute (SDARI), to improve the 3D modelling potential of Dassault Systèmes' software 3DEXPERIENCE.

A pilot project has combined the Dassault Systèmes software with BV's VeriSTAR calculation tools, and has SDARI working out the design for a new bulk carrier using the Harmonised Common Structural Rules (CSR-H).



"Designed for Sea" captures existing design information and leverages standard parts, design templates, specification catalogues, integrated knowledge and design rules to ensure design quality and compliance with requirements and regulations. Image courtesy of Dassault Systèmes

BV executive vice president for the marine & offshore division, Philippe Donche-Gay, told *The Naval Architect*: "In the past we have had to do a 3D model for each calculation and 20 years ago these calculations would have taken months; now with the greater computer power the calculations take a few weeks, but the yards are still saying that this is too long."

Speeding up this process through reduced modelling time could therefore be useful for the yards and class societies alike. In order to achieve quicker calculation times the pairing of Dassault Systèmes' 3DEXPERIENCE with Veristar Hull, HydroStar, Veristar Stability and Veristar HLC to create Finite Element Models, stability models and hull vibration models will create a single 3D model for all the calculations rather than a model for each element.

According to Donche-Gay, BV and Dassault Systèmes shared the software with SDARI for the purposes of the pilot project and SDARI's experience has been very positive. Overall, the creation of the 3D model and Finite Element models saved around 20% of the time taken when using conventional modelling systems, giving an overall 40% saving in time and therefore also reducing costs significantly.

However, BV also sees an extra benefit to shipowners, as with the 2D drawings coming from the yard and 3D models and calculations being developed by BV and its partners, the 3D model will be stored by the class society and will be automatically updated from operational data sent automatically from the vessel.

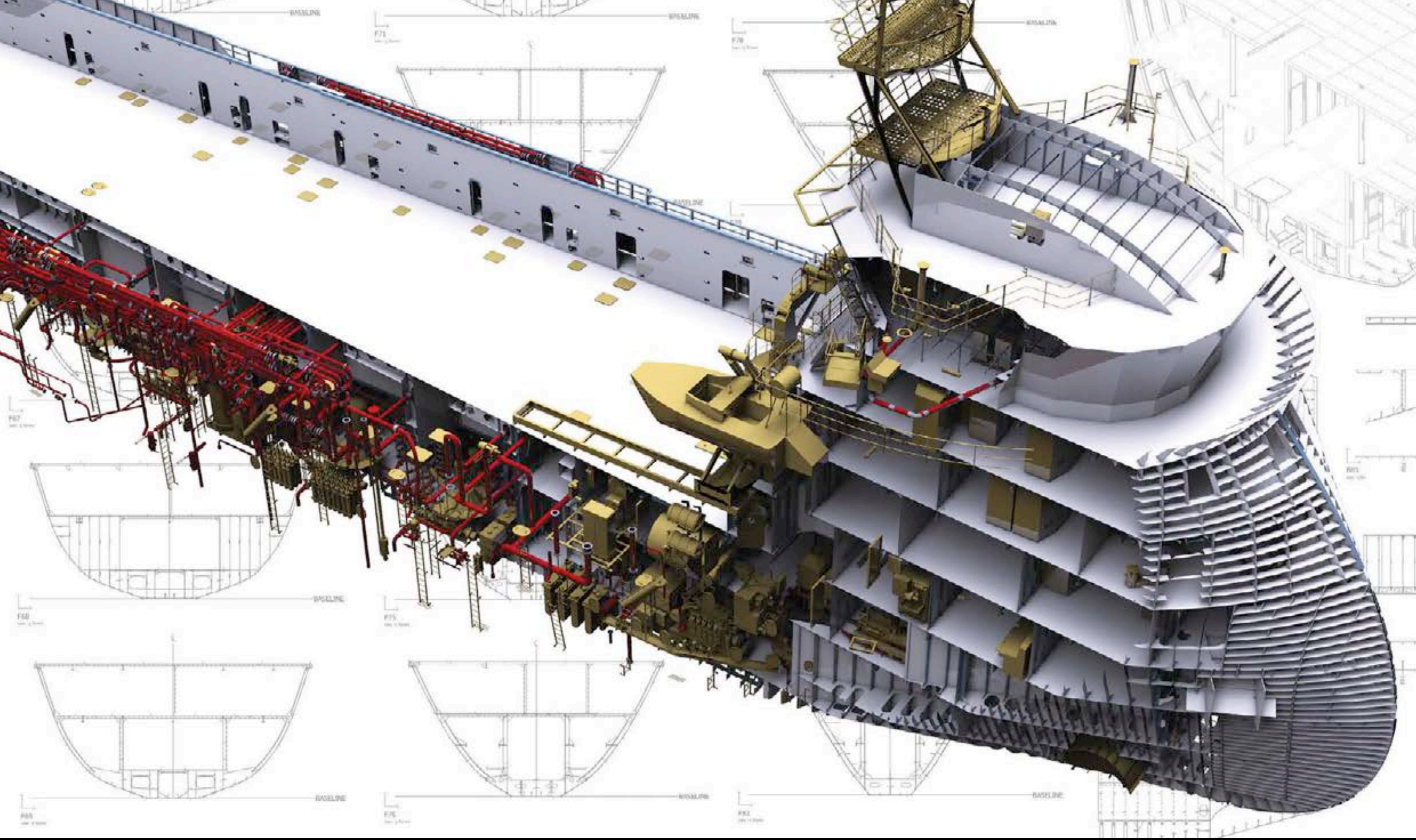
"This will mean that the vessel's digital twin can help with planning drydockings, for example, reducing the time, and therefore the cost, of drydocking substantially," says Donche-Gay. He added that BV is expecting to launch an app at the June Posidonia exhibition which will give the company's maritime customers instant access to details of their fleet from a smartphone or ipad, granting them greater and more immediate control of fleet information.

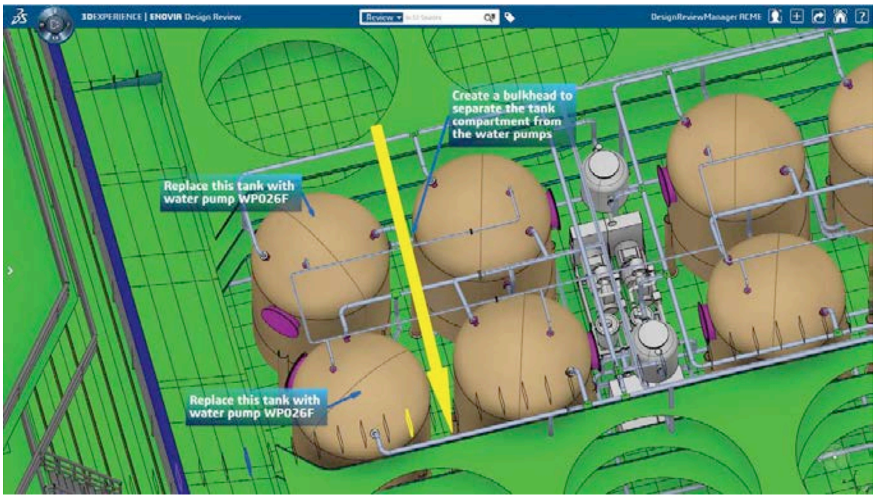
Collaborative DNA

Collaboration ultimately underpins Dassault Systèmes' 3DEXPERIENCE platform, which seeks to simplify complex industrial projects such as shipbuilding with a single network through which all build dimensions are shared.

Since its launch in February 2012, the platform has continued to grow, according to Alain Houard, vice president, marine & offshore, Dassault Systèmes, who says that the company is constantly improving the solutions it offers or the platform infrastructure, adding one or two design experiences a year.

The company's latest offerings in the marine and offshore segment include "Designed for Sea", a solution focused on





Review and analysis of a ship's engine room basic design water tight penetration between the structure shell and pipe. Image courtesy of Dassault Systèmes

allowing customers to design, optimise, validate and certify marine products, and "Optimised Production for Sea", a production planning process.

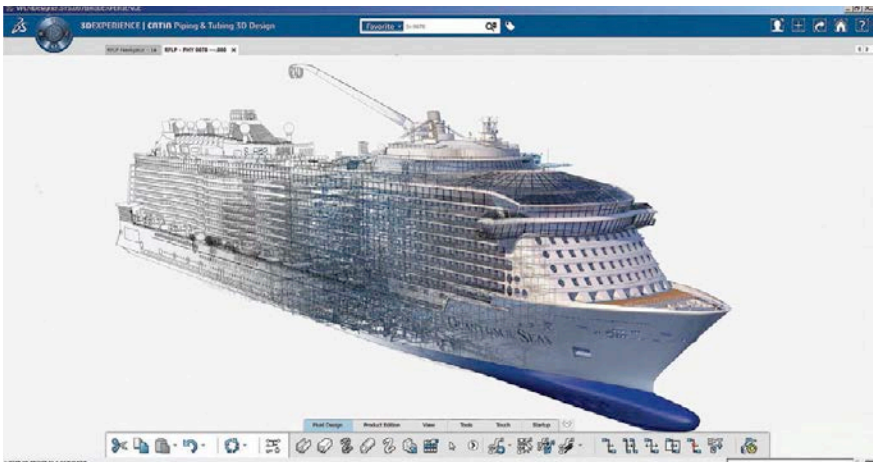
"Designed for Sea" has recently been adopted by Meyer Werft and covers all design phases from basic to final design. Its main feature, as facilitated by the platform, allows all actors in the design process to work together, connecting owners' requirements, regulations, engineering teams and suppliers by a single system. This means there is a greater awareness of events in a build, workers can see what their colleagues are doing, and the shipyard's design efficiency is greatly improved as a result, according to Houard. Meyer Werft has deployed an on premise version of the system to 300 of its workers as they collaborate on the construction of the first vessel to be built with the new platform. It is hoped that the integrated approach being taken will alleviate the pressure placed on the design process by the need to deliver innovative experiences for cruise customers.

"Optimised Production for Sea" is an extension of this idea, but has been specifically created to manage the complex assembly of ships, particularly for cruiseship assembly where workers will only have months to assemble around 10 million parts. This design experience brings a 3D planning tool that clarifies work instructions and production deadlines. Houard says it aims "to make the real world match the theoretical world," and can, for example, automatically take into account weld shrinkage and the need for plates to be cut larger than shown in "Designed for Sea".

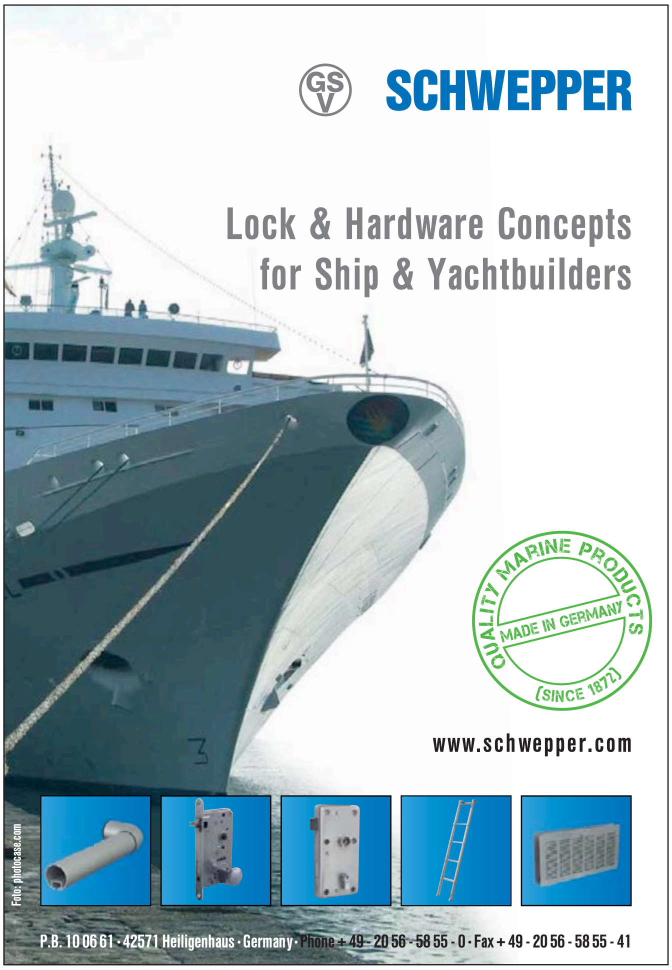
The 3D model is key to the process and can be changed on a step by step basis from raw state to sub assembly. Part of its benefit comes from the way it portrays the needed assembly method, as in comparison with 2D design images it allows those working on the build to easily view and understand what is needed of them. Houard points out that this can be especially helpful when language barriers are present as the 3D models circumvent the potential language differences of a design and manufacturing team. With this in mind, virtual reality (VR) seems the next step and Houard believes that a complete VR solution could be on the horizon given a wider acceptance of the technology. Dassault Systèmes can already deliver solutions mixing the virtual and real worlds to customers on a case by case basis, for example, where a shipyard can use a tablet to place virtual parts in the context of a physical ship, but it does not have an official offering for marine and offshore at the moment.

Houard emphasises that "It's not just about having the best design tool, it's about having the best design approach," and for Dassault Systèmes this approach is an increasingly integrated and simplified one. The announcement of partnerships with classification society BV and military yard DCNS suggests the company is not alone in this belief, and that the future will bring further integration of design and regulatory software systems.

The company made a conscious effort in the development of its platform to break from batch-based design and silo thinking, as it believed the speed of the design process would only change with a paradigmatic shift in the way thoughts were shared, moving to a more expansive and free-flowing model. It intends to carry on this process and has suggested that future offerings will continue to focus on providing managers with a summary of what is needed; a level of completion percentage of work being done; elements that allow businesses to make more sense of what they're doing; and increased automation of the decision-making process wherever possible with a graphic or dashboard approach, making management easier. *NA*



A 3D model of piping and tubing onboard *Quantum of the Seas* created in the 3DEXPERIENCE platform. Image courtesy of Meyer Werft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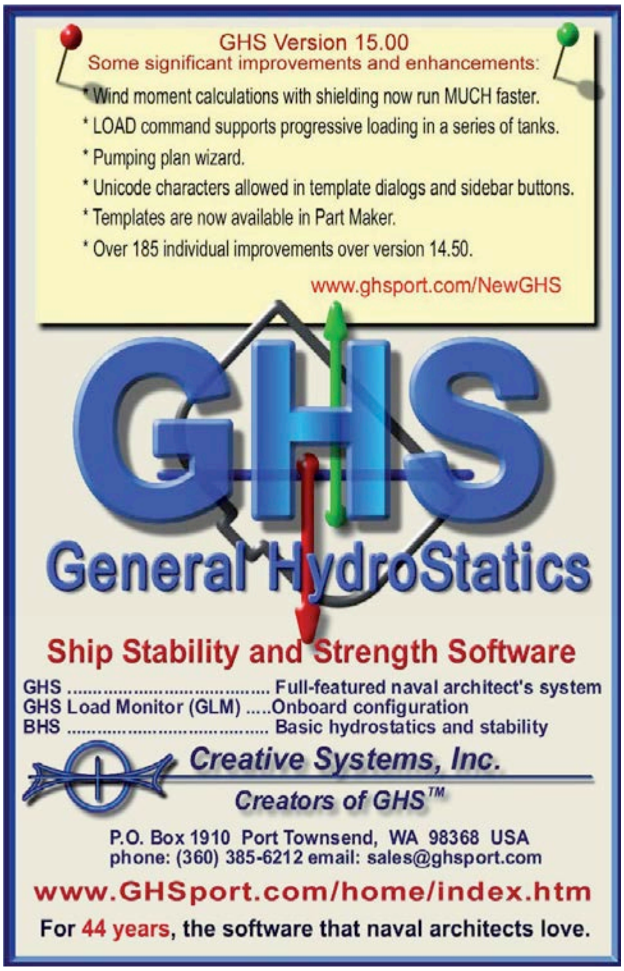
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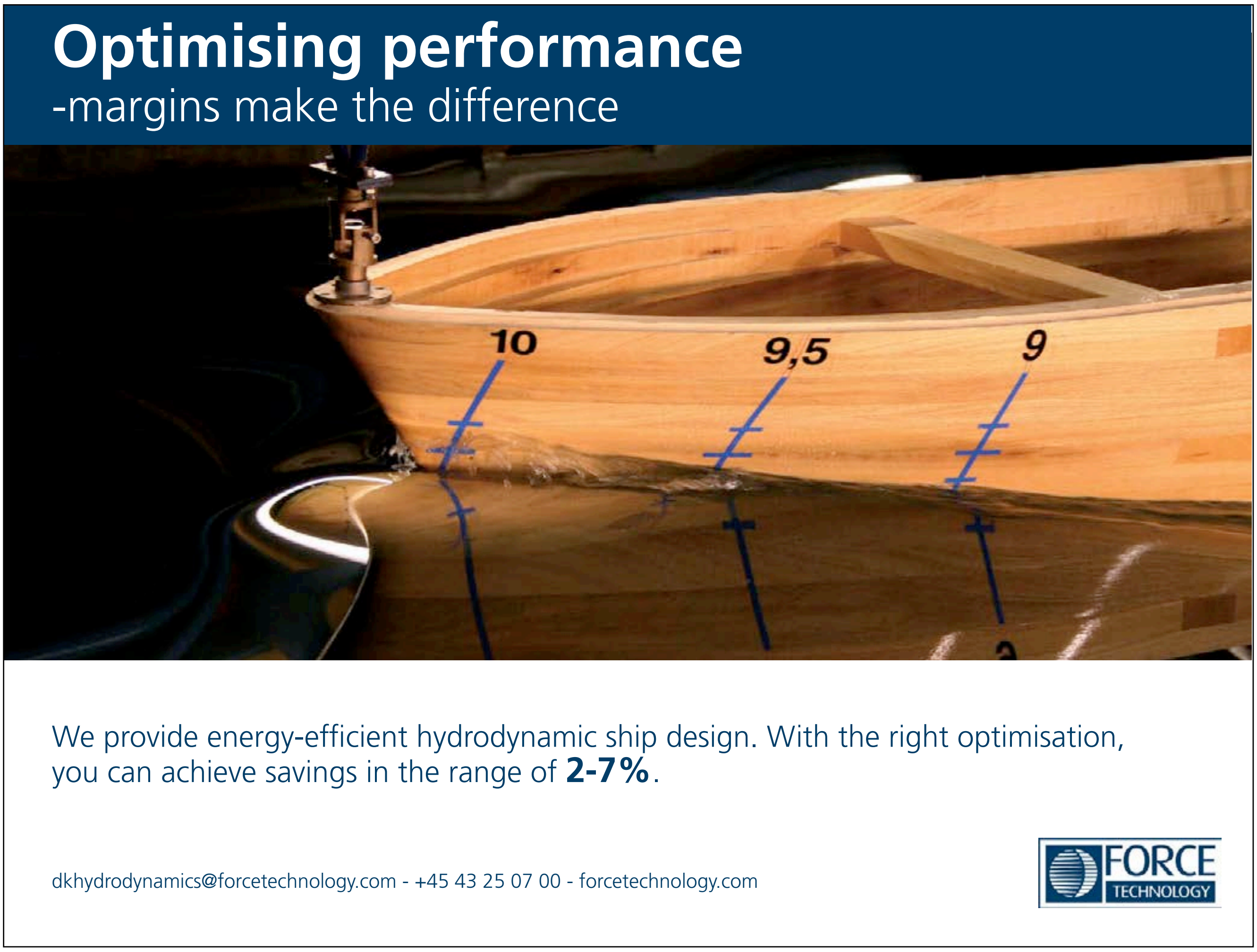
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Developing and delivering integrated initial 3D design

Jan Furustam, product manager, naval architecture, NAPA Ltd, explains how an integrated 3D design model can simplify the ship design process from the off

As a designer, satisfying the needs of different stakeholders including the owner, the classification society and colleagues, is essential. However, no matter how you approach it, the initial and basic design process of a ship is complex. The feasibility of a new design must be evaluated within a short timeframe, and when the aim is to reduce the lead time while ensuring that the new design is as safe, efficient and competitive as possible, an environment where the data is spread across different systems is not the most productive.

Hosting the design information in a single 3D model also has its challenges. Compared with traditional ways of working, such as paper drawings, spreadsheets and different documents, the vast amount of time needed for describing the design has traditionally been the challenge. However, when a topological 3D model exists, the downstream benefits will be significant for both decreased lead time in design changes and especially for the elimination of human error and inconsistencies due to data transfer between applications and documents not being up to date. Using a centralised system also helps to retain and accumulate knowledge and eases the work connected with supporting several systems and data sources in the same organisation. Additionally, industry standard formats for portability of data help in handovers and communication with all the stakeholders of the shipbuilding project.

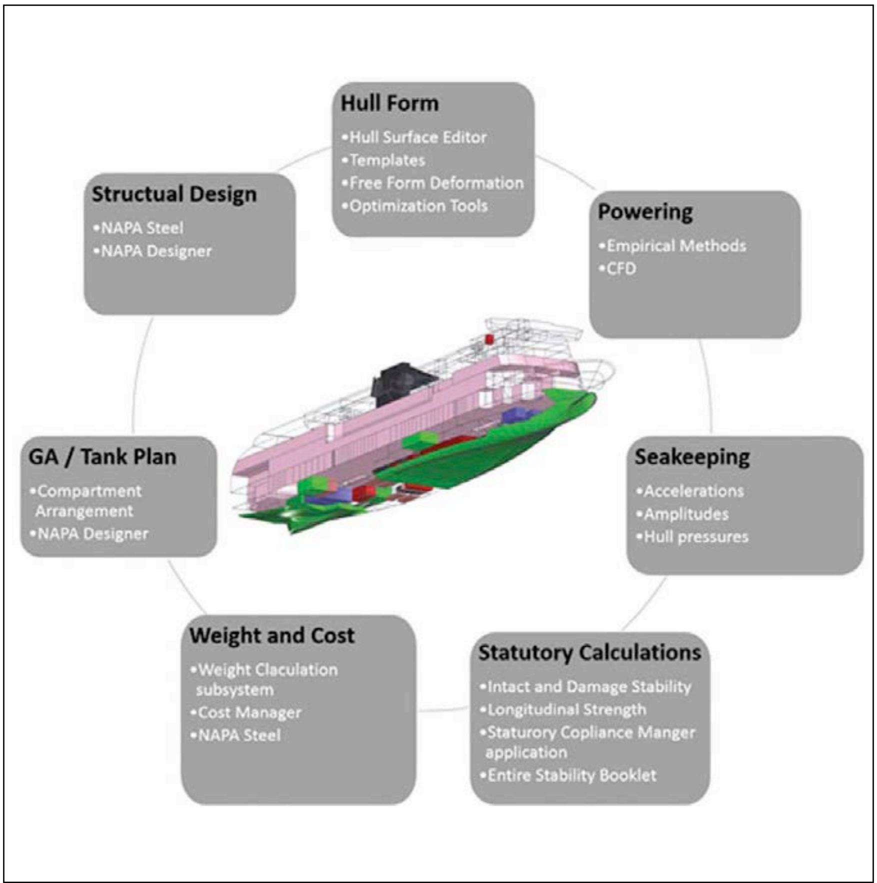
A 3D Model stands out as especially beneficial when there is a need for performing design changes; something which commonly occurs in the initial and basic design processes. To get the maximum benefit from a design tool it needs to support and enforce modelling conventions that allow a model to be updated immediately and without any extra effort after a change in the design. Combining such a flexible model with naval architectural analysis and structure design creates a platform capable of supporting true optimisation of the design.

The overriding vision for the development of the next generation of the NAPA early design tool has been on focusing on the creation of a consistent 3D model as early as possible. In order to make this happen, a new design tool has been developed. This creates a detailed 3D model at an earlier stage so that, for example, contract negotiations can be supported, and so that the model can continue to be used further into the design process, providing a backbone and necessary data for naval architects and future structural analysis.

Modelling

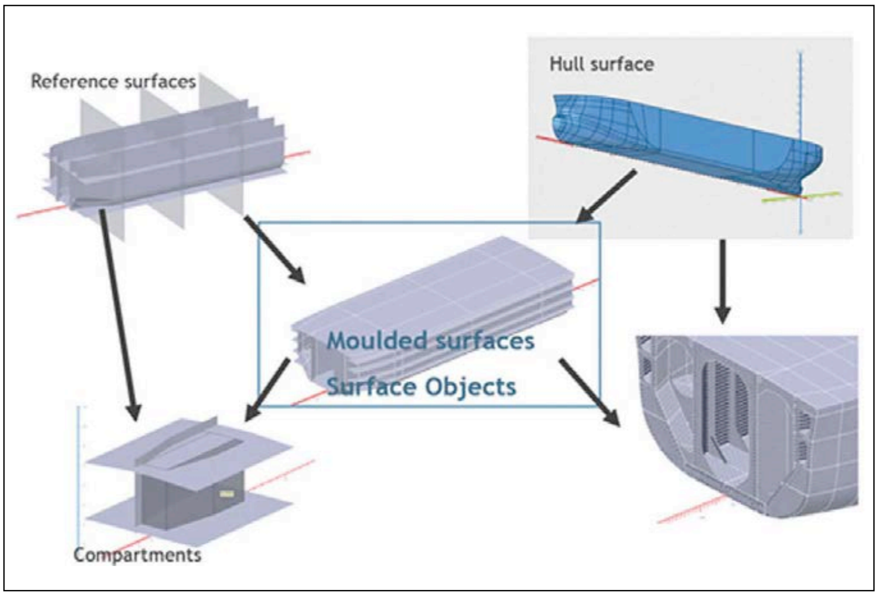
The compartment model is essential for many studies in the ship design process as it hosts fundamental information such as volume, bottom area, wall area, centres of gravity and the distribution of volume, and Napa's compartment model serves the designer in a number of disciplines:

- Capacity
- Loading and intact stability
- Damage stability



An example of disciplines and how NAPA software can be used in ship design

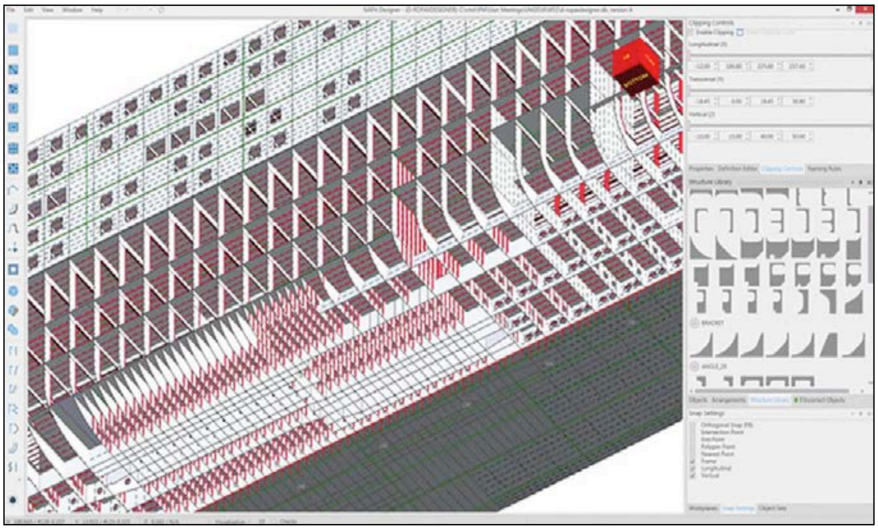
A flexible model is built up by reference surfaces, common for both compartments and structures



- Weight calculation
- Insulation studies
- Safe return to port
- Painting control together with structural model
- Corrosion control together with structural model

Creation of the compartment model is fast, and when completed by using reference surfaces, design changes are very quick and updated derived results can be obtained instantly and accurately.

The 3D geometry is associated with additional information about the purpose of compartments and structural details, which are necessary in the approval phase of the ship. This associated information is available in output functions, calculation results, and interfaces to other supporting software, and makes the 3D product model a unique tool in the early design stage of ships.



A structural model in NAPA Designer

Structure design

NAPA Steel supports structural design from the initial design phases to the classification drawings and rule check. Recently, there has been significant effort in the development of NAPA Designer to incorporate this. The tool holds a totally new user interface for NAPA's geometry, including that also used for naval architecture, and features functionality for modelling of the moulded surfaces, compartments and structural details.

The tool's 3D product model can be used for a range of tasks in the ship plan approval phase. These can include weight and cost estimation; checking class society rules through interfaces to check software; FEM meshing with automatic meshing options; and generating plan approval drawing with NAPA Drafting solution.

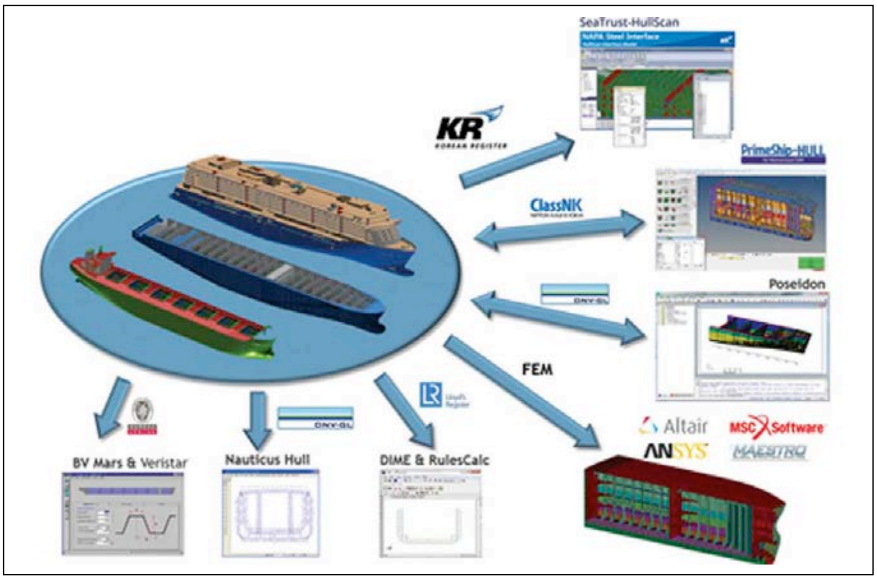
Introducing this software to 3D ship design also makes these functions highly useful in the early design stages; previously, 3D structure models were only available in later design stages because of the amount of work needed to adapt the 3D model to frequent design changes, a common occurrence in the early design phases.

Producing drawings from a 3D model

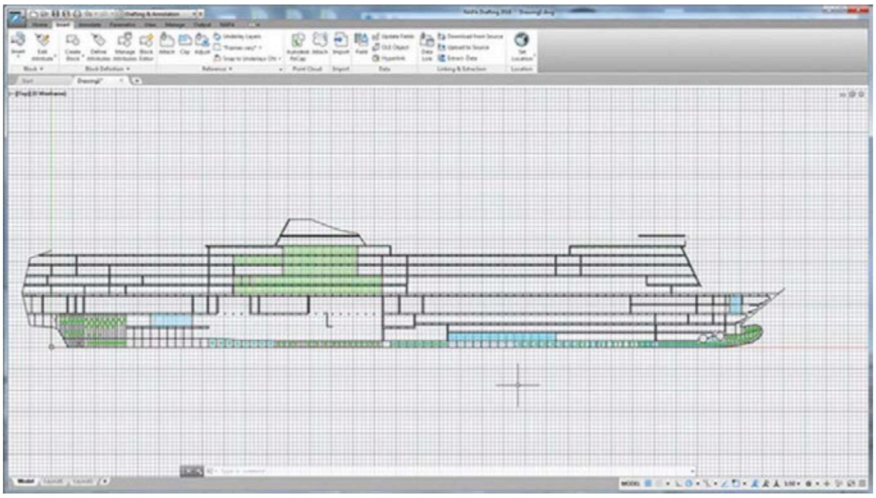
Even though 3D design is getting more and more common in early design phases, the drawings still have an important role in the ship design process. They are used for approval and also for sharing intermediate design results during the ship designing process. In addition, many stakeholders involved in the design process, such as different design departments at the shipyard, subcontractors, ship owners, class societies and authorities, prefer using 2D drawing as the primary information source in the approval stages. This is beneficial, for example, in terms of providing a low cost media solution that requires no extra software; however, it also has drawbacks. Not only is it additional work, but there are also potential problems with errors in cross references and the compatibility of common information.

The NAPA approach combines the benefits of 3D modelling and 2D drawings, and NAPA's latest development in the automatic generation of 2D drawings from a 3D product model, NAPA Drafting, comes with several advantages:

- NAPA has finalised the OEM contract with one of the world's leading CAD vendors, combining NAPA 3D technology with state of the art 2D drafting technology
- It is consequently easy to produce drawings from models in a standard 2D drawing format – this covers both structural drawings and general arrangement drawings produced from a NAPA compartment model
- The strongest point is the update function, which highlights changes between the 3D model and 2D drawing and lets the user make decisions about updating the drawing – this covers both the geometry of the drawing but also all of the annotations.



NAPA Interfaces for plan approval



Jan Furustam says creating drawings based on the 3D model is faster and easier using NAPA Drafting

The new tool supports the creation of classification drawings for structural design, but can also be used for obtaining sections of the compartment model for general arrangement design. This ensures that the model and the drawings are consistent and reduces the time constraints of design changes.

Weight and cost calculation

Weight calculation is a critical discipline in naval architecture and cost estimation of the ship. It is therefore of utmost importance that the weight is correctly estimated and then correctly followed up during construction. The detail of the weight model spans from having general formulae (e.g. based on the main dimensions) in the beginning of the project, to a detailed model containing all components in the ship.

NAPA supports this undertaking in its Weight and Cost calculation module. In the early stages of the project, estimates without a detailed model are required, for instance estimating the structural weight based on the volume of compartments or by estimation based on floor areas. Compared with measuring from 2D drawings, the volumes calculated automatically and correctly by a 3D modelling tool leave little room for human error. In addition, the calculations are automatically updated when the design changes, speeding up the process.

Seakeeping and manoeuvring

The ship's behaviour in waves is interesting when focusing on the wellbeing of the crew, passengers and the structures of the vessel. NAPA contains tools for evaluation of downtime, seakeeping criteria, loads on hull, and steering and manoeuvring, to help better understand this during the design stage.

The seakeeping codes that are available are based on the Strip Theory and the linear Panel Method. Strip Theory gives fast and accurate estimates, considering the simplifications that the method implies. More accurate results (at a slight cost to calculation time) can be obtained by the Panel Method, which can currently be applied for zero speed too.

Manoeuvering studies can be conducted using the NAPA manager application. This can also be used to generate the wheelhouse poster and pilot card, which are mandatory items onboard the vessel's bridge.

Conclusions

Switching from scattered information from multiple sources to an integrated 3D design model significantly reduces the complexities and problems associated with ship design. The initial design phase, where changes are frequent and updated results are needed quickly, is made much simpler by a system that employs flexible geometry and includes, if not all the engineering analysis capabilities, then at least the working standard interfaces to support analysis tools like those for scantling analysis needed for class approval of structures. *NA*

Algoma builds on its earlier success

Having started its fleet renewal programme in 2011 with the delivery of the Algoma Mariner-series, the Great Lakes operator, Algoma Central Corporation, is continuing to upgrade its fleet with its team of designers at the centre of its development of the latest self-unloading vessels

Following the delivery of its Algoma Mariner-series, Algoma Central Corporation (ACC) ordered a further 12 ships from European and Chinese yards, a five-ship order from Nantong Mingde Heavy Industries in China was made for the gearless bulker and gravity type self-unloading (SUL) ships. In Europe, the Uljanik Group of Croatia agreed a deal with ACC to deliver five similar SUL's, but with the discharge boom forward. An order of two similar, boom aft SULs, was made at Jiangsu Yangzijiang Shipbuilding Co. of China.

Algoma Equinox at the Nantong Mingde shipyard in China during its construction. The ship was delivered in September 2013

Three Nantong Mingde 225m gearless bulkers were delivered in the fourth quarter 2013 and the second and fourth quarters of 2014. A fourth gearless bulker and the first SUL are expected to be delivered in 2016. Delivery of two 225m boom aft SUL's from the Yangzijiang yard will be in the first quarter of 2018 and the five boom forward SUL's from the Croatian yard, Uljanik, will consist of two 198m vessels to be delivered in the first and third quarters of 2017 and three 225m ships to be delivered during 2018.

Vessel designs agreed with the shipyards had significant input from ACC in the shape of Don Larkin, director of fleet development, naval architecture, who also looks after transport economics and cargo systems integration; Bernie Johnson, director of special projects marine engineering, who also covers the brief for electrical and control systems and approval of all equipment as well as the supervision of site teams; Robert Houston, director of technical environmental technologies, also covering ship production methodologies, outfitting, systems; and Al Vanagas, senior vice president and technical executive responsible for fleet renewal comprising all 12 ships, marine engineering, operational integration and all technical and commercial aspects including profit and loss.

Larkin says in a tongue in cheek fashion: "Naval architects do have a place in the world, indeed, some of our best friends are members of that tribe". He does, however, also point out that as shipowners and operators they have a significant amount to offer during the design phase of the ships that will be included in the ACC fleet.

"As shipowners and operators it has long been apparent to us that the input of those who will operate the ships and with luck, make money with them is of the utmost importance in the delivery of an exceptional merchant ship. This is not always acknowledged by professional designers. Algoma recognised this during the construction of the last generation of lakers, maintained that capability through the years, and applied resources in-house to interface and in many cases override the judgement of the 'designers'. In fact, the designers of these ships are ex-chief engineers and an ex-VP of operations at a shipyard."

Involvement of these four experienced members of staff was considered "a necessity" by ACC in the development of their newbuildings.

Some of the specific issues that needed to be addressed for ACC at the design stage included the recognition that the vessels' operations would be entirely within the North American Sulphur Emission Control Area (SECA) and that the ships would require technology, in this case the Wärtsilä closed-loop exhaust gas scrubbers, to meet this requirement.

Launching of *Algoma Equinox* from China's Nantong Mingde yard

	1970s (last Generation)	2010s-onward (current Generation)
Environmental		
Machinery	Generally medium speed	Tier II Wärtsilä slow speed
Weight penalty associated with SS ME (compared to MS ME) has become significantly less than the 300-500 tonnes estimated in 1970s		
Exhaust Gas Scrubbing	Nil, remaining fleet is burning low-Su distillate selectively to manage sulphur emissions	Closed loop scrubber fitted. Vessels are burning IFO-380
WBT	Only ballast exchange required in designated areas	Ships are designed to accommodate retrofit of WBT when the technology matures. This includes space reservation, dimensioning of pump discharge pressure and electrical generation capacity.
Resistance and Propulsion	Hull form tested in St.Alban's, Herts in mid and late 1970s	Hull form designed by Deltamarin using RANSE techniques, including three iterations and testing in Hamburg (HSVA), and including another three iterations in model scale.
Structure	State of the art techniques did not include widespread access to finite element techniques	Widespread use of NASTRAN and FE programme suites marketed by the large Classification Societies. Weight and fatigue life impacts currently unquantified.
Power consumption	Universally AC @ 60Hz	Variable frequency drives have been applied to previously AC and even hydraulically-powered consumers. A closer matching of power supplied (so consumed) to that demanded yield energy efficiencies.
	Electrical consumers (motors) were of lower efficiency and light included mostly incandescent and some fluorescent tubing.	Widespread application of LED lighting, within the house, cargo, navigation spaces.. Navigation lights use LEDs where available.
Delivery Voyages	Only a handful of the existing fleet was constructed beyond the Great Lakes Basin.	No domestic capacity exists for the construction of these merchant ships. Delivery of lakers, which have ~50% of the hull strength of similarly-sized ocean going vessels requires minimization of still water bending moment, through loading, weather routing and is based on hydro-elastic analysis conducted by LR Southampton.
		RANSE Reynolds Averaged Navier Stokes Equations. Like structural FE, made commercially accessible through computational advances.

A comparison between the old and new generation vessels

In addition, the provision for the retrofit of a ballast water treatment system, which would be commissioned once the technological barriers to effective operation in sometimes turbid, almost always fresh water, are eliminated.

A trade profile which includes operation in confined waters, including rivers and canals within the St. Lawrence Seaway for around one third of the vessels' operational time.

Lakers must operate with minimal assistance from ashore for mooring, shifting (warping) or manoeuvring. The ships are equipped with high angle/performance rudders and bow and possibly stern thrusters.

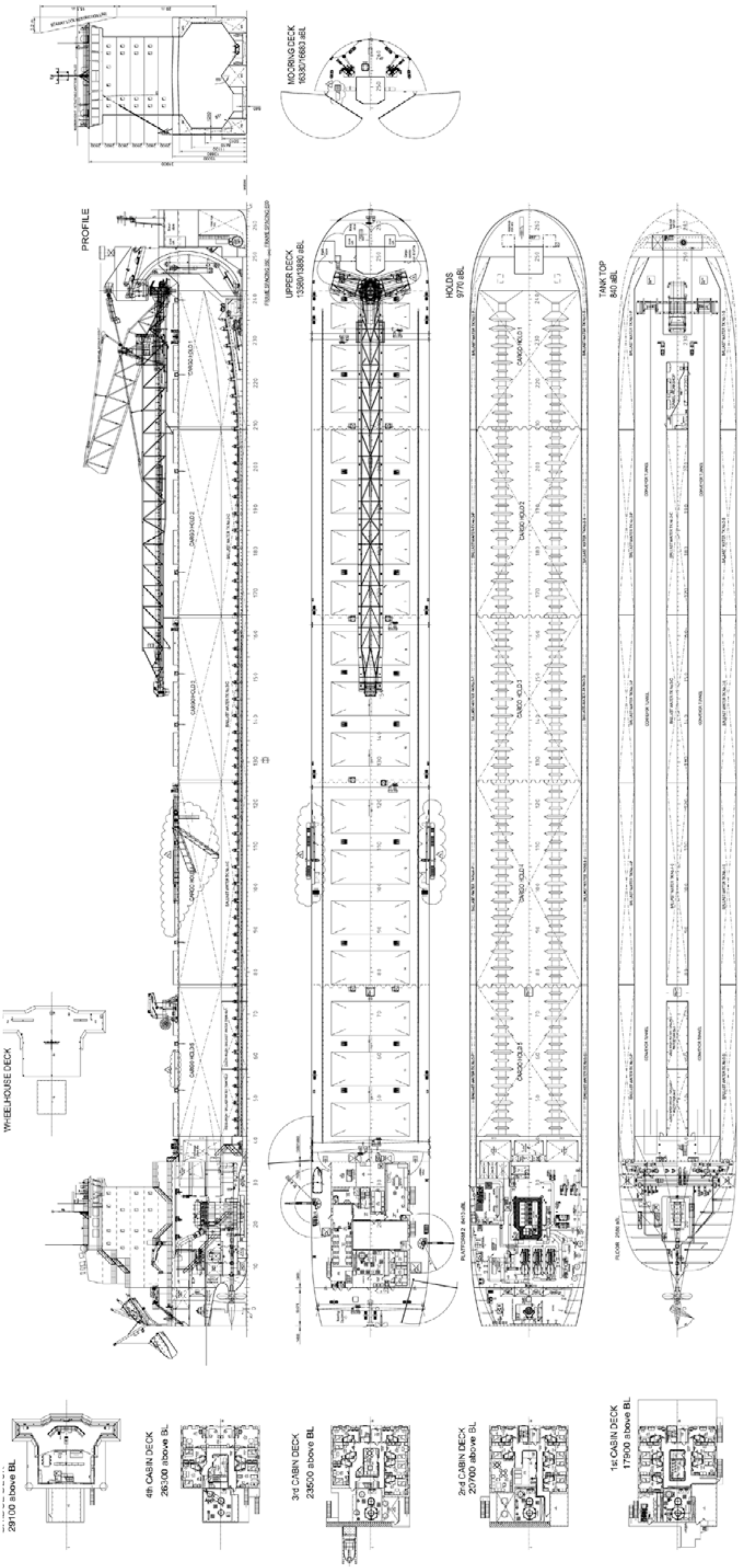
There is also a requirement that these land locked ships can operate with significant autonomy. For example, from the Western extremity of Lake Superior to Port Cartier, a grain transhipment port in the Gulf of St. Lawrence involves 1,564 nautical sailing miles. Port Cartier to Bristol, England is 2,617 nautical miles.

However, the wave environment within the lakes means that the vessel hull strength (midship modulus) will need to be only 50% of that required on a deepsea ship having identical dimensions.

Included in the design considerations is that the vessels will operate in a region with a 10 month navigating season. Locks within the canals are deactivated from January-April each year due to low temperatures, but some ports have a longer operating season and can be served by ships if canal transits are not required. Freezing conditions eventually make them inaccessible. The ship's systems and structure must be designed for this low temperature environment.

Gravity fed conveyor belts elevate the bulk cargo material to the deck-mounted 80m long deck boom for discharge ashore at rates exceeding 5,000tonnes/hour. This capability has the obvious implications for the ballast system.

Competitive pressures from other modes, specifically rail, which operates year-round and complies with different emissions standards, have meant that the vessels must be able to provide a cost effective alternative. *NA*

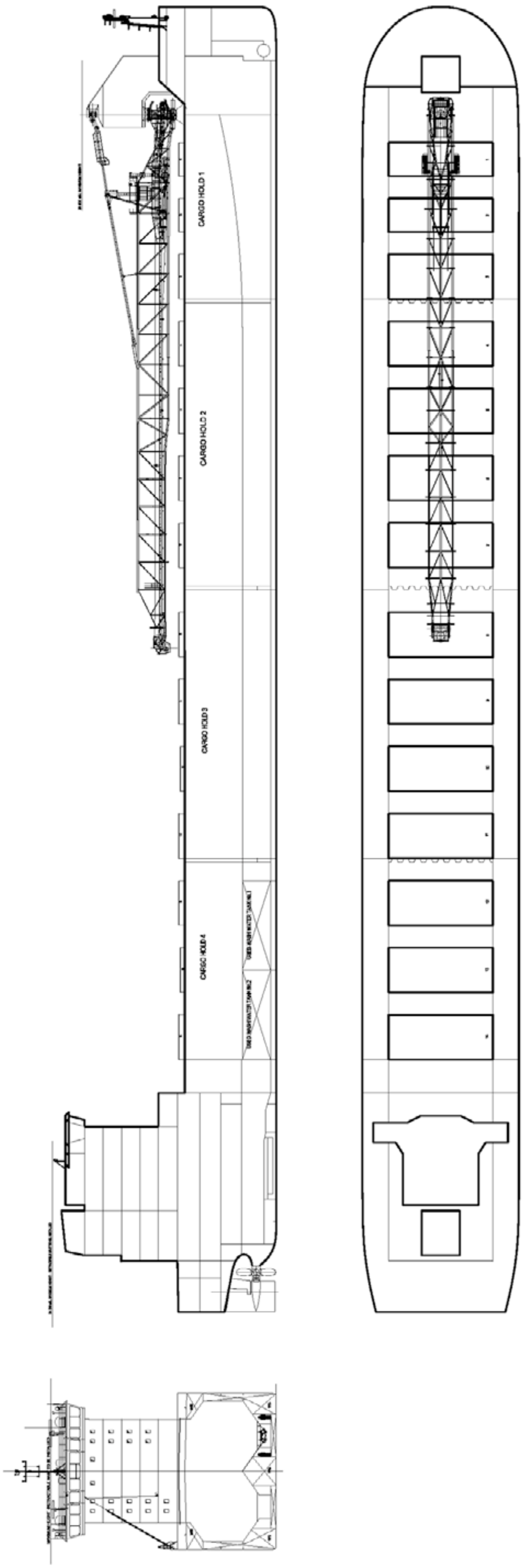


GA for Great Lakes 225m SUL bulk carrier

TECHNICAL PARTICULARS

SUL boom forward bulk carrier

Length overall: 225.550m
Length b.p:. 222.485m
Breadth moulded:..................................23.770m
Depth moulded:.....................................13.580m
Draught design (Seaway): 8.150m
Draught design moulded: 8.136m
Flag:..Canadian
Class Notification:......... ✠ 101 A1, Great Lakes Bulk Carrier, for Services on Great Lakes and River St. Lawrence, LI, ✠ LMC, UMS, ECO (A, GW. OW, P, IHM), NAV1, CAC3
Description notes:.......................Self-Unloading, Part Higher Tensile Steel, Shipright (SCM< PCWBT)



GA for Great Lakes 198m SUL bulk carrier

TECHNICAL PARTICULARS

SUL bulk carrier

Length overall	198.350m
Length b.p.	195.285m
Breadth moulded	23.770m
Depth moulded	13.580m

Thorco Lohas completes heavy lift set

Danish heavy lift company Thorco Shipping will soon take delivery of the tenth and final vessel in its L-class newbuilding programme that started in 2012. *Thorco Lohas* was launched in mid-February and it, along with its sister ships, will offer the company's customers a more efficient heavy lift alternative

Thorco Shipping, which is headquartered in Denmark, announced the launch of its final heavy lift vessel in a series of 10 from the Japanese yard Honda Heavy Industries.

Thorco Lohas will join its sister vessels as part of a fleet of modern, fuel efficient and low emission, heavy lift vessels. The 131m ships are 16,950dwt each with a MAN-B&W 7S engine developing 5,180kW of power and two auxiliary engines of 400kW each. Hull attachments have improved the hydrodynamic performance of the vessels, lowering their fuel consumption and, therefore, their emissions.

According to Thorco partner and CEO, Thomas Mikkelsen: "The new vessels are of a well-known design to Thorco, have high specifications, are modern and more fuel efficient, which all together meet the increasing demands of the industry and optimise our performance and efficiency to serve our clients in the best way."

All 10 ships were built at the Saiki Shipyard in Saiki City, Oita, Japan. The yard is owned and operated by Honda Heavy Industries whose major shareholders include NYK Line, Mitsui OSK Lines and the Exeno Yamamizu Corporation.

The ships are equipped with two electrohydraulic cranes which each have a safe working load of 50tonnes and a reach of 32m.

They are flagged with the Panamanian register and classed under the ClassNK banner with the notation NS*(BC-XII, EQ C V & DG) IWS MNS*.

Cargo hold capacity includes 2,249.22m^2 in hold 1 and 2,298.15m^2 in hold 2 while the total grain volume for both holds is 26,066.6m^3. Removable tween decks with an electric hoist for lifting the tween deck cover also allows for the vessels to carry up to 200TEU on deck.

However, the *Thorco Logic* and *Thorco Lohas* are slightly different to the other eight vessels as they have been fitted with energy saving devices, though Thorco would not specify what these devices are.

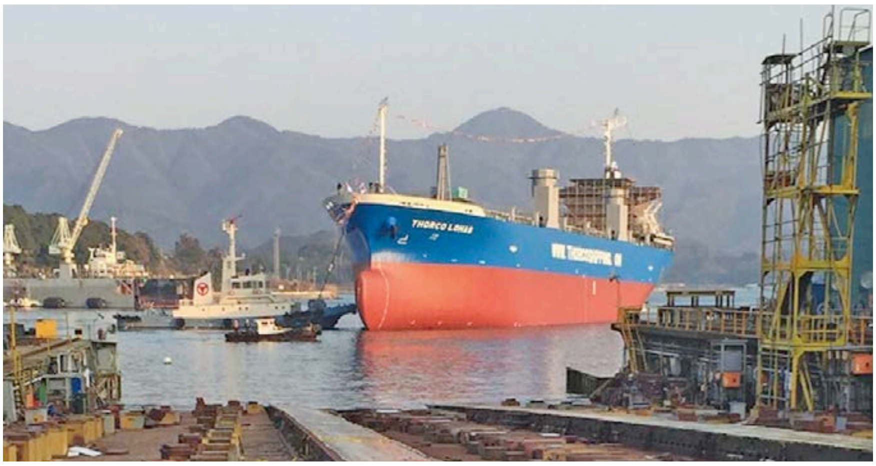
Owned by the conglomerate, Thornico, which has around 120 companies under its umbrella, Thorco has been renewing its fleet over a period of years. Christian Stadil, owner and CEO of Thornico referred to the company's fleet renewal programme, saying: "We firmly believe that when a market is under pressure, when the market is like a closed door, this also equals an open door in terms of the opportunities that will arise, so when an opportunity like this presents itself, we strike." *NA*

TECHNICAL PARTICULARS

Thorco Lohas

Length	131.66m
LPP	122m
Beam	23m
Draught fully loaded	9.6m
Air draught	41.14m
Tank Capacity	
HFO 96%	847.50m^3
MGO 96%	115.80m^3
Ballast	5,947.76m^3
FW	850.19m^3
Cargo hold	**1**
Tank top	803.30 m^2
Tween deck	870.67 m^2
Hatch cover	575.25 m^2
Total	2,249.22 m^2
Cargo hold	**2**
Tank top	770.70m^2
Tween deck	892.2m^2
Hatch cover	635.25m^2
Total	2,298.15m^2
Volume	
Hold 1 bale/grain	12,414.58 / 13,072.94m^3
Hold 2 bale/grain	12,255.08 / 12,993.66m^3
Total bale/grain	24,669.66 / 26,066.60m^3
Permissible Loads	
Tank top	11.9 mt/m^2
Tween deck	4 mt/m^2
Hatch cover	2.5 mt/m^2
Main deck	2.5 mt/m^2
Hold Equipment	
Three air changes pr. hour	
Electrical hoist for shifting tween deck cover	
CO_2 fitted	
Grain fitted	
Fitted for carrying dangerous goods	
Dehumidifier fitted in the hold	

Launch of *Thorco Lohas* has ended the current 10-ship newbuilding programme in the Honda Heavy Industries yard in Japan



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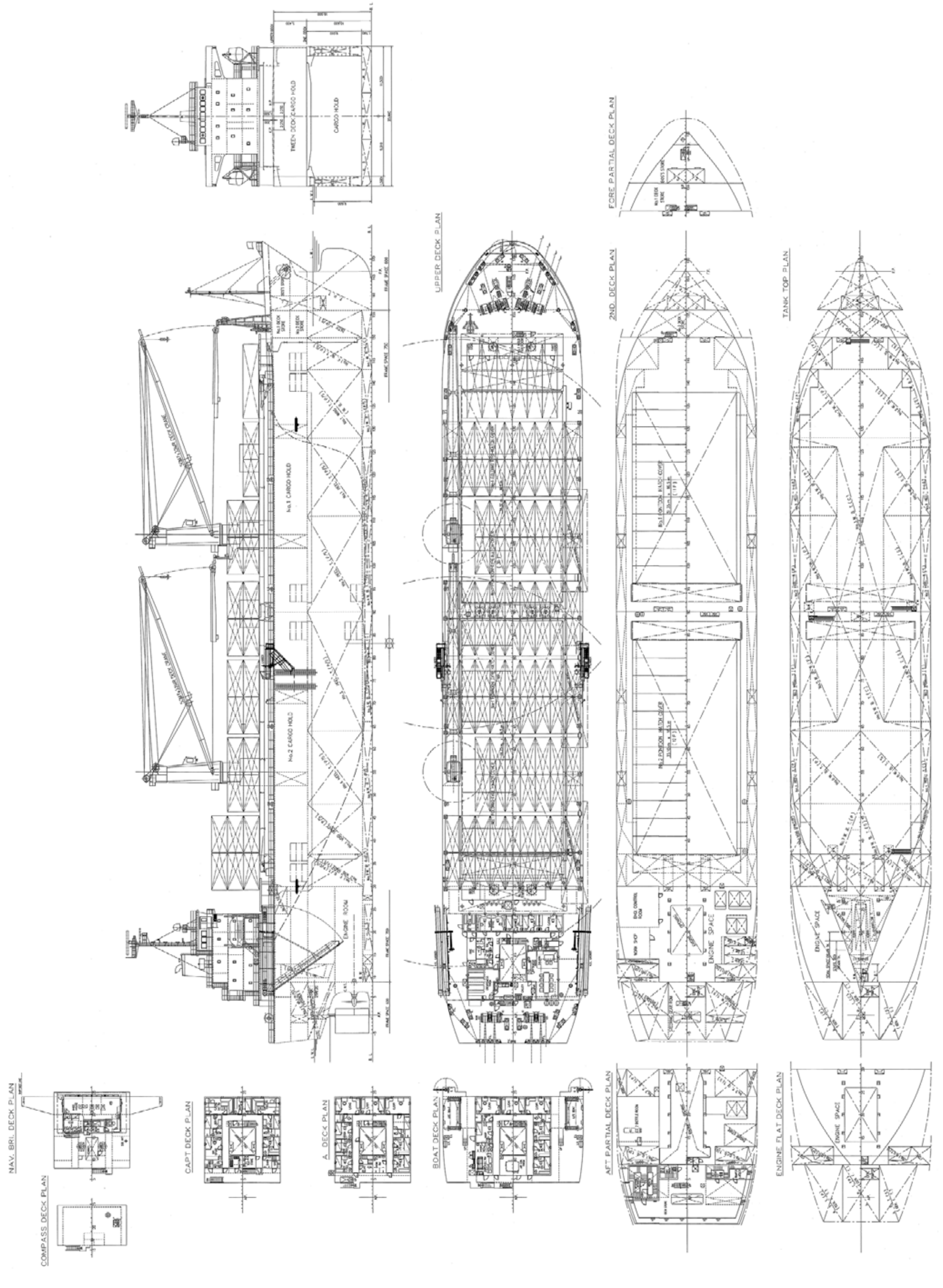
GA plan for *Thorco Lohas*' sistership, *Thorco Legacy*



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Boxing clever

Dear Sir,

It was interesting to read in the February 2016 issue of *The Naval Architect* the Letter to the Editor from Mr W T Cairns with his recollections of the corporate rivalries and infighting surrounding the design and construction of the early containerships, prompted by the article 'Revolution in a box' in the Foundations series in the November 2015 issue.

As the author of the article, I should like to make a few points. Had my task been to write a general history of early container shipping it would have been remiss of me to leave out the background he covers. But it was not. The remit for the Foundation articles that ran in NA during 2015 was to use INA/RINA papers to illuminate some areas of development in naval architecture of great concern at the time, or still relevant today. Choice of the three Marshall Meek papers was a considered one. Two papers on cargo liners reviewing changes from generation to generation, then one on a major design shift, all from the standpoint of a single designer. The container vessel paper seemed to hand several hostages to fortune, talking about design decisions taken in the absence of reliable data, before they had been vindicated or discredited from service experience with the vessel. Data and observations in the article were taken from the papers.

The comment about use of rivets in the cargo liner classes is a good one. When trying to identify subjects for the Foundation series I toyed with the idea of an article on the uneven, sometimes reluctant progression from rivetted to welded structures, to be provisionally titled 'The rivet as comfort blanket.'

Mr Cairns writes 'I was there'. So was I, but viewing the situation from a very different standpoint. As a former Shaw Savill engineer cadet I was getting in sea time for tickets. People were sounded out by the company to see who would be interested in transferring to the Shaw Savill containership in the OCL consortium. My answer was no, and there were three reasons. One was that qualification inflation had taken off in the UK, so that in the longer view a degree would be an advantage. I had been offered a place at university, effective before the ship went into service. The second reason was the point pressed by Meek in the cargo liner papers, which were read with interest at the time by those of us running cargo liners in other trades and companies, that is the time spent in port working break bulk cargo rather than carrying goods across the seas. For engineers, the workload in port could be heavy but there were consolations in time off for social life and sightseeing ashore as the ship went from port to port around the Australian and New Zealand coasts. The promised high utilisation of a containership seemed to offer a tedious voyage out, a few days at a container berth, then back. Good for the owner but not much fun. The third reason was technical. I had long before decided that the future lay with the motorship, and that steam was basically an old technology that had just about reached the end of its development. Not that motorships were trouble free; some of the company's older vessels had the reputation of being real workhouses, but diesel engines seemed to be improving. Transfer to a steam containership felt like being a step in the wrong direction.

"the real first was getting worldwide acceptance of a limited range of box sizes, resulting in reconstruction of the whole logistics chain, of which the ships are a part"

Mr Cairns raises the matter of excessive stability. David Moor (Vickers St Albans tank) contributed to the written discussion on the Meek container vessel paper. It is worth quoting from what he wrote: "Each of Mr Meek's splendid series of papers has described a ship design more complicated than its predecessors in every way, including the hydrodynamics: having been intimately connected with the vast programmes of experimental tank work carried out in each case, the writer is, he hopes understandably, disappointed that each successive paper contains less on this most important aspect of the design. This disappointment is heightened in the present case by the awareness that the tests so cursorily described have advanced our knowledge and experience far beyond anything hitherto published.

"Beside the bow and stern variations mentioned the effect of large changes in transverse inertia were investigated. The first forms proposed had Cit =0.59, of the order required for modern 500ft ships of the same fullness, but this gave excessive stability, and for the first time in his experience the writer was asked to prepare a new design with nearly 20% less transverse inertia! The final form has Cit= 0.54."

On the question of 'firsts', surely the real first was getting worldwide acceptance of a limited range of box sizes, resulting in reconstruction of the whole logistics chain, of which the ships are a part. Throughout recorded history there seems to have been an urge to containerise shipping within the social, economic and technical limitations of the time. From semi-standardised pre-filled amphoras carried in dedicated ships of the classical era, to the wine trade of the middle ages with ships dimensioned to suit standard wine tuns, to Brindley's canal boats optimised to carry uniform coal containers pre-filled at the mine and land them for onward transport in the city. *NA*

Yours
Richard White (Member)

The Royal Institution of Naval Architects

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Call for Papers

Shipping is one of the most efficient means of transportation for bulk commodities. However, as part of the global effort to reduce greenhouse gases (GHG) the industry must design and operate lower emissions-higher energy efficient ships. IMO introduced mandatory standards on the energy efficiency (EEDI) of the majority of new built vessels and further regulations are expected to be developed for ship types not already covered. The Energy Efficiency Design Index and the Ship Energy Efficiency Management Plan (SEEMP) has been adopted for existing ships in an attempt to monitor (Energy Efficiency Operational Indicators -EEOI) and improve their efficiency.

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RINA's Historic Ships conference returns for a fourth instalment that will not only focus on the restoration and preservation of historic vessels, but also the research and investigation into the engineering and efficiency of historic designs through modern naval architecture techniques.

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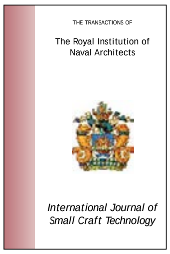

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