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Publisher Mark J Staunton-Lambert

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Editorial & Advertisement Office:
8-9 Northumberland Street
London, WC2N 5DA, UK
Telephone: +44 (0) 20 7235 4622
Telefax: +44 (0) 20 7245 6959
E-mail editorial editorial@rina.org.uk
E-mail advertising advertising@rina.org.uk
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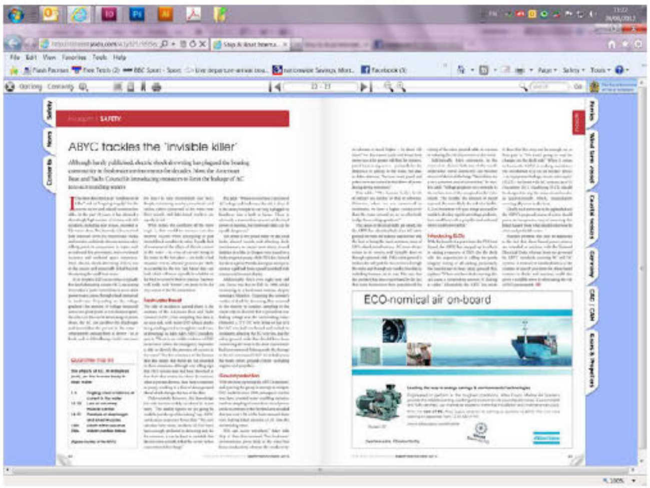

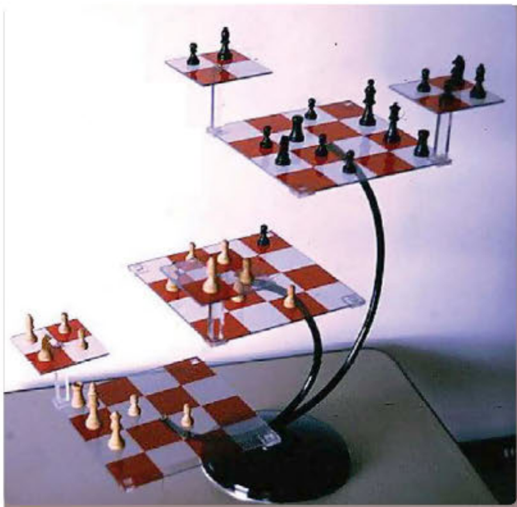

Collaboration is the name of the game

The triple requirements of environmental friendliness, economic frugality and high levels of safety are posing new challenges to vessel designers and they will need to find new ways to collaborate to find solutions to new challenges

Complex situations require complex solutions and the situation that the maritime industry finds itself in today is certainly complex. New regulations regarding emissions of SOx and NOx together with particulate matter, the Ballast Water Treatment Convention and new rules governing carbon emissions to come have added to the complexity of an industry that was already tackling safety issues as well as economic challenges.

This three dimensional challenge of economics, environment and safety, like three dimensional chess, possibly represents the greatest challenges this industry has had to face in its history. Piecing all the elements together and making sure they meet industry and societal needs from every angle will be a difficult strategy to devise.

Ship design and building, particularly in the modern age, has always been a collaborative effort, but with these new challenges the collaboration between owners, designers, shipyards, researchers and government is going to have to intensify substantially.

In Japan that collaboration took the form of industry, academia and government financing a number of research projects with the stated aim of maintaining the position of the Japanese shipbuilding industry as a quality provider of vessels, not necessarily cheap, but definitely high quality.

Similarly, Denmark as a nation, has understood the requirement to collaborate in order to innovate. In this month's issue *The Naval Architect* takes a look at how the Danish Government has pushed a number of industries, including its maritime sector, to develop research programmes that will bring prosperity to the nation and retain the country's place in the global economy.

For the maritime industry this will mean an initial four year period where 16 research programmes, broken down into five work projects will be undertaken by Danish academia and industry working together for the good of society.

Is this a change in the modern world? Well our Foundation feature this month looks back at the resistance research conducted in the 1950s on the paddle steamer *Lucy Ashton*. The research was an example of the kind of collaboration that is necessary for the industry to prosper.

That research was conducted by the British Shipbuilding Research Association with help from the Ministry of Supply and others. The *Lucy Ashton* research shows that collaboration in the industry is nothing new. Perhaps, however, collaboration is changing in its nature.

Next month, *The Naval Architect* will cover the collaboration between a class society, an university and industry as Lloyd's Register, newly installed at The University of Southampton's Bolderwood campus along with the Wolfson Unit, the towing tank at the same campus and the B9 design company that is looking to develop wind assisted power in an effort to decrease the environmental impact of shipping and adding an economically viable dimension, that is cheaper energy, to the mix.

It is likely that more collaborations of this nature will take place as the complexity of the industry increases and the cost of research soars, but the returns offered through the development of new technology will be beneficial in both monetary and social terms, in the environmental footprint, the safety of new ships and the economic benefits to us all.

It is expected that as the industrial world spreads and the population of the globe, not only increases, but also prospers there will be a requirement for changes on a grand scale.

Industry is already undergoing fundamental change in the Western economies and those changes are set to intensify as, for example, automation replaces manual effort with up to a third of jobs as we know them being lost through automation, that could be up to 10 million jobs in the UK alone, according to some economists. Such upheaval in the work place was only matched by the Industrial Revolution. The next phase in the development of the global economy has been called the second Industrial Revolution.

Technology is about to take centre stage once again and it is the research programmes such as the ones in Denmark and that undertaken in Japan and the kind of collaboration between industry, academia and government that will supersede national borders and narrow sector interests, and will provide the platform for a new era in the maritime industry.

That future has a greater depth; it is definitely 3D. *NA*

Regulation

Compliance alliance calls for better enforcement

"Regulation with bite," is how the chairman for the Trident Alliance, Roger Strevens described the emission control areas (ECA), not because of stringent sanctions for those that fail to comply; but because of the costs for those that do comply.

Strevens, talking at a Trident Alliance meeting at the, inaugural European Shipping Week in Brussels in March said that while the cost of oil had fallen in price the difference between the cost of high sulphur HFO and its low sulphur cousin MGO was still between 40 and 60%. With that differential in price the driver [for non-compliance] is still there.

However, the main difficulties with the ECA regulations are the enforcement arrangements which appear piecemeal at best, particularly in Europe where there are a number of jurisdictions, and seem unenforceable in some regions, particularly when the SOx restrictions are globalised in 2020 or 2025.

Trident Alliance members are asking a number of significant and pertinent questions to which there appear to be no answers from the regulatory authorities. For example, are vessels liable to fines from every state as they pass through each jurisdiction's waters, if not who will impose the fines? When the restrictions on SOx go global who will monitor vessels for compliance in international waters, who will enforce the regulations in international waters and who will in effect enforce compliance?

These questions are important as the cost of compliance is high, if the enforcement regime is weak those not in compliance will have a significant cost advantage over operators who adhere to the regulations.

The danger for the regulatory authorities will be that a failure in the enforcement regime will eventually lead to the failure in the regulation as those who initially comply will find themselves disadvantaged by those who have ignored the rules.

Bill Hemmings, a policy officer with the Brussels based Transport & Environment organisation, told the Trident Alliance meeting: "We need to move towards continuous monitoring, SOx monitoring should be conducted from inside the funnel and the gas information should be shared via a computer and internet link. We need to move in this direction."

The THETIS system is an internet based information system for port state control which will help to solve some of these issues between European states and a Memorandum of Understanding has also been signed by Canada and Russia to join the THETIS project, according to Hemmings.

The regulators at the EU appear to agree on what is necessary for the industry to move forward in this regard. João Aguiar Machado, director general, DG Mobility and Transport, at the European Commission, told delegates at the European Shipping Week: "The IMO should not be a playground for national interests; it should be the creator of good, strong, regulation," he called for "a global system for data on fuel consumption and emissions."

Meanwhile, at the same event Fotis Karamitsos, the deputy director general (acting) DG Mobility and Transport, at the European Commission warned: "There is a lack of appropriate EU coordination at the IMO which meant that we lost opportunities for the EU's maritime industry; we find ourselves displaying schizophrenic behaviour as a result."

Regulation

EU promises innovation

EU Transport Commissioner Violeta Bulc told European Shipping Week conference delegates that Europe could lead the way in maritime safety and environmental innovation.

Shipping "is very relevant" for the EU, said Bulc, and she added it "offers incredible platforms, both social and environmental" for development and innovation, but she added "we must invest as much in the relationship between players as anything else."

Bulc believes that there will be a "wave of innovation" that will find solutions to the environmental impact of the industry and the safety of those at sea, passengers and crew.

However, she warned that regulation is important and that she would seek to establish a global database for CO_2 emissions before the 2021 meeting of the IMO.

In rounding off her speech Bulc concluded that "the objective for my term [in office] is to integrate shipping into the European transport system." She said ports and digital connections are key to this objective.

R&D

Research centre opens in Singapore

ClassNK's new Global Research and Innovation Center (GRIC) in Singapore is its first outside Japan. The centre which opened in February coincided with a new Memorandum of Understanding (MoU) with the Maritime and Port Authority of Singapore to carry out joint R&D projects focused on enhancing ship safety and environmental sustainability.

Singapore's Maritime Port Authority, chief executive, Andrew Tan and Yasushi Nakamura, ClassNK's executive vice president, shake on the MoU that will see maritime R&D develop on the South Asian

ClassNK's role in Singapore greatly expanded in 2011 when a MoU was signed together with Nanyang Technological University (NTU). Since then ClassNK has collaborated with the Energy Research Institute in developing maritime industry related projects.

From the outset, GRIC will play a pivotal role in advancing a new joint research project launched in December 2014 to develop an exhaust gas cleaning system (EGCS) to control SOx emissions from ships outside of emission control areas (ECAs). ClassNK will work together with Nippon Yusen Kabushiki Kaisha (NYK Line), the Monohakobi Technology Institute (MTI), NTU, SembCorp Marine Technology Pte Ltd, and a leading EGCS manufacturer to simplify EGCS operations, reduce costs and unit sizes, and minimise CO_2 emissions for installation across a range of vessel types.

GRIC has also announced a pilot scale demonstration project to develop a Zero-Emission Desulphurisation process for Maritime applications (ZEDSMart).

Building on these opening projects, GRIC will expand its scope of maritime research with safety projects related to vessel structural integrity and fatigue, data analytics to assist in real-time anomaly detection of machinery, real-time monitoring of emissions and condition-based monitoring of structures for ship and machinery operations, and applied research in alternative fuel engine technologies. GRIC's mandate also includes tackling challenges faced by the maritime industry such as onboard noise and vibration.

Fuel

Safety in numbers

Oil major ExxonMobil has started to market its low sulphur HFO as an advanced fuel. The Advanced Fuel Marine ECA 200 (AFME 200) is part of a new category of marine fuel specifically designed to comply with the 0.1% emissions control area (ECA) sulphur cap and help engineers to safely make the switch from high to low sulphur fuel.

During the refining process ExxonMobil says that sulphur, metals and other contaminants are all removed. "This enables the fuel to comply with the ECA sulphur cap and also helps to optimise the performance of engines and extend component life," says the company.

"The viscosity of AFME 200 is comparable to heavy fuel oils (HFOs) enabling similar storage and handling practices for both fuels onboard vessels. Both fuels require preheating, therefore, reducing the risk of thermal shock to engine components during switchovers to comply with the ECA sulphur cap." According to the oil major.

Thermal shock could result in mechanical failures when switching from heated HFO to marine gas oil (MGO) at ambient temperatures. The fuel also has a higher flashpoint than MGO and is therefore less volatile. This makes it safer to use in boilers as there is a reduced risk of boiler furnace explosions. ExxonMobil Premium AFME 200 also has excellent ignition quality and good lubricity, says the company.

Power

Nautilus Mineral's ship set for Rolls-Royce power

Dubai shipowner Marine Assets Corporation has opted for Rolls-Royce power on its innovative deepsea mining vessel.

The 227m-long ship, under construction at the Fuijan Mawei shipyard in China and due for delivery in 2017, will be fitted with six B33:45 medium-speed diesel generator sets providing 31.4MW of power.

In total Rolls-Royce will deliver six 9-cylinder engines to the shipyard from March 2016, three underwater mountable thrusters, two retractable Azimuth thrusters and two bow thrusters.

The ship is designed by SeaTech Solutions of Singapore and will be operated by Canadian company Nautilus Minerals at its Solwara 1 project off the coast of Papua New Guinea. The ship will be able to mine copper, gold and silver ore from the seabed in water up to 1,600m deep.

Mark Reeves, Marine Assets Corporation, chief operating officer, said: "Since becoming involved in this project it is apparent that there is huge potential in subsea mining. Nautilus is the market leader in this segment and I believe *Solwara 1* is the first project that has actually come off the drawing board. Site surveys and sampling has proven that the subsea mining sector can be extremely lucrative compared to land mining, with mineral content per tonne of ore considerably higher than land-based mines." *NA*

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IMO sets MEPC/MSC agendas

Harmful aquatic organisms in ballast water, technical and operational measures to enhance the energy efficiency of international shipping and reducing greenhouse gas emissions from ships will be three items on the agenda when the Marine Environment Protection Committee (MEPC) 68 meets from 11-15 May, *writes Sandra Speares.*

Meanwhile the International Code of Safety for Ships using Gases or other Low- flashpoint Fuels (IGF Code) will be put forward for approval at the Maritime Safety Committee meeting from 3-12 June, with other agenda items including goal based new ship construction standards and passenger ship safety.

Although not yet in force the Ballast Water Management Convention has thrown up a number of industry concerns about its implementation and industry bodies, including ICS, IUMI, BIMCO, INTERTANKO, CLIA, INTERCARGO, InterManager, IMCA, INTERFERRY, ITF and the Nautical Institute have tabled a submission saying that they believe positive steps were taken at the last MEPC meeting towards addressing industry concerns.

However, their submission to the next meeting concerns the treatment of type-approved ballast water management systems installed prior to the application of the revised Guidelines (G8). The paper discusses the need to provide assurance to shipowners who install "first generation" ballast water management systems, which are operated correctly and maintained in good condition, that they will not be forced to replace these systems or be otherwise unfairly treated due to any periodic lack of efficacy for reasons outside of their control or be required to replace such systems following subsequent application of the revised guidelines (G8).

Meanwhile, the chairman of the Ad Hoc Expert Working Group on Facilitation of Transfer of Technology for Ships is expected to provide a written progress report to MEPC 68 of progress made at the group's meeting in January this year.

Also on the agenda for discussion at MEPC are the results of the Sub-Committee on Pollution Prevention and Response (PPR), which met in January.

Revised guidance for the Inventory of Hazardous Materials, an important requirement of the Hong Kong International Convention for the Safe and Environmentally Sound Recycling of Ships, 2009, will be discussed at MEPC.

The revisions to the previous 2011 guidelines include updates to the threshold values for asbestos, polychlorinated biphenyls (PCB), polybrominated biphenyls (PBB), polychlorinated naphthalenes (PCN) and radioactive substances, as well as exemption and bulk listings.

When the Hong Kong Convention enters into force, ships to be sent for recycling will be required to carry an inventory of hazardous materials onboard, which will be specific to each ship.

Other issues to be addressed as a result of PPR include a definition of black carbon and revisions to exhaust gas cleaning systems guidelines.

Draft amendments to the NOx Technical Code 2008, concerning revisions for the testing of gas fuelled engines and dual fuel engines for NOx Tier III strategy, were agreed for submission to MEPC 68, with a view to approval and subsequent adoption, as were draft amendments to Selective Catalytic Reduction (SCR)-fitted marine diesel engine guidelines.

The issue of migrants has been a hot topic in recent times with a high level meeting of UN agencies held in March to discuss the issue. More than 3,000 were lost at sea in 2014. The ICS is making a submission to the Maritime Safety Committee on new industry guidance on large scale rescue operations at sea. The purpose of the guidance is to ensure the safety and security of seafarers and rescued persons during such operations. The guidance was developed in response to the growing number of merchant ships involved in the rescue of persons, often migrants, in the Mediterranean.

Another issue on the agenda will be the implementation of e-navigation to enhance the safety of navigation and the protection of the marine environment. A submission by a number of parties will argue that e-navigation which provides information in electronic format to the bridge team will enhance safety onboard vessels, as well as simplifying exchange of information between ships and between ships and the shore.

At the last session of MSC it approved, in principle, the draft International Code of Safety for Ships using Gases or other Low-flashpoint Fuels (IGF Code), and also approved proposed amendments to make the Code mandatory under SOLAS and the MSC meeting in June is expected to adopt the Code and SOLAS amendments.

The IGF Code will provide mandatory provisions for the arrangement, installation, control and monitoring of machinery, equipment and systems using low-flashpoint fuels, focusing initially on liquefied natural gas (LNG), to minimise the risk to the ship, its crew and the environment, having regard to the nature of the fuels involved. NA

Ballast water treatment

IMO surveys BWMS market

Online surveys are part of an IMO studies, which aim to provide a comprehensive review of the technical standards and approval testing procedures in the Guidelines (G8), for approval of ballast water management systems.

All stakeholders involved in the testing, approval, fitting and operation of ballast water management systems (BWMS) are being invited to complete online surveys, as a part of an IMO study to assess the implementation of the BWMS approval guidelines and the performance of type-approved systems.

The study aims to provide a comprehensive review of the technical standards and approval testing procedures in the G8 for approval of ballast water management systems, initiated by IMO's Marine Environment Protection Committee (MEPC) at its 67th session in October 2014. The intention is to address concerns that the testing regime for the approval of BWMS needs to be sufficiently robust and consistent, so that approved systems will meet the standards set out in the International Convention for the Control and Management of Ships' Ballast Water and Sediments, 2004 (BWM Convention).

The surveys can be accessed at the website.google.com/a/wmu.se/d2study/and will remain open until 1 June 2015. All interested and relevant stakeholders are invited to participate.

The study is being carried out by the IMO Secretariat in partnership with the World Maritime University (WMU) and its outcome will be reported to MEPC 69 in spring 2016.

www.imo.org.uk

Ballast water treatment

Techcross' BWMS MoU

Ballast water management system provider Techcross, and Drydocks World (DW), the largest shiprepair facility in Dubai, have signed a Memorandum of Understanding (MoU) on 23 February 2015.

DW has said that it has recognised a need to support its customers and believes that good and effective cooperation with selected BWMS providers will be critical towards providing such support.

Techcross, selected as a partner with this MoU, has shared goals to provide accessible, accurate and up-to-date information to shipowners, managers or other customers of DW who may have a need for BWMS installation on their vessels. They agreed to provide technical service and engineering from the TECHCROSS to DW, service support from DW to TECHCROSS and joint marketing.

The MoU between is intended to take advantage of the significant retrofitting market. Techcross is expecting to provide qualified service stably in the tremendous retrofitting market after BWM Convention is ratified.

www.techcross.com

LNG

ABB powers up fast ferry

ABB has announced that the company has won an order to deliver a complete electric power plant, electrical propulsion systems and an energy management solution for Estonia-based Tallink Grupp´s new liquefied natural gas (LNG) powered fast ferry.

The large-scale ferry will be built at Meyer Turku shipyard in Finland for delivery in the beginning of 2017. The 49,000gt vessel will be about 212m in length. The ferry, planned to carry 2,800 passengers, will operate between Tallinn, the capital of Estonia, and the Finnish capital Helsinki.

ABB's power and propusion system will help the new ship to minimise fuel and power consumption while providing a reliable power supply for all the electrical power equipment and systems in the LNG powered ferry. ABB will deliver the complete power plant and propulsion systems, including synchronous propulsion motors and ACS600SD drives, medium voltage generators, the main switchboard, propulsion transformers, and thruster motors.

ABB will also provide engineering, project management and commissioning services including remote diagnostic services, comprehensive training for the crew and an access to ABB´s worldwide marine service network that will guarantee professional service contacts in both ports.

The vessel's energy efficiency will be taken one step further with ABB's energy management system EMMA, which will support the vessels' crew in managing energy-related processes, practices and decision-making, minimising the vessels' overall energy costs.

In addition, MacGregor, part of Cargotec will also supply the complete turnkey delivery of the ro-ro cargo access and handling equipment for ro-pax ferry.

MacGregor's ro-ro equipment package includes a bow door, bow and stern ramps/doors, front and rampway doors, hoistable and movable ramps, lifting platform, stores hatches, doors for passengers, pilots and bunkering, along with associated hydraulic power packs.

The contract includes design, hardware and installation, with deliveries planned during 2016. The completed vessel is scheduled for delivery in early 2017.

www.abb.com

www.cargotec.com

Ancillary equipment

Tycan chains and Dyneema lashed together

Industrial chains for handling heavy loads are being produced for the first time from DSM's ultrahigh molecular weight polyethylene (UHMwPE) fibre, branded as Dyneema. DSM Dyneema has formed a strategic partnership with Load Solutions in Bergen, Norway, for development, manufacturing, sales and marketing of link chains made with Dyneema fibre. The chains, branded as TYCAN, are fabricated from webbings and have numerous economic, environmental and safety advantages over traditional chains that for centuries have been made in iron and steel, the company has said.

TYCAN is produced for Load Solutions by Industrias Murtra, a premium textile manufacturer based in Spain. The first products have already created substantial interest in several markets during their development phase. Certification and testing have taken place during the last two years. TYCAN chains have already passed the first and second levels of certification by class society DNV GL. Full and final certification of TYCAN is expected in early 2015.

www.dsm.com

CAD/CAM

AVEVA inspires next generation

AVEVA has announced that AVEVA Marine and AVEVA Bocad software licences will be deployed in Korean universities and schools to encourage the ongoing development of the local marine industry. Students will be introduced to the ship design process through hands-on experience with essential engineering and design disciplines.

"We welcome AVEVA's support to bring critical job skills to our students', said professor TaeWan Kim, Seoul National University. "By working closely and training the professors and teachers on the software, AVEVA is enabling the university to give the students the best experience of industry-leading design software."

Students will be able to use the software in classes including Computer Aided Ship Design, Ship Detailed Design & Modelling and Fabrication Technologies based on Ship Structures. There are over 20 academic institutions involved in this initiative including Seoul National University, Korea Advanced Institute of Science and Technology (KAIST), Pohang University of Science and Technology, and Pusan National University.

www.aveva.com/academic

Classification

RINa software selected for cruise ferries

Italy's leading cruise ferry operator Moby has chosen the RINa InfoSHIP software suite for managing maintenance and purchase processes across its entire thirteen-ship fleet.

Moby opts for RINa InfoSHIP

RINa InfoSHIP Maintenance and Purchase Module (MP) has been developed in cooperation with IB Software and Consulting facilitates and reduces the costs of management of planned and unplanned maintenance, stocking and inventory.

The package of software which Moby will deploy is the core of the InfoSHIP suite and is equipped with a wide range of features for encoding and building a model of the technical structure of the ship, for the creation of an onboard database, for the control of the entire range of maintenance activities, and for managing the supply chain of spare parts, consumables, services and material management.

www.rina.org

Ancillary equipment

Tightening up with Stanley

Stanley Engineered Fastening is now offering its unique self-locking Spiralock thread form nut, which is highly resistant to shock, vibration, and temperature induced loosening, in a full range of corrosion-resistant, stainless steel, fractional and metric hex flange nuts.

The company has said that benefits can be achieved from the product from the corrosion protection delivered by the nuts' Grade 316 austenitic stainless steel composition, which can be used instead of lower grades of stainless steel.

These fasteners are used to maintain joint integrity on everything from large diesel engines to highly classified battleship parts and equipment. Fasteners in the ship industry are frequently subjected to repeated exposure to wash downs, harsh chemicals, and salt spray.

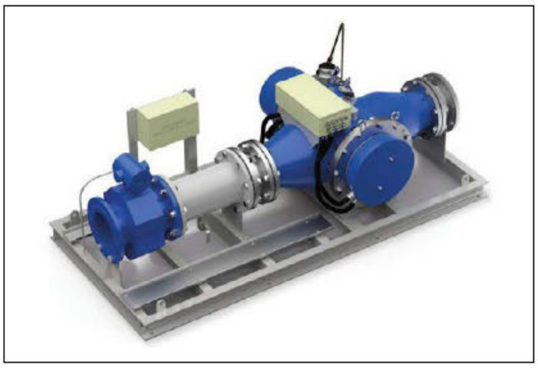
The company says that the Spiralock thread form solves thread loosening and joint integrity issues by

changing the physics of how the threads interact. In traditional 60degs threads, the gap between the upper edges of the male and female threads can lead to shock, vibration, or temperature-caused thread loosening. Stress concentration and fatigue at the first few engaged threads is also a problem, particularly with softer metals. The unique profile of Spiralock threads closes the gap that causes loosening, improving the integrity and reliability of threaded joints.
www.stanleyengineeredfastening.com

Ballast water treatment

Wärtsilä supply's its explosion proof (EX) BWTS

A series of eight new 33,000dwt chemical tankers, currently under construction in Asia, will feature Wärtsilä Aquarius UV Ballast Water Management Systems (BWMS), each of which is certified for explosion proof (EX) requirements. This contract, which was signed in January, is the first EX-system delivery since the Wärtsilä Aquarius UV system was granted EX-certification in spring 2014.



Wärtsilä to supply its explosion proof ballast water treatment system to eight chemical tankers being constructed in Asia

Each of the eight vessels will have two Wärtsilä Aquarius UV systems installed. The particulars of this design required a partnership approach with the shipyard in order to successfully integrate the BWMS into the hazardous area, with the addition of deepwell pumps already delivered.
www.wartsila.com

Cargo handling

Contract for car carriers

TTS Group has, through its subsidiary TTS Marine in Gothenburg, Sweden, entered into a firm contract for delivery of cargo access equipment for three car carriers. The total order value for TTS is approx. NOK25 million (US$3 million).

The three pure car/truck carriers (PCTC) are under construction at Uljanik shipyard, Croatia, with deliveries of the equipment due to be completed during 2016 and 2017.

In addition, TTS is to supply electric drive systems and shell doors for two new cruise ships built at the German shipyard Meyer Werft. The ships, owned by Asia-Pacific cruise line Star Cruises, will be the first large cruise vessels with all-electric shell doors.

The 151,000tonne 21-deck cruise ships will each accommodate some 5,000 passengers.

The first ship, to be named *Genting World*, is due for delivery to Star Cruises in fall 2016; its sister ship a year later. They will both be put in service in the rapidly growing Asian cruise market.
www.tts-group.com

Ancillary equipment

WE Tech gets Turkish order

WE Tech Solutions and the Turkish Besiktas Shipyard have signed a contract for the delivery of two of WE Tech's Direct Drive Permanent Magnet Shaft Generator solutions to a series of 15,100dwt asphalt carriers, recently ordered by the Canadian shipowner Transport Desgagnés. The contract includes an option for two more vessels.

The delivery of the Drive technology will commence in December 2015.

With the WE Drive and the Direct Drive Permanent Magnet Shaft Generator technology, the energy efficiency of the machinery reaches unprecedented levels in the shipping industry. With its active front-end low harmonic drive technology, the WE Drive allows the shaft generator to operate over the full main engine speed range, while generating electricity for the vessel's electrical network with high efficiency over the entire range. This feature is particularly prominent in electrical part loads – the normal electrical load condition in any ship.

In 2014, WE Tech received several orders of Direct Drive Permanent Magnet Shaft Generator solutions. These solutions will be delivered to the Chinese Tianjin Xingang shipyard for a series of four newbuild vessels owned by Wallenius Lines of Sweden, to Avic Dingheng Shipbuilding for a series of four newbuild vessels owned by Terntank Rederi of Denmark, and to Zhejiang Ouhua Shipbuilding for a series of three newbuild vessels owned by Torvald Klaveness of Norway.
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A view from the top

Surveying the wreckage of the global economy from Tsuneishi Shipbuilding Company headquarters Kenji Kawano, the president of the shipbuilder, is attempting to find niche markets to keep the yards afloat until the economic recovery gains enough traction to sustain newbuilding growth

It is a sobering thought that in the nearly 100-year history of Tsuneishi Shipbuilding its newly appointed president, Kenji Kawano, has shared virtually 40% of that company's evolution.

Further evolution of the group, particularly overseas, is expected with Kawano looking to add to its Asian operation with a fourth regional yard, including its facilities in The Philippines, China and Japan, and a sixth overall if the South American yards, in Paraguay and Uruguay are included.

Kawano says the group are looking at sites in a number of countries including The Philippines, Indonesia, Malaysia, Bangladesh and Cambodia: "but, the most likely place for new yard is either Indonesia or The Philippines". These two countries would mean that a new yard would be close to its main market for its diversified business.

"Shipbuilding is in recession," says Kawano, "and yards will suffer, we want to prevent that by looking at different markets."

Currently the company is looking at the smaller ship market in South East Asia including the potential of Indonesia and The Philippines as well as South America. The company already produces River Barges in Paraguay and Tsuneishi has that experience which it can transfer to other parts of the company.

"Indonesia has 17,000 islands and The Philippines has 7,000 islands that are serviced by mainly old Japanese ships, there is a need for ships in this region," claims Kawano.

Clearly this is a diversion for the shipbuilder that has until now largely concentrated on bulk carriers with a few other vessel types included, such as a small container ship design, 1,020TEU, a 50,300dwt product tanker range and a 106,000dwt crude oil carrier.

Tsuneishi president, Kenji Kawano, appointed in January, aims to steer the company through a difficult economic period by developing new niche markets

The design and construction of these ships has been aided by the development of Tsuneishi Group's other businesses including the iron works, equipment manufacturer, Tsuneishi Engineering. That was in 1979, but the group had developed significantly before that date and also subsequent to it.

The shipbuilding group itself started out as a repair facility repairing wooden ships in 1917 under the name Shiohama, in the village of Chitose in Hiroshima. The company did not take on the Tsuneishi name until 1942 when Shiohama was merged with two neighbouring shipbuilders.

The first steel vessel was not built until *Miko Maru* was delivered in 1958 and in 1963 the Tsuneishi Iron Works was founded. However, the most significant date was 1977 when the Shinshoji Temple was built… and Kawano completed his studies at Kyushu University and joined the company as a fully fledged naval architect.

In the time since Kawano first joined the yard the evolution of the company has picked up the pace, though the two events are not necessarily connected. In 1978 Kambara Marine and Tsuneishi Port Service were founded. A year later Tsuneishi Engineering was born and by 1982 the Japanese yard made its first move abroad opening a yard in Uruguay.

By 1984 the company began building the first of the TESS (Tsuneishi Economical Standard Ship) class of ships, the TESS40 was developed.

Then came the shipbuilder's second significant investment abroad with the development of the Filipino yard in Cebu. The Cebu facility, which was established in 1994, was the result of Japan's economic success which had caused the yen to strengthen considerably, making exports of costly vessels difficult to maintain, particularly in the face of increasing competition from the fledgling shipbuilding industry in South Korea.

Nine years after the founding of the Filipino yard Tsuneishi opened a Chinese facility, for much the same reasons. Tsuneishi Group (Zoushan) Shipbuilding (TZS) spent the first three years of its operations building vessel blocks, but in 2007 the yard built its first complete ship. That, however, was just before the banking crisis was to plunge the global economy and the shipping industry in particular into seven years of crisis.

R&D is key to maintaining the company's position in the market and its commitment to new research is clear with the building of the US$1 million *Jo Sho Maru*, a one-tenth size ocean going bulk carrier model

Kawano believes that the Kambara Shipping Company, the group's own liner service which supports its foreign-based yards, is one of the reasons that the Filipino and Chinese facilities have managed to maintain standards and compete with Chinese and Korean yards in terms of cost.

"The Filipino and Chinese yards are supplied with Japanese manufactured parts and equipment through our own service operated by Kambara Shipping Company. This is our strength," explains Kawano.

Philippines yards have had significant problems in maintaining supplies of steel and equipment for their shipyards (see *The Naval Architect* January 2015, pages 34-36) causing costs to increase through delays.

Tsuneishi has managed to secure the benefits of its high quality equipment supplied through its own liner service and still maintain its competitive edge through the lower costs afforded by building ships in The Philippines and China, according to Kawano.

Even with the development of the overseas yards and the liner service, however, Kawano admits the group has been hit by the downturn in the shipbuilding industry. The company plans to develop a niche in smaller vessels to maintain work at its facilities that Kawano hopes will maintain the various yards through this difficult period.

Inside *Jo Sho Maru* Tsuneishi technicians can develop their ideas for making the shipbuilder's vessels more fuel efficient and safer

As Tsuneishi Group focuses on its foreign operations, workers at the group's home yard in Japan could be forgiven for considering what their role will be in the immediate future. Kawano insists that the yard will not be closed down and that the Shiohama yard has a crucial role to play in the development of the company.

"Even if the yen rises to 80 to the dollar we will operate the Japanese yard at a loss," claims Kawano, "if the yen depreciates then that will be a relief, but if it strengthens it will be difficult. However, the Japanese yard's role is R&D and to develop new ship designs. Also the Chinese and Filipino yards cannot work independently so we will need engineers to train the Chinese and Filipino workers," he adds.

Research and development is a key element to the future plans of the group, according to Kawano, with the company having the largest market share in the Kamsarmax it is "a good performance appreciated by our European customers from Greece, Norway and Britain".

Investment in research, including US$1 million spent building a one-tenth size Kamsarmax bulk carrier named *Jo Sho Maru*. The vessel is 22.9m in length has a 1.44m draught and a displacement of about 110tonnes and it uses an electric motor for power. *Jo Sho Maru* operates in coastal waters and is used to develop the knowledge of the vessel, which always sails in ballast condition, and how the vessel operates in a variety of sea conditions.

Maximum passenger capacity for the vessel is eight, but Kawano says there is often two or three design staff collecting data from the sensors on board. "By using a one-tenth sized model you can get more accurate readings for matters such as operational safety and fuel efficiency," explains Kawano.

As the Hiroshima yard approaches its 100th anniversary the group is continuing to look forward at how it will develop in the future. One thing for certain is that as Kawano surveys the fall out of the economic crisis that began in 2007 and persists today, Tsuneishi will continue to deliver for its customers until the fortunes of the maritime industry return to a more stable footing. At which point it will no doubt develop again. *NA*

Condition monitoring in the marine sector

Gavin Coull, key account manager marine at SKF, explains how condition-based maintenance is gaining popularity in the marine industry helping to cut costs and improve reliability

An SKF engineer monitors equipment onboard a vessel, condition-based monitoring will become the norm as shipowners seek to decrease vessel down time

Condition-based maintenance (CBM) is a proven technique in manufacturing. It helps to improve overall machine efficiency and ensures timely and accurate repair of machines by keeping a constant watch on their condition, and identifying errors before they can cause problems.

CBM uses a number of proven manufacturing industry techniques – including vibration analysis, infrared cameras and ultrasonic monitoring – to carry out regular (or even continuous) health checks on machinery. Any problems, such as a malfunctioning pump or vibrating bearing, can be picked up at this stage and replaced or repaired well before it fails and causes further problems.

Any industry that uses a wide variety of machines can derive a huge benefit from CBM. Because of this, it has considerable potential in the marine sector. One reason is that the needs of marine customers are similar to those in manufacturing: improving maintenance procedures, boosting uptime and cutting costs, for example. But, the industry's natural conservatism – coupled with reliability, stringent regulations and tough economic conditions – means that the take-up of CBM has been relatively slow.

However, this is already beginning to change. Major marine classification agencies have adapted long-standing rules and regulations so that a properly implemented CBM programme is recognised as an acceptable way of verifying machinery conditions.

Cost pressure

The manufacturing sector is under huge cost pressure, and shipbuilding has not escaped that type of pressure. At the same time, shipowners are also trying to make their operations as lean as possible. They need to minimise cost, and have tried a number of ways to do this, such as optimising trade routes, reducing cruise speeds and improving fuel efficiency in order to protect operating margins.

Cost-conscious shipowners might see CBM as an unnecessary expense, but in fact the reverse is true: by investing in CBM technologies that are already widely used and proven for reducing machine operating and maintenance costs in the manufacturing sector, shipowners and operators can benefit from the efficiencies that arise from greater machine reliability. In many cases this can have a positive impact on the number of days that each vessel can remain at sea.

The early adopters of CBM have been the highest value vessels, such as cruise ships, and those used in the oil and gas sector. Increasingly, though, CBM technology is being implemented in a far wider range of cargo ships, large and small.

Traditionally, a ship used in the offshore sector is brought into dry-dock every two-and-a-half years for a complete overhaul of onboard machinery. For merchant ships this period is generally longer, at around five years. In either case, every day spent in drydock represents lost revenue.

Investing in automated condition-based monitoring systems could potentially delay the need for these major overhauls – meaning that a ship will undergo fewer major maintenance operations during its lifetime and spend more time at sea. Routine repairs can also be carried out with more confidence, and be planned to take place while vessels are in port or at sea, so that they do not affect normal operations.

CBM carries a number of clear advantages to shipping fleets. Firstly, it allows the crew to plan maintenance well in advance. This is gaining increasing importance, as economic constraints have seen the average number of onboard staff shrink considerably over recent years and human resources need to stretch much further.

The key strength of CBM relies on transferring crucial performance data to remote monitoring stations – whether through a hand-held device operated by an onboard engineer or through sensors mounted at various points on the ship. The availability of round the clock analysis means that, if necessary, immediate action can be taken – up to and including transporting parts or repair crew to a ship at very short notice.

Onboard analysis

Customers opting for the more basic portable data collection package such as an SKF Microlog Analyser will involve an onboard engineer using the device to collect data readings. At the other end of the scale is an end-to-end integrated solution that covers complete condition monitoring and service delivery – in which information is gathered from sensors located around the ship, which is essential in hard to reach places. These sensors are hard wired back to a central onboard control room. Data can then be analysed by ship engineers or, more commonly for critical equipment, transmitted to a shore-based facility for interpretation by remote experts.

In either case, the return on investment can be substantial. The availability and reliability of vessels increases, operating and maintenance costs are reduced and even environmental and onboard safety concerns are more actively addressed as regular monitoring has the capability to report on emissions and the overall health of the ship.

There are three key trends emerging here. The first is simply that CBM is beginning to be used more frequently onboard ships. The second is that increasing amounts of this data are being gathered by fixed sensors, rather than by hand. This applies to both 'continuous' data – which is effectively an ongoing health check – and data that flags up immediate problems, such as an alarm to warn that a machine component is about to fail.

And thirdly, far more remote monitoring is being used – where data is sent from ship to shore, for expert analysis. While this will not replace onboard engineers, it will help them to make better use of their time. A large ship might have a crew of just eight people, who need to prioritise their time towards navigation and running machinery, rather than analysing complex data. The ability to hand this job over to onshore experts frees up their time, and ensures that the risk of mistakes – due to a lack of time – are minimised.

Despite many similarities, there are some key differences that do not translate directly from the manufacturing to the marine sector. One is the availability of network or satellite bandwidth.

By its very nature, condition monitoring generates large amounts of data. In a conventional manufacturing environment, with on-site analysis, data overload is rarely a problem. On-board ship, once the vessel is out of reach of land-based communications networks, it is impractical to send such high volumes of data over satellite links, especially if it has to compete for bandwidth with voice or other more critical communication. Information must therefore firstly be carefully analysed and filtered, with only the most relevant data being transmitted for onshore analysis.

Thrusters and motors

A key area in which CBM could have a huge influence is thruster monitoring. Thruster propellers are responsible for accurate manoeuvring of even the largest ships into port, or in dangerous and restricted spaces. Because of their importance, it is critical to keep them in peak condition and ensure there is no interruption to their rotational capacity.

Using CBM to keep a close eye on thruster performance can help to circumvent these kinds of problems. An integrated CBM system, for both propulsion and positioning thrusters (tunnel and azimuthing thrusters) in the marine and offshore industries is useful for ship operators and thruster manufacturers, and applicable to both newbuild and aftermarket installations.

SKF has developed such a system, which focuses on three main areas: lubrication issues, such as the oil condition of the gearbox, or problems caused by water or debris; vibrational effects; and electrical faults. Data collected from thruster monitoring is based on accurate readings of these parameters, rather than a physical inspection of the thruster – which can be a problem due to its relative inaccessibility.

At the same time, ships cannot remain at sea with faulty motors, so electric motor testing plays a huge role in CBM.

Products such as winding analysers monitor the condition of insulation within the motor and the likelihood of it failing as it begins to deteriorate. They can also help to identify issues caused by the power supply (such as imbalances and harmonic distortion) or overheating, as well as detecting cracked or broken rotor bars. Winding analysers also perform the high-voltage surge test, which reveals insulation weakness between turns, coils and phases long before the motor displays any signs of failure.

A handheld monitor for use by crew aboard a vessel

Networked solutions are available to help analyse multiple motors at once. One SKF system incorporates the NetEP motor analysis system. This provides an automated evaluation of the condition of an electric motor, helping to reduce the cost of ownership. It can identify weakened or faulty rotating equipment and send data analysis reports via the internet. Data can be collected from 32 motors simultaneously, with the results analysed from anywhere that has an internet connection. It eliminates the need for route-based monitoring which is standard with portable devices. In terms of profitability, a better knowledge of each motor's general state, efficiencies and weaknesses makes it easier for operator to keep control of both cost and energy output.

Shipowners can also go through a Client Needs Analysis (CNA), to help them to improve onboard maintenance procedures. The CNA is a survey of around 40 questions, which is put to the maintenance operations team. It takes a full day of interviews to gather the relevant information, which then generates a score of a company's maintenance performance – often revealing immediate ways in which to boost procedures and cut costs. In addition, the report provides a roadmap for future improvements. CNAs are widely used, and proven, within manufacturing, but still in their early days in the marine industry. Nonetheless, they can be an effective first step in planning the introduction of an onboard CBM solution.

Environmental push

It is not just maintenance data that is important. CBM is increasingly moving into performance monitoring. Shipowners

A thermal imaging camera used onboard can detect maintenance problems before they become a serious event

require a large array of information, such as fuel consumption and emission levels to optimise operations.

New solutions are emerging to help meet these needs. For example, Turbulo BlueMon from Blohm + Voss Industries (BVI) is an emission monitoring system that records everything in one place. By linking to GPS position data, the system helps compliance with MARPOL conventions: if a ship is approaching an area with higher emission standards a warning can be sent to the bridge so that emission levels can be rechecked. Data remains available for 24 months, allowing later verification of compliance.

This and other systems are effectively filling in the ship's logbook automatically – the kind of operation that is likely to become far more common in future. Fitting this technology to an entire fleet would allow a shipowner to benchmark its environmental performance against industry standards, or identify the best performing crews and vessels.

There is a further benefit of centralised data collection, in that it helps to overcome a common trend within the marine industry – that of engineers rotating between ships, with knowledge of individual vessels inevitably being lost as staff move on.

Where next?

The marine industry will not adopt CBM overnight. The main focus of marine engineers is reliability, as a means of optimising vessel availability; this has historically been carried out using visual or time-based maintenance inspections, so changing the culture will take time. This change will be driven by economic pressures and by ever tougher regulations on, for example, emission controls and machine safety.

Perhaps the biggest challenge faced by marine engineers is to manage multiple onboard machines; indeed, in many instances there are so many machines on each ship, from so many different suppliers, that it resembles a floating factory.

In order to manage this, shipowners and operators will increasingly need to find strategic partners that can offer ship-wide, fleet-wide condition monitoring – enabling them to increase the time that each vessel spends profitably at sea. *NA*

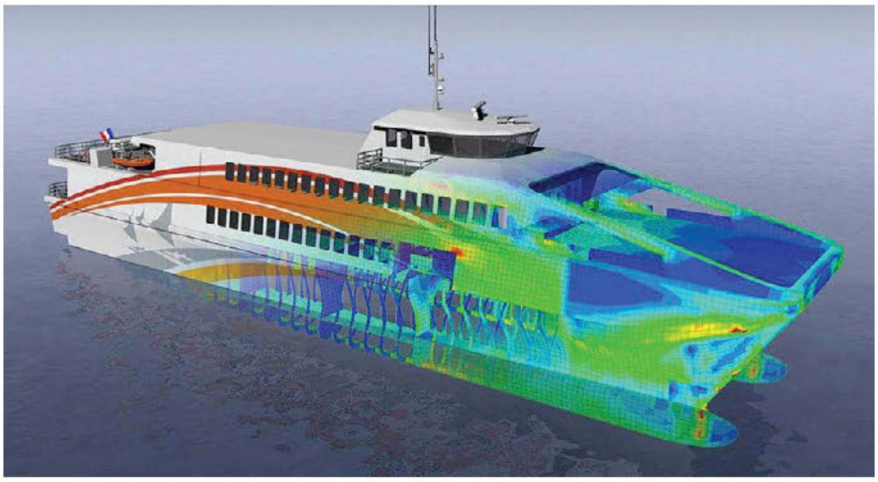
Compit's new age computing

Big data and big computers – COMPIT 2015, the 14th International Conference on Computer and IT Applications in the Maritime Industries will be held from 11–13 May in Ulrichshusen, Germany, presenting progress in IT for ship design and operation

The Conference on Computer and IT applications (COMPIT) in the maritime industries was first held in the year 2000 and COMPIT has since established itself as a key conference in information technology for the maritime industries, bringing together software developers and users.

Most participants come from industry, reflecting the practical relevance of the event. Selected papers for the upcoming conference illustrate general trends in maritime IT. The main trends, in short, are:

- Super, Mega, Peta, Exa – Redefining supercomputing. Computing power continues to grow exponentially. This opens new applications. CFD is one technology that is particularly greedy in terms of computational power. Frontier applications already use massive computer architectures with 200,000 cores in parallel.
- Big data enters the scene. Big data uses simpler algorithms, but huge amounts of data. Processing all this data is not the problem anymore. Turning the data into useful information is the challenge. Applications appear in fleet operation and intelligent maintenance schemes.



Advanced simulations support advanced ship designs. Source: Strand7

COMPIT covers three full days. Traditionally each day is dedicated to a major phase in the lifecycle of ships:

- Day 1 – ship design with sessions on: "hull models", "simulation-based design", "coupled simulations", and "high-performance computing for CFD"
- Day 2 – ship lifecycle management and production with sessions on: "product lifecycle management", "IT for ship production & ship repair", "Virtual & augmented reality", "marine (swarm) robotics"
- Day 3 – ship operation with sessions on: "Ship routing", "Big data & Performance insight", "Sea traffic management", "Towards unmanned shipping"

It is particularly difficult to say which session steals the limelight this year. "High-performance computing" on Day 1 is a contender. So are "big data" and "sea traffic management" on Day 3 (for the short-term pragmatists) and "unmanned shipping" (for the practical dreamers and those who like a bit of provocation). The best idea is to have a look at the complete programme and pick your own winner(s).

Ships are 3D objects

Two solution philosophies can be discerned from current market developments for the core design system: single-system approaches (one system from design to production) and multi-system solutions.

The industry appears to see the future in flexible alliances between different vendors and their specialised software. Coupling key applications at carefully selected points, in an incremental and agile manner is yielding progress faster than "cathedral solutions". Herbert Koelman (SARC) gives an example of how this approach is implemented in the Netherlands: "A Virtual Single Ship-Design System Composed of Multiple Independent Components" describes a pilot case where a general CAD programme (Eagle, as used by Conoship), a specific ship design program (PIAS by SARC) and a CAE system (NUPAS by NCG) are linked into the loop. The conclusion is that coupling dedicated software packages is a better strategy than trying to develop monolithic "one code fits them all" ship design software. Or in short: cooperation beats integration.

Plug-and-play

Assorted engineering simulations have always played a key role at COMPIT. Less mature simulation technologies focus on demonstrations of what has become possible. Very mature technologies, such as finite-element analyses (FEA), focus on rapid, cost-effective model generation.

The trend is towards multi-disciplinary applications. As for CAD applications, the preferred approach is via loosely coupled applications. A "plug-and-play" culture is developing where software codes work together like individual companies within a larger holding. User-friendly design shells such as CAESES (ex-FRIENDSHIP Framework) and exponentially growing computer power (largely through parallel computing on many processors at the same time) have encouraged this development.

Super, Mega, Peta, Exa

Computing power is growing at a staggering rate. Currently, the most powerful computer, Tianhe-2, capable of 33 Peta-Flops, consists of some 3 million cores. (Your PC is likely to have two or four cores. DNV GL's parallel cluster is the biggest in the maritime world and has 7,600 cores).

The first computer capable of 1,018 floating-point operations per second (1 Exa-FLOPS) is expected to arrive in around 2020. This so-called exa-scale machine is likely to have 300 times more cores than the Tianhe-2. In short, the architecture of future supercomputers will be much more parallel than in the past. And number-crunching software must adapt accordingly. Computational Fluid Dynamics (CFD) is spearheading this development.

Milovan Peric (CD-adapco) gives a perspective on the development in "From Single-Processing to Massively Parallel CFD", extrapolating from two decades of personal experience with pushing the frontiers in CFD, not only in the maritime industries.

Tatsuo Nishikawa (Ship Research Center of Japan) gives us a glimpse of the future with a paper entitled: "Application of Fully resolved Large Eddy Simulation to Self-Propulsion Test Condition of Double-Model KVLCC2".

The K-computer is the largest computer in Japan, currently the fifth largest computer in the world. This powerful machine allows the simulation of numerical ship propulsion tests resolving even the characteristic turbulence structures in time and space. The simulations use 60 billion cells and 200,000 cores in parallel. For perspective, this is 10,000 times the number of cells and cores we typically employ at present in industry applications.

A decade may easily pass before such computing power becomes widely available in our industry. In the meantime, we can start using "the cloud" and renting computing power and the massively parallel software licenses required for such computations. Hildebrandt et al. (Numeca and CPU 24/7) present how this might work in "Business and Technical Adaptivity in Marine CFD Simulations".

The technical adaptation refers to adaptive grids, which give resolution on demand. This evolving technique leads to the more efficient use of existing computer capacity. But, the real story lies in the "pay-on-demand" business model which could become a fundamental game-changer giving access to advanced CFD also for small and medium enterprises.

For dessert, Caponnetto et al. present "The Role of CFD in the Design of America's Cup Yachts". For the America's Cup, the Formula-1 equivalent in naval architecture, the classical towing tank test has been replaced completely by the Numerical Towing Tank – not least thanks to the availability of high-performance computing. In fact, the classical towing tank has been replaced by hundreds or thousands of numerical towing tanks that test design variants in parallel.

Big Data – A star is born

"Big Data is like teenage sex: everyone talks about it, nobody really knows how to do it," [Dan Ariely, professor at Duke University]. Well, at least now we will talk about it and as time goes by, we may get the hang of it.

More data has been created in the last four years than since the beginning of time. This data is created by machines, such as AIS data, machinery sensors, embedded chips. Big Data is high-volume, high-speed and high-variety data that is difficult to process using traditional tools. Big Data may help us with business intelligence, predictive maintenance, streamlining traffic flows and other performance enhancement. Whether we like it or not, Big Data is entering the maritime industry and it is time that we understood it better.

Dausendschön's "Big Data - Business Insight Building on AIS Data" gives some concrete examples how Big Data analyses can help ports and ship operators to improve operational performance and gain business insight on competitors. Knutsen et al. focuses on data structures for condition monitoring and predictive maintenance in "Implementing a Hadoop Infrastructure for Next-Generation Collection of Ship Operational Data". (Apache Hadoop is a popular software platform for Big Data applications).

Koch et al (Atlantec Enterprise Solutions & Lloyd's Register) also cover Big Data maintenance decision for machinery and equipment in "Improving Machinery & Equipment Life Cycle Management Processes". Collectively this session will present an introduction to the terminology and potential solutions for Big Data in the maritime industries.

The enigmatic MONALISA

The EU-project MONALISA 2.0 focuses on e-navigation, or the now preferred term Sea Traffic Management (STM), in essence the maritime equivalent of air traffic management, where land-based control centres have extensive insight into ship data and rights in routing ships.

This will support safer shipping, but also better logistics and fuel efficiency. Siwe et al (Swedish Maritime Administration, Viktoria ICT) will give an overview of the vision and achieved milestones of the project in "Sea Traffic Management – Concept and Components". Sea System Wide Information Management (SeaSWIM), is the key infrastructure and will provide a basis for information exchange. SeaSWIM has four functional sub-concepts: Strategic Voyage Management, Dynamic Voyage Management, Flow Management and Port Cooperative Decision Making.

Roboship

We already have totally automated trains, and there are advanced studies to have aeroplanes and cars with no one flying or driving them. Could this be possible for ships? What could be the advantages and disadvantages? Giampiero Soncini (SpecTec) discusses "Sense and Nonsense of No-crew, Low-crew Ships" looking at what is possible, what is feasible and what is only a dream (for now).

Besides legal and political hurdles, there are still many technical issues to be resolved before we may see unmanned cargo shipping; however, the required technology for assorted sub-tasks is evolving. *NA*

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Innovation – the rising star

As government initiatives go Denmark's Blue INNOship partnership is up there with the best. Copenhagen is seeking to develop a green innovation model that will position the country's industry in the forefront of green technological developments and boost the economy at a stroke. *The Naval Architect* looks at the initiative's early steps

Bringing together academia, industry and government institutions is always an uneasy fit, but in Denmark this is exactly what they are attempting to do, reasoning that the result will be for the greater good.

It is not just pie in the sky, but an attempt to unify the diverse strands of technological development, social needs, industry and academia. In an effort to achieve those goals government has created a number of so-called societal partnerships that will speed up innovation in such diverse areas as medicine, agriculture, building construction and last, but not least in the maritime sector.

Denmark's aim is to use Danish competencies to speed up innovation. The target is to create a Green Innovation Model through a loose fusion of companies, universities and government funding groups, which have been brought together under the Blue INNOship banner. These companies and institutions will spend the next four years researching technological advancements that will create value for all the stakeholders and ultimately for society as a whole.

"We need to learn how to work together better," explains the Blue INNOship chairman Lars Bo Jensen, who is mainly employed by marine engine manufacturer MAN Diesel & Turbo. "We must speed up the innovation process, but if I told you that in four years-time we will have a fully functioning innovation model I would not be 100% correct."

The creation of an innovation is an evolutionary process and that requires funding agencies to fund, universities and industry to research and trial and owners to buy into the process and support it by utilising the new technology.

The initial 16 projects, divided into five work programmes, will be funded to the tune of US$20 million by the companies

Cooperation is the key to developing a forward looking and inclusive maritime industry says Blue INNOship chairman, Lars Bo Jensen

and organisations participating in the partnership, the Innovation Fund Denmark and private maritime funds such as the Danish Maritime Fund and will run for four years, says Jensen, after that the group will look to build on their successes.

Some of the projects are more ambitious than others in terms of cutting emissions. The Dynamic Propeller Shaft Speed Control project aims to reduce emissions by 2-3%. The project 'owner', that is the leading organisation, for the dynamic shaft is AP Møller Maersk (APMM) and it says: "The solution has a significant saving potential with low investment costs providing a fairly cost effective solution with short payback time."

The development is relatively simple and can be retrofitted while a vessel is in port, the technology does not compete with existing technologies and so can be a very effective cheap method for improving efficiency.

The project expects to develop a test shaft for two-stroke engines with software embedded.

A more complex project will be the design and development of a new ro-ro ferry by Danish naval architects OSK – Shiptech. According to OSK: "The goal is to achieve a cost reduction of 50% per trailer and a CO_2 emission reduction of 70% per trailer compared with a large conventional vessel in use today on a service of around 120 miles."

The catamaran design is currently being finalised and a patent on the design is currently being sought by OSK – Shiptech. However, when the project ends in four years-time it is expected that the group will be able "to develop a business case that will enable an operator and/or investor to start negotiations with partners, as well as with customers, ports, shipyards, and authorities."

According to OSK – Shiptech the major challenges facing the Trailer Cat project is to update the design of ro-ro vessels from the 1970s, but with larger ships. The new ships will need to meet the latest environmental regulations while remaining competitive with land-based transport.

In order to achieve those goals the newly designed vessel will need to be significantly larger, in order to reduce unit costs, while the turnaround times for the ferry concept must be reduced significantly in order to reduce costs further.

Drawbacks could be that each vessel will be designed to meet the requirements of a specific route. In addition, the vessels will be wide and will be significant consumers of terminal space and docking facilities and this in turn will require significant harbor

Trailer Cat is aimed at decreasing trailer unit costs by 50% and emissions by 70% claim Danish naval architects OSK – Shiptech

investments which in turn will limit the vessel to a single route.

MAN Diesel & Turbo will also be looking at developing the pre-swirl fin designs which improve the flow of water into the propeller. The difference in this work project is that the fins will be controllable, further reducing fuel consumption and improving the efficiency of the propeller.

Savings of 3-5% are expected from this project and, like the dynamic shaft design, the controllable fin is cheap to install and offers a relatively quick payback time.

"No competing solution is known that has the benefit of the described invention. The barriers [to market] lie in developing and maturing the invention which will be the main focus throughout the project," says project owner MAN.

Another complex and significant project will be owned by the Danish Technical University (DTU) Chemical Engineering department which will look to develop methods of Selective Catalytic Reduction (SCR) of NOx on Ships.

The objectives for this project are:

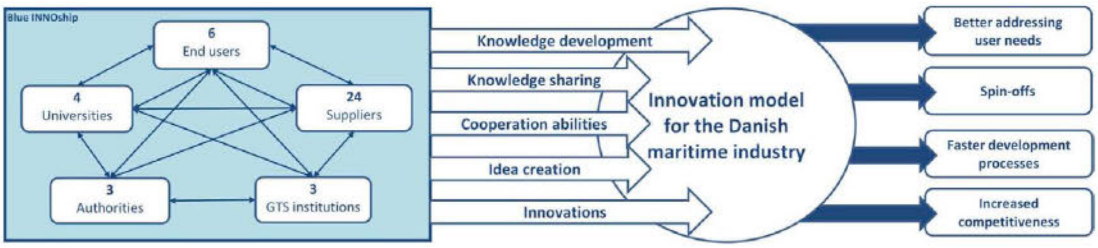
1) To identify the optimal operational strategy with respect to dosing of NH_3 in relation to the formation of ammonium bisulphate (ABS), forming sticky deposits and ammonium sulphate (AS), forming less sticky deposits.
2) To develop a model that can predict the relative formation of ABS and AS and thereby the tendency for fouling in the ship boiler and SCR catalytic reactor
3) To investigate the influence of pressure on the level of oxidation of SO_2 to SO_3 over the SCR reactor and derive kinetic models for this reaction
4) To measure how large a fraction of the ABS, AS and sulphuric acid aerosols are captured in the wet SO_2 scrubber
5) The investigate how the kinetics of the main SCR reaction and the formation of by-products is influenced by system pressure and derive kinetic models for these reactions, that can be used in catalyst reactor design.

Overall the goal of the project is to develop the tools and mathematical models that will allow manufacturers to produce improved SCR products.

However, there may be some significant barriers to the market for the DTU project, as identified by the project owner: "The primary entry barrier is the competing EGR technology (Engine Gas Recirculation). The investments related to the EGR technology are higher, whereas the SCR technology has higher operating costs due to the cost of the reducing agent, i.e. urea.

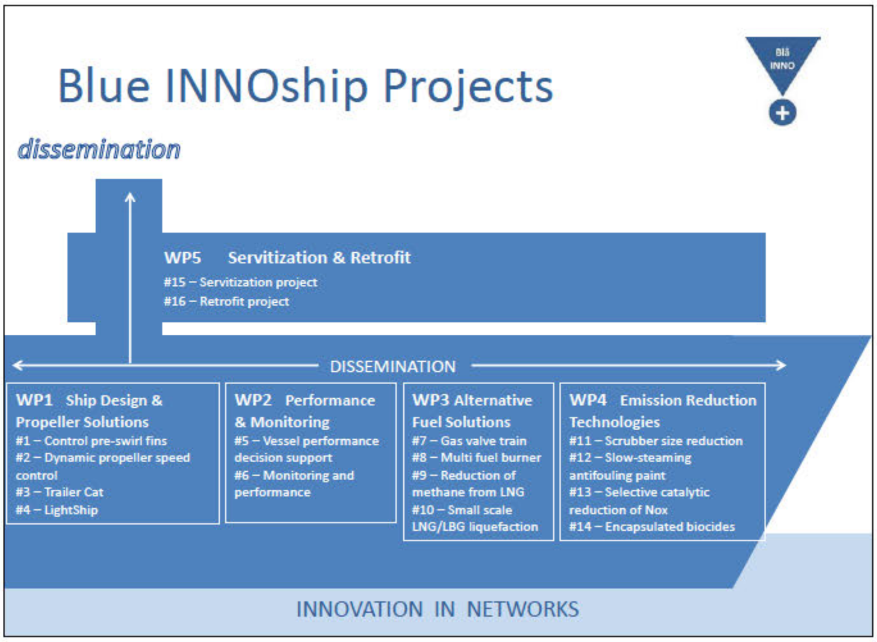
"The cost competitiveness of the SCR technology depends on the service hours in NECA [NOx Emission Control Area] areas. The SCR technology requires an engine that is optimised for SCR with respect to exhaust temperatures in the entire load range, but these solutions have been developed at a very low fuel penalty for 2-Stroke engines by leading engine manufacturers. 4-Stroke engines can be fuel optimised up to 6% for use in combination with SCR."

In an effort to overcome these barriers the developers say they "will include a cost estimate for the SCR technology in order to assess the cost competitiveness."



An Innovation model will be an important outcome of Blue INNOShip

Overall Blue INNOship will seek to reduce costs for those operating in the maritime industry and to significantly reduce the pollutants from the vessels used in the conduct of the business of moving cargo by sea. Innovation is the key to the success of this initial round of projects and that innovation is both technological and social. Moving like a binary star industry and academia will need to work as one; one cannot succeed without the other. But, the mutual benefits of that success should be the ultimate driving force that will make the Danish industry's star shine brighter in the future. *NA*



The Blue Innoship work programmes and projects

Determining the design sea states for heavy-lift vessels

For more than six years, Dockwise has been gathering weather and ship motion data and added it to the Octopus navigation tool. This Octopus motion and weather database includes up to 1.6 million nautical miles of 'now casted' weather data along a sailed route. Michael Deelen, Dockwise, The Netherlands, explains the benefits of this added data

This research describes a suitable method to implement the Octopus weather data into the design process of heavy marine transport engineering, resulting in a more consistent operational margin over the whole range of design wave heights. The basic aim is to increase the margin at lower design sea states <5.0 [m] and to reduce the operational margin for higher design sea states. The operational margin is defined as the difference between the design wave height and the now casted wave height along the route of the vessel.

This Operational Based Method (OBM) uses a Joint Probability Density Function combining a marginal 3-parameter Weibull distribution for the significant wave height with a conditional log-normal distribution for the zero crossing wave period to extrapolate the wave data to the 10-year return design contour.

The weather routing capacity of the captain is included here. It is shown where the Octopus data can be implemented in the design process for heavy marine transport engineering and how the data can be used to evaluate the design sea states. The OBM leads to a more accurate and representative design wave calculation, when compared to the standard Dosuite method.

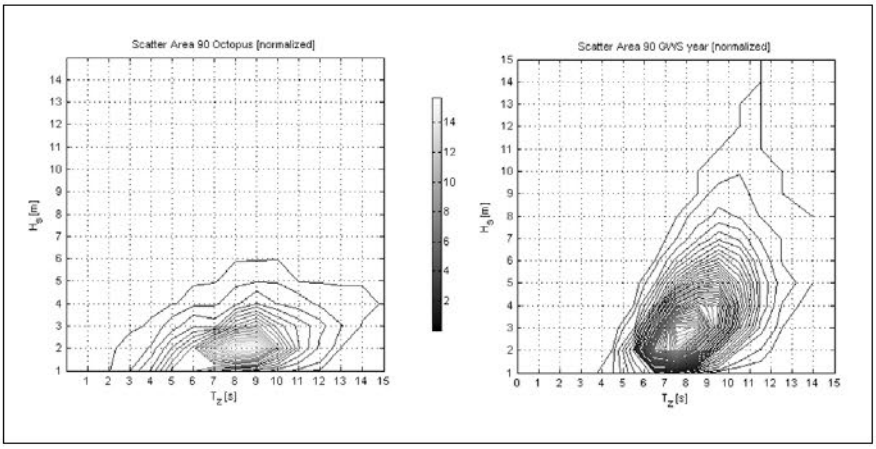


Figure 1: Wave scatter diagrams Octopus vs. Dosuite

Octopus scatter diagrams

The limiting design accelerations in Heavy Marine Transport are often based on the severe weather conditions around the Cape of Good Hope (CoGH), but ultimately depend on the route of the vessel.

To have the database in a workable format (the database is stored as time records of the wave data encountered along the route of the vessel), they are converted into wave scatter diagrams. This conversion makes the comparison with the Global Wave Statistics (GWS) scatter diagrams, as used in Dosuite (the Dockwise design wave height programme), much easier. Furthermore, both methods use scatter diagrams as a basis.

In Figure 1 the Octopus wave scatter diagrams (with effect of bad weather routing) near the CoGH are visualised. For comparison, the annual GWS wave scatter diagram (without effect of bad weather routing) is also added. The difference between the conventional design wave climate and the observed wave climate is clearly visible, especially in wave height.

From scatter diagram to design wave height

The Octopus data could be implemented in the design process as a new weather database, as indicated by the dotted line in Figure 2. This is the most obvious location, as the Octopus wave database is converted into wave scatter diagrams and both Dosuite and OBM use scatter diagrams as a basis. Because the weather database is changed, both methods calculate different design sea states. Note that the calculation of the non-environmental part of the design values like RAOs, response spectrum, spectral moments, etc. will not be changed.

However, the underlying method in Dosuite results in a design wave height which is always lower than the maximum observed wave height in the GWS diagram. Whereas the new operational design method makes use of the weather database built up from the sailing vessels, it means it would be entirely based on weather which has already been encountered. For a design method, it is often required to design for sea states which have a very small probability of being encountered.

If the Dosuite method would be used for obtaining the design sea states and only the weather database is changed, the resulting design sea states will be unrealistically low. Therefore, it is required to extrapolate the wave height data to obtain sea states with lower probability of occurrence.

JPDF – OBM

The Octopus wave scatter diagrams consist of two variables (wave height and wave period); which means that two distributions are required in order to make the extrapolation possible. The probability of a certain sea state in a wave scatter diagram can be described by a joint probability density function (JPDF). The used distribution to extrapolate to the long-term wave climate is the Marginal 3-parameter Weibull distribution for the significant wave height and a conditional log-normal distribution for the zero-up crossing wave period. This distribution is referred to as the LoNoWe method.

For evaluating the fit of the distributions, the wave scatter diagram is converted into a logarithmic contour plot. So, the logarithm is taken of the numbers in the wave scatter diagram, before fitting the contour lines. The advantage here is that more emphasis is given to the rarer observations (higher sea states). Although no 'extreme' waves are included in the Octopus wave scatter diagrams, the research shows that the Octopus wave data can be very well described by the LoNoWe method.

Extrapolation of Octopus wave data

To extrapolate the data the 10-year return period has been used as well, which

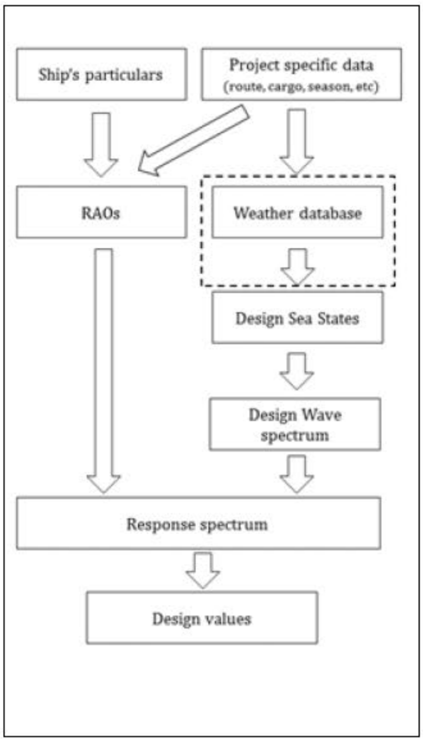


Figure 2: Schematic overview of HMT design process

is generally accepted in heavy marine transport engineering.

When the Weibull distribution is used for extrapolating the Octopus wave height data, it is seen that the tail of the Octopus wave height data clearly deviates to lower probabilities of occurrences then calculated by the Weibull distribution. This demonstrates the direct effect of weather routing by the Dockwise masters.

The extrapolation of the wave period is done with a conditional Log-Normal function, in which the term conditional refers to a certain wave period per wave height bin. The modelling of the parameters is done by empirical regression functions. For each period, the wave height has a maximum value (lower bound) because a wave has some physical limitations like the maximum wave steepness. The upper bound is determined by the contour line, calculated by the LoNoWe method.

OBM design sea states

A model is built to calculate the design sea states, following from the contour lines of the JPDF. The model is able to calculate both the yearly and seasonal design sea states. The output of the model can be seen in the resulting JPDF contour lines. The 10-year (design) contour lines of the Octopus wave data, provided by the JPDF, result in the design sea states of the OBM. To place the OBM design sea states in perspective, Figure 3 shows both the yearly OBM design sea states as well as the Dosuite design sea states. Whereas the waves stored in the database are now casted waves, it could be that waves were lower or higher in reality. To account for this limitation, a wave forecast error (WFE) is introduced. Currently, the WFE is set at 1 [m] for the wave height and 1 [s] for the wave period.

Developments

Last year the cooperation started with the Marine Warranty Surveyors of DNV GL, Matthews Daniel and LOC together with Meteogroup (the weather forecasting company) and Amarcon (the creator of Octopus). The ultimate goal is to have this method implemented as a new design method in heavy marine transport engineering. However, a lot of development work still has to be done. A few months ago a new research is started to investigate the local Wave Forecast Error and to account for this error in the design programme. *NA*

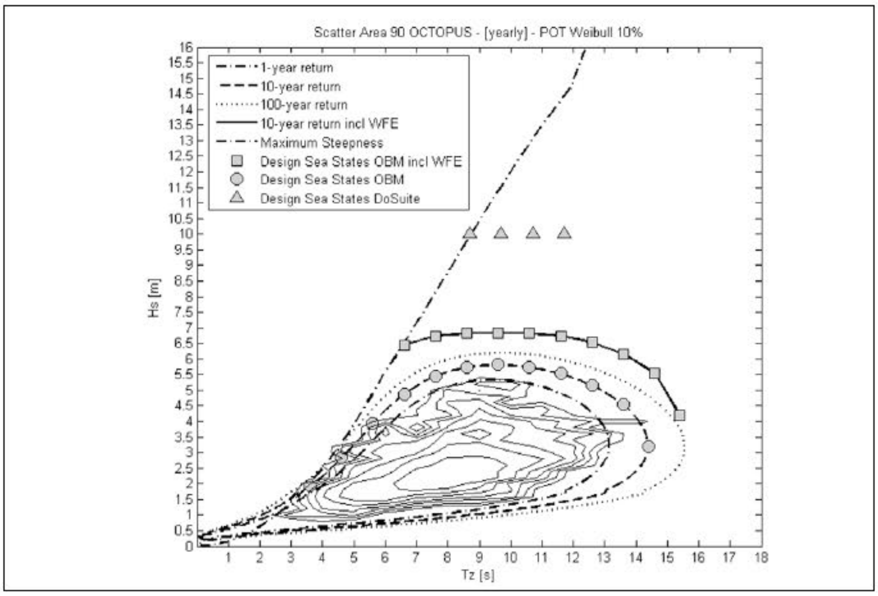


Figure 3: Yearly OBM design sea states vs. Dosuite design sea states

Numerical simulation for heavy-lift ship stability

Numerical simulations can be used to prove sufficient safety against capsizing as a result of the sudden loss of crane loads during heavy-lifts. Regulations which would require such evidence are currently under discussion at IMO and among class societies. Ole Hympendahl, DNV GL explains further

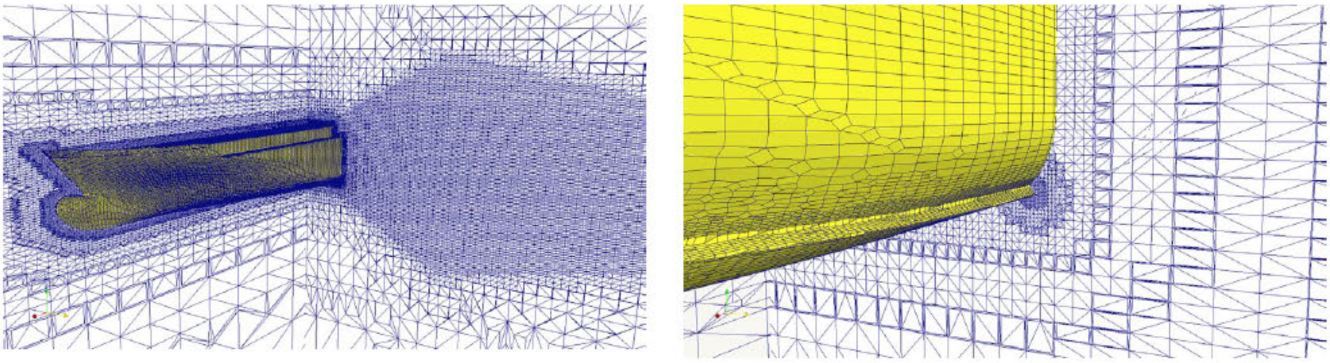


Figure 1: Numerical grid surrounding for stability investigation; global view and bilge keel detail

Many heavy-lift ships are equipped with a quick acting ballast system, which can pump water between wing tanks to counter the changing list that occurs during lifting a heavy load. However, these systems cannot be expected to cope with the sudden loss of load caused by the failure of the lifting gear. Such a loss will cause the ship to immediately roll away from the side of the load. If cargo hatch covers are open during such an operation, downflooding will occur when the hatch coamings immerse.

Up to this point, international stability regulations have not addressed the danger of capsize in the event of a sudden loss of crane load (e.g. due to cargo handling gear failure). Appropriate guidelines to ensure an adequate and uniform level of safety against capsizing under all conditions are currently under discussion at IMO and among the classification societies. Such regulations will have to consider the addition of stability pontoons, as these are often used to increase stability for heavy-lift operations in port.

The safety of the lifting operation can be demonstrated by either complying with a simplified criterion based on the righting lever curve properties or by performing a time-domain simulation to assess the maximum (dynamic) heeling angle. By necessity, the simplified criterion must cover a multitude of possible cases and as a result be overly conservative in individual cases.

DNV GL demonstrated the feasibility of such simulations for four representative test ships, using the viscous CFD solver OpenFOAM. Both breaking waves and buoyancy effects are automatically accounted for in such a simulation. Although computationally intensive, CFD is the only feasible simulation approach as inviscid potential-flow codes are not able to predict roll damping correctly. For the CFD simulation, the near-field around the ship (including bilge keel, rudder, and stability pontoon) was subdivided into 1.5 million cells. Grids are locally refined in areas of high flow gradients and in the air-water interface region. This ensures computational efficiency and accuracy.

These investigations obtain a time series of the ships' transient roll motion initiated by the sudden loss of crane load. The predicted maximum dynamic heel and the final static heel are used to assess the stability requirements for a lifting operation.

Adequate safety against capsizing as a result of the sudden loss of crane load during heavy-lifts can be demonstrated by numerical simulations of the ship's transient roll behavior. These simulations can add to the safety of heavy-load ships both in design and operation as they enable a more thorough stability assessment. *NA*

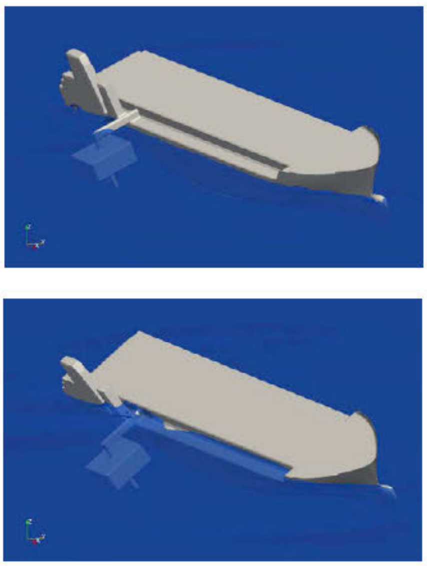


Figure 2: CFD simulation of heavy-lift ship and attached stability pontoon after loss of load

Structured planning reaches greater depths

Dannelly Brown and Beth Korkuch, NASSCO explain submergence testing that has been carried out on heavy-lift vessels for a different type of application

In 2011, the US Navy awarded NASSCO a contract to design and build two heavy-lift, float-on/float-off vessels designated as Mobile Landing Platforms (MLP), shown in Figure 1.

Before delivery, both MLPs were required to undergo Mission Deck submergence tests to the satisfaction of the US Navy technical authorities, Navy acquisition office, the civilian operator, and classification society, ABS. These tests were intended to demonstrate successful ballasting to a contractually specified depth of water over the Mission Deck to allow heavy-lift cargo to be floated on or off.

Although the Initial Design and Naval Architecture (IDNA) group at NASSCO had ballasting experience supporting previous NASSCO ship construction programmes and floating dry dock operations, they did not have direct design experience with heavy-lift vessels. The US Navy's experience was limited to previous charters of heavy-lift ships and no US shipyard had ever built and classed such a vessel.

Eighteen months prior to sea trials, NASSCO management allocated funding and personnel to begin planning. The planning effort began with weekly meetings of key personnel who brainstormed potential risks to the two primary objectives:

- Ensure the safety of the ship and the 160 people on board
- Successfully execute the submergence test to the satisfaction of all stakeholders.

The ideas for potential risks were captured in the first of several risk matrixes associated with the MLP sea trials event. Retiring risks involved three parts:

- Rigorous investigation, research, and calculation
- A detailed, well-communicated operational plan
- Operational preparation of pre-planned, practiced responses to potential equipment failures.

Investigation, research, and calculation

Each item in the risk matrix was systematically assigned to an individual point person who led the effort to conduct the necessary research and define actionable strategies to mitigate or eliminate the identified risk. This effort engaged a broad spectrum of disciplines within NASSCO's engineering department, including naval architects, structural engineers, marine engineers, and electrical engineers. For example, some of the initial risk reduction tasks substantiated assumptions about the ballast pump performance, validated assumptions about the appropriate free

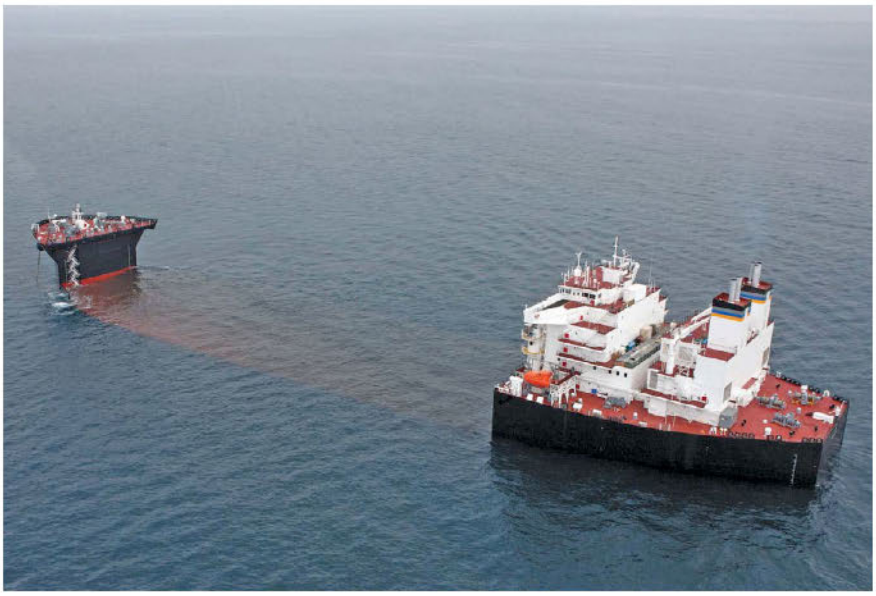


Figure 1: USNS *Montford Point* submergence test

surface corrections required, or defined environmental conditions acceptable for performing the sea trials event. Over time, investigation shifted away from common operating practices on heavy-lift ships to instead focus on the MLP's systems and their anticipated performance.

Operational plan

In order to mitigate risks, both the engineering and test and trials departments identified crucial needs for the understanding of the MLP's systems and for a having a specific operational plan. Naval architects, systems engineers, and test engineers developed a ballasting test procedure specific to the ship conditions during sea trials, referred to as a ballasting sequence.

The ballast sequences were the backbone of the plan for the submergence test. Therefore, it was essential that they be efficient and clearly communicated. Once initially developed by IDNA, the ballasting sequences were continuously improved through nine iterative review cycles by test and trials, ABS, the customer, and a heavy-lift industry expert, by addressing risks to both technical performance and document legibility.

Rigorous reviews and face-to-face communication eliminated potential misunderstandings between the creators of the ballast sequences and the ship operators. Extensive training with these sequences empowered every individual on board to voice a valid opinion if something did not seem to be going right during trials.

A single example of thorough understanding and clear communication involved tank level readings. Commercial tank level indicators (TLIs), like the ones on the MLP, are accurate to within +/- 3%. However, they are less accurate when tanks are filled above 90% and below 10% and will naturally fluctuate as the ship moves in a seaway.

The sequences required many ballast tanks to be filled to a level of 98%. Prior to sea trials, the naval architects familiarised themselves and the customer with the limitations of the TLI system and the procedures by which the test engineers would determine when to stop pumping. The submergence test could then be successfully completed even if the final TLI reading was not 98%. Through prior communication between the test engineer, the cognisant engineer of the TLI system, and the customer, the risk for trial failure due to mis-communication or inaccurate expectations was reduced.

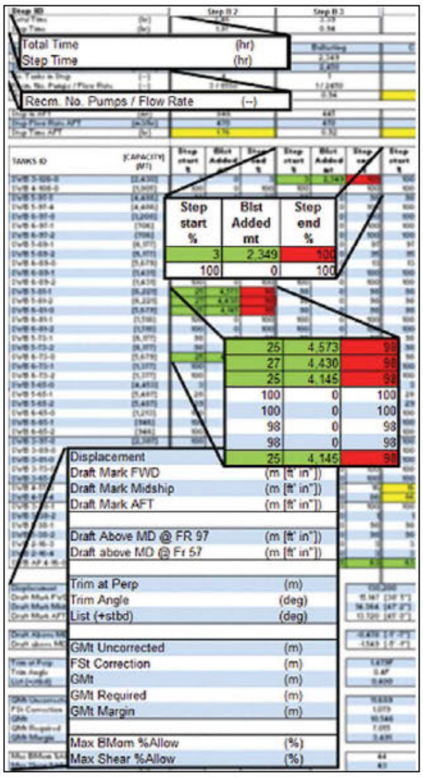


Figure 2: partial ballast sequence sheet

Each of the ballasting sequences used during trials ultimately fit on a single sheet of paper, see Figure 2. Each sequence demonstrated compliance with well-defined contract requirements and provided the operator with a clear step-by-step ballasting process.

Operational preparation

The operational preparation followed a parallel approach to the original programme risk-reduction methodology. A list of potential risks and the extents of their impacts enabled naval architects, systems engineers, and test engineers to systematically identify solutions and reduce potential risks during sea trials.

The impact of each risk item was assessed by categorising failures as either unrecoverable, meaning the submergence test could not be performed, or recoverable. The categorisation of recoverable and unrecoverable failures allowed the discrete application of appropriate mitigation strategies for each risk.

For each potential failure, the sea trials team created a pre-planned response. Each response identified the action plan, named a qualified point of contact from each shift, and provided the location of all required tools. These responses were practiced through both physical drills and extensive oral rehearsal to guarantee that everyone understood his or her role in each response plan. Training was so extensive that every NASSCO sea trials team member knew the first step to every response, "If it doesn't seem right, stop the pumps and close the valves tight!"

Both initial research and detailed reviews of the sequences enabled naval architects to develop a near-intuitive level of understanding of ship characteristics and physical systems. This allowed the naval architect to fulfil his or her role as part of the response to potential failures by quickly and confidently make real-time changes to the sequences.

NASSCO believes that properly trained personnel with the appropriate tools are the key to an efficient casualty response. This philosophy applies equally to a pipefitter fixing a leak or a naval architect on a laptop. In both cases, thorough planning and knowledgeable people are the primary tools for eliminating potential risks.

Conclusion

Eighteen months after planning was initiated, NASSCO successfully and safely completed the submergence trial of the first US-built and classed heavy-lift ship, the USNS *Montford Point*. The initial challenge due to lack of experience was overcome through extensive investigation and continuously working with the customer and classification society to establish clear testing requirements.

Detailed risk matrices were employed in the planning process to identify potential risks. Items in the risk matrices were then addressed through specific and actionable strategies to mitigate or retire risks. These risk mitigation strategies relied on comprehensive investigation, thorough understanding of the ship systems and behaviour, in-depth planning for anticipated problems, and a clearly communicated plan that was accepted at all levels of the involved organisations.

Exhaustive planning and preparation transformed an event previously surrounded in uncertainty and risk, into a well-defined, actionable plan that was executed by a confident team that proved capable of adapting to the challenges of a previously unprecedented testing event. *NA*

Roll out of Bigroll's fleet

Dutch heavy-lift company, BigRoll, is set to have the first vessel of its fleet launched this year

BigRoll, a merger between BigLift and RollDock, with its combined experience will be offering the market what it deems as a first class solution for modular cargo handling. The company has ordered a total of four heavy-lift vessels for this purpose. The first two of the MC Class module carriers, *BigRoll Barentsz* and *BigRoll Bering*, are set to be delivered in 2015 and 2016 with the other two left in the series scheduled for delivery in mid-2016 and 2017.

Hans Groeneveld, engineer, BigRoll explains that the: "MC Class vessels are specifically designed to deliver modules and equipment for large projects and are highly suitable to travel to remote areas, such as the arctic."

Groeneveld notes that a lot of land-based energy projects in the above mentioned remote areas are currently being set up, which stimulates the need for building modularisation plants overseas. With that, an increase in demand for worldwide module transport is seen.

BigRoll Barentsz is set to be delivered in 2015 and is the first in the series of four vessels

The MC Class is the newly designed wide deck module carrier of BigRoll. One of the main features of the vessels is that they have a very high ballast pump capacity in order to reduce loading and discharge times, thereby also increasing safety levels during these operations.

The vessels have no dock walls as the multifunctional RollDock vessels have. The MC Class vessels have a large deck that measures 125m x 42m and has a loading capacity of 24tonnes/m^2. The deck is completely flush and can be used over its full length and the vessel's beam for loading, discharging and stowage.

The MC Class has been newly designed with a focus on high ballasting capacity, low fuel consumption, high service speed and good seakeeping behaviour, which means lower acceleration forces on the cargo. The company has highlighted that the innovative hull design and propulsion configuration ensure reliable and short transit times. The vessels have Finnish Swedish 1A Ice Class and the powering and steering systems are designed with redundancy and the vessels can be equipped with DP2.

Groeneveld says that BigRoll's focus is to serve the onshore modularisation project market and the offshore transportation market. The projects in these markets are increasing both in size and in complexity, and ever higher environmental demands must be met for the various project locations. The first two vessels will start in the Yamal LNG project that will be built at the Yamal Peninsula in Russia.

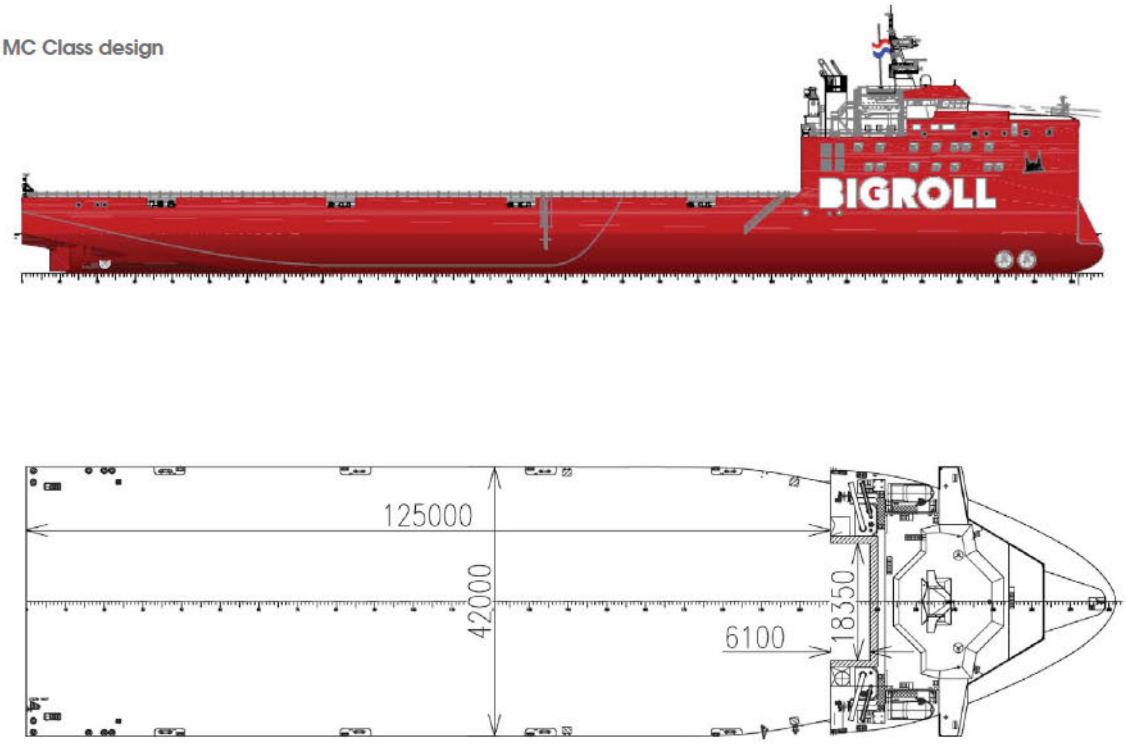
The 15,100dwt heavy-lift vessel series has a length overall of 173.00m and is classed with the notations of ✠ 100 A1 strengthened for heavy cargoes, submersible to a depth of 1.5m below cargo deck in harbour only, Shipright ACS(B), LI, Winterisation H(-55°C), *IWS ice class 1A FS at a draught of 6.100 meters ✠LMC, PSMR, UMS, CCS, ICC, IP, NAV1, IBS, with the descriptive notes: SHIPRIGHT (SCM). *NA*

TECHNICAL PARTICULARS

BigRoll Barentsz

Length oa:	173.00m
Length bp:	162.80m
Beam:	42.00m
Draught freeboard:	10.50m
Depth cargo deck:	12.00m
Deadweight design:	15,100dwt
Deck space:	125.00 x 42.00m
Deck strength:	20tonnes/m^2
Accommodation:	32 extra + 2 pilots
Stern load maximum:	10,000tonnes
Side load maximum:	15,000tonnes
Ballast capacity:	12,000m^3/h
Main engines:	2 x Wärtsilä 6L32/ rated output 2880kW 2 x Wärtsilä 8L32/ rated output 3840kW
Propulsion:	2 x nozzled controllable pitch propellers 2 x rudders
Auxiliary engine:	Caterpillar C32 Acert
Bow thrusters:	2 x FT225 M-D/1,000kW
Stern thruster:	FT225 M-D/ 1,500kW

BigRoll's MC Class design



SAL Heavy Lift stays the course

German-based shipping company SAL Heavy Lift believes the heavy-lift shipping market will increase and diversify

SAL Heavy Lift has highlighted that the break bulk and heavy-lift market is still recovering from the economic crisis that hit in 2009, which is slowly but steadily starting to improve.

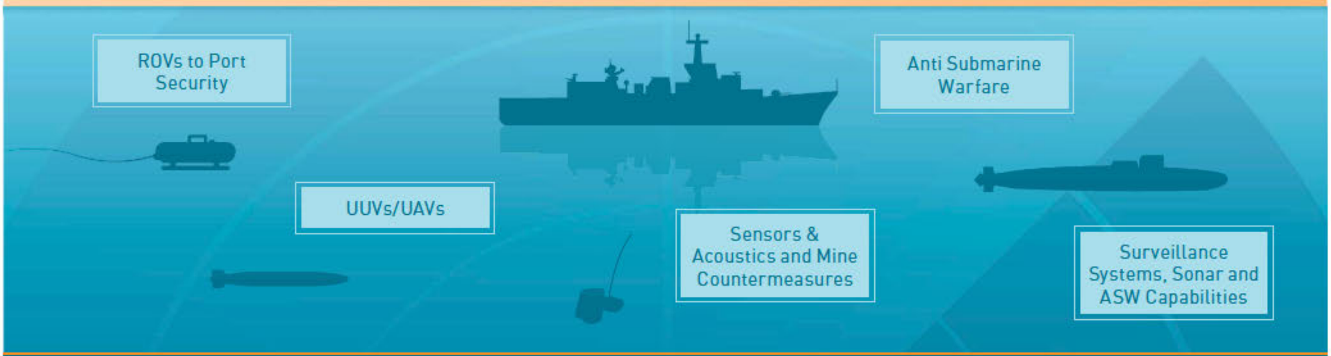
"We have over the past few years seen a few consolidations in the market, and tonnage that shifts hands. The entrance of private equity into our end of the shipping world has created an increased pool of newbuilds, but primarily in the lower to mid end of the market up to 800tonnes capacity," says Christian Hoffmann, head of marketing and corporate communications, SAL Heavy Lift.

The company says that a few companies have ordered tonnage for the high end of the market (+1,500tonnes). The market for tonnage is relatively scarce, but has its rights in the construction and offshore segments especially. Hoffmann adds that: "It is hard to state – we see a wide range of activities across the business segments we operate in."

The company will continue to focus on versatile, high quality and class defining vessels in the future as well, it says.

"So far there has from our point of view not been justification to order newbuilds, but we are constantly evaluating what vessel types we deem right for the business segments we operate in," says Hoffmann. "We foresee a role for larger heavy-lift vessels in this industry and believe in growth in this business segment."

Currently the company operates in the semi-liner, project transport and offshore installation business. Several interesting projects in the past period that SAL Heavy Lift has been involved in have been in the mining and port handling segment, with transportation of large ship-loaders. In the offshore installation business the company has also conducted pre-pile installation for the Wikinger offshore wind farm in the German North Sea. *NA*



ROVs to Port Security
Anti Submarine Warfare
UUVs/UAVs
Sensors & Acoustics and Mine Countermeasures
Surveillance Systems, Sonar and ASW Capabilities

Collaboration in design and engineering

Herbert Koelman, SARC, The Netherlands explains how Netherlands Center for Geodesy and Geo-informatics (NCG), SARC and Conoship have joined forces to be able to create a better CAD/CAE software system

In the early days of the application of computers for the design and engineering of ships, inter-programme communication was somewhat cumbersome, however, there was a spirit of optimism that an interconnected world was about to emerge.

The first step in that process was the embracing of the concept of a 'neutral model'; one common repository where all data resides, and to where all applications are linked. Figure 1 demonstrates that without such a model, and with eight applications, 56 bilateral interfaces must be available, in sharp contrast to the only eight interfaces with the common model.

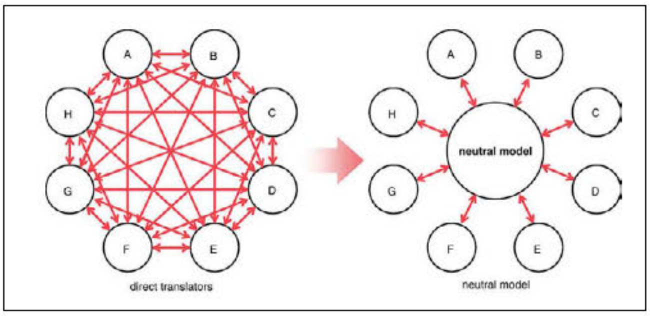


Figure 1: A neutral model is assumed to save on interfaces, ([2])

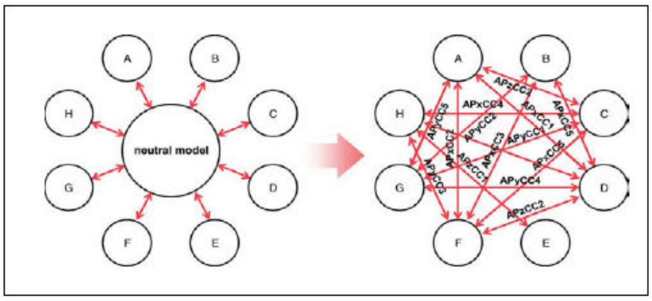


Figure 2: From theory (left) to practice (right), ([2])

It was a fine idea at the time, which formed the core of quite some developments; just for The Netherlands, there are five. Also international neutral model standards emerged, such as initial graphic exchange specification (IGES) and Standard for the Exchange of Product Model Data (STEP). Decades on; a survey[1] on the use data exchange standards shows that those neutral model standards are only applied in some 35% of the cases. Without commenting, we can conclude that the neutral model did not emerge fully.

An overview paper[2], reflects on the potential of the neutral model paradigm, and concludes:

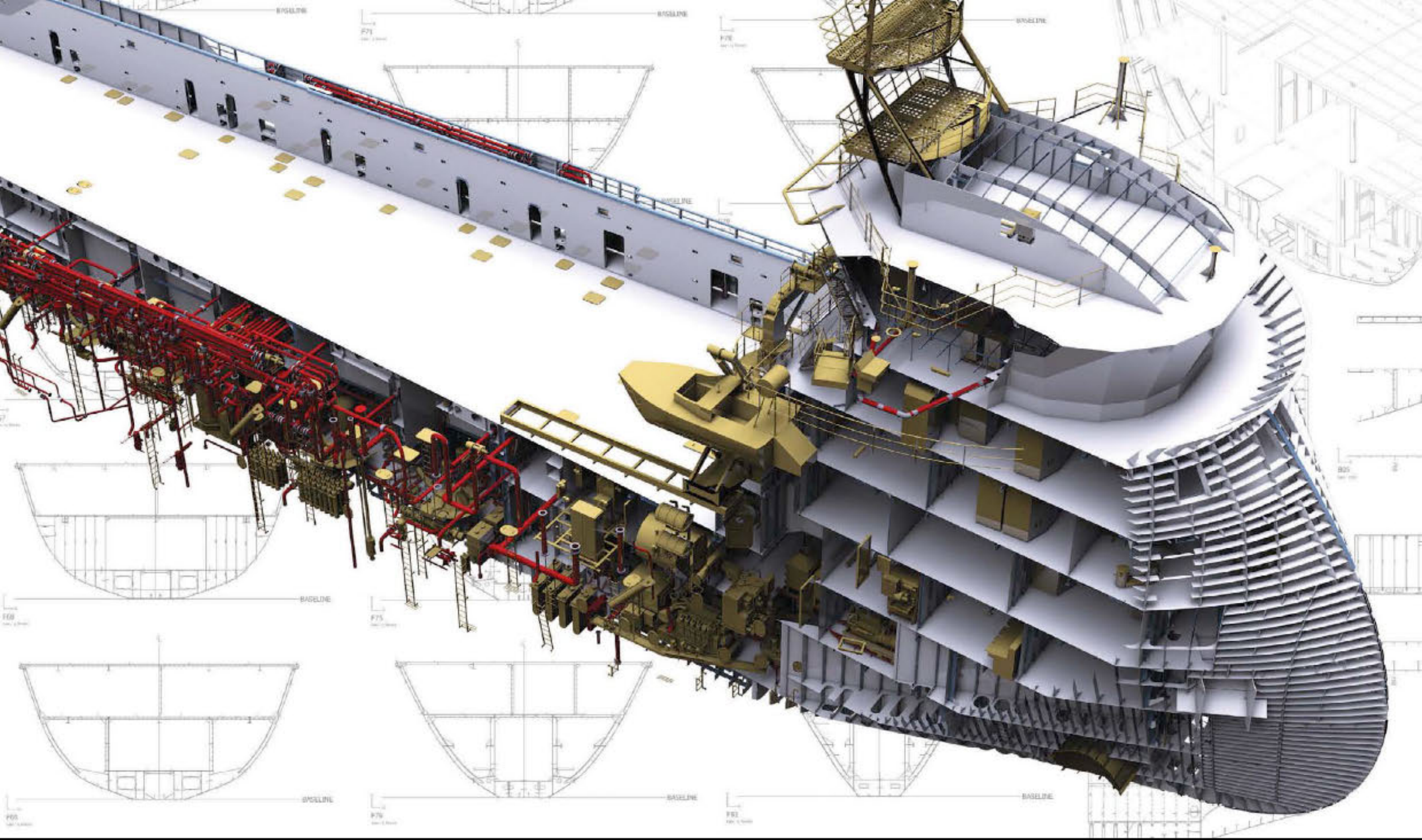
- The assumption that a neutral model can be postulated, be made available, and be used by all applications does not hold.
- The meaning of the applied concepts – the semantics – should be agreed on the forehand. For this reason the contributing parties should know each other.
- Multiple representations for the same entities might be applied – this is called 'representation variation' – and brings the requirement of conversion between representations. Some representation can unambiguously be converted (e.g. straight line through two points → vector representation), others cannot (e.g. triangulated surface → NURBS). An experiment with three conversion examples leads to the conclusion that "In all three cases, significant differences between the files were found: some entities disappeared, others appeared, and again others were changed". The paper concludes that "The neutral model does not really exist"; instead there are multiple converters for the variety of representations, as depicted in figure 2.

With this background knowledge three Dutch partners undertook the endeavour to adapt their tools and products in order to create a CAD/CAE system, composed of already available components. The aim was a single virtual ship design and engineering systems. The partners involved are NCG – manufacturer of the NUPAS-CADMATIC software for CAE, Conoship – a ship design office, and SARC – manufacturer of the PIAS Computer Aided Ship Design software. Having learned the lessons that a centralised top-down approach requires quite some effort and does not guarantee success, a more grass-roots kind of approach was adopted:

1. The dictionary is not predefined, but grows on demand. Just like a dictionary of a natural language.
2. The applications communicate over the network, by the TCP/IP protocol.
3. As 'language' XML was adopted, for the reasons that it is easy to understand by a human, it is easy to consume by a computer and it offers some semantic support.
4. A central repository – a common database or other form of data storage – is initially not used.
5. Not only is data shared, but applications can also send requests to others – and receive a proper reply.

The last item may require some elucidation. Up to now most approaches have been data-centric, so communications were limited to the 'product model' of the ship design. However, the disadvantage is that each participant – application – should replicate the entire product model, in order to be processed.

Given the pitfall of the 'representation variation', as discussed before, such a



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BASIC DESIGN

- Reuse initial design data from Rhino, Maxsurf, NAPA and others
- Rapidly develop a basic 3D structural model
- Manage change with associative and parametric 3D modeling features
- Create de-featured 3D models for FEA
- Generate 2D classification and general arrangement drawings from the 3D model
- Automatically update drawings as changes happen
- Allocate space for major systems
- Define a list of major equipment for the project
- Place major equipment in the 3D model
- Verify the 3D model against P&ID's
- Visualize the 3D model onsite or in the cloud via Autodesk Navisworks

DETAIL DESIGN

- Directly reuse the basic design
- Rapidly add detail to the 3D model
- Automatically build the production model (marking, assembly, bending and more) as the 3D model is created
- Expand shell plates including forming templates
- Common environment for all disciplines
- Add intelligent penetrations through structure
- Visually define the build sequence and other part breakdowns
- Automatically identify and manage welding
- Automatically add bevel information
- Define pipe spools
- Model wireways and route cable
- Automatically maintain part naming based on assembly sequence and properties

PRODUCTION DESIGN

- Automatically nest plates and profiles directly from the model
- Generate NC code for any burning machine
- Generate pipe and HVAC spool drawings
- Generate 3D assembly drawings
- Generate profile plots/sketches
- Generate 2D workshop drawings
- Generate system arrangement drawings
- Generate cable pull schedules
- Automatically update drawings as changes happen
- Drive NC profile cutting
- Drive NC pipe fabrication
- Visualize the assembly sequence
- Create as built models from laser scan data
- Generate customized reports from the model

SSI

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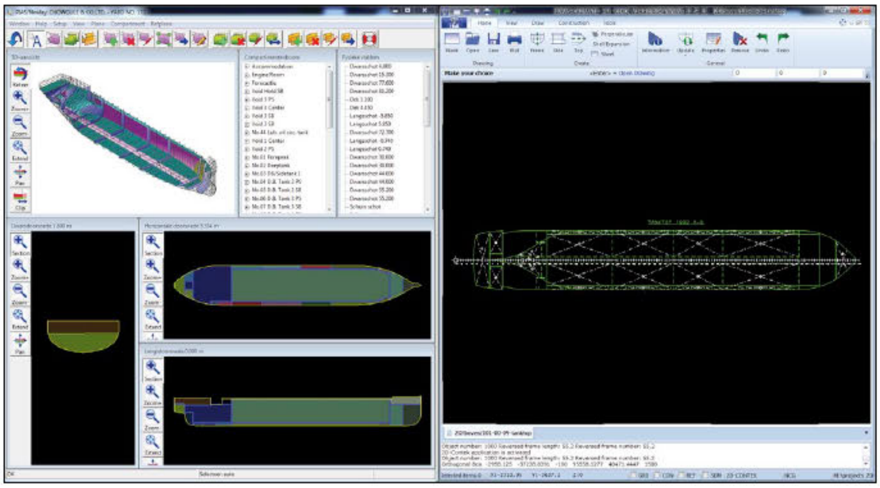


Figure 3: Left the PIAS modeller for internal shape, right the generated tank plan in NUPAS-CADMATIC

replication will in any case be laborious, and might even fail. However, if one application is capable of simply asking for a derived result, life becomes much easier. For example:

- If application A manages the shape data of hull form and compartments, then application B can request the shapes of intersections from A at different levels. In this case a general arrangement plan application can quickly be set up in a general CAD system without the need for the CAD system to maintain a full geometric model.
- Commonly, in a tank plan a list of tanks and their capacities and centres of gravity is included. Again, in order to save the tank plan application from the burden of volumetric computations, those parameters can be requested from a connected application which already has this capability, for example the tank sounding module of the hydrostatic package. These requested capacities are not stored in any way, neither local, nor central. They are simply printed in the tank plan, and never used again. The advantage is that we don't need to worry about the validity of stored data, if the tank plan is updated the capacities are simply requested again and recomputed.
- If an application has specified capabilities, say to enlist all compartments and bulkheads that are encountered by a pipe, then the other applications can use this capability without the need to replicate it.

Such a request-reply way of operation was recently also proposed in [3].

NCG, Conoship and SARC have implemented a pilot for such a system, which is about to be finalised for evaluation by now. Figure 3 shows a screenshot. Essentially, in this way a single virtual CAD/CAE system has been created, which consists of collaborating, but otherwise distinct tools. The pilot covers:

- Hull form design
- Internal shape design and manipulation: bulkheads, decks and compartments
- Structural arrangement topology
- Generation of general arrangement plan and tank arrangement plan.

The hull form details are available to all three systems in a reply/request fashion. The internal shape and structural topology (which are essentially the same) is visible in each of the three systems, while a modification in one system is immediately synchronised with the others. In this way the consistency of the ship design is ensured, in, for example, the following scenarios:

- The internal geometry is modelled in NUPAS, and immediately available in the other software. With the Conoship CAD system a tank plan is generated, including a tank volume table, which is generated by reply/requests to PIAS. After each geometry modification the tank plan is re-generated, so the volume table is always up-to-date
- The internal geometry is modelled in PIAS, and applied for the preliminary intact stability and probabilistic damage stability calculations. Based on this geometry, in NUPAS all construction is modelled, a process in which for practical reasons some geometry may be adjusted. Afterwards, the modified internal geometry is immediately available in PIAS for final intact and damage stability assessments
- With the internal geometry modeller open on the left monitor, and Conoship's CAD application – which includes sizing verification tools on the right - the system works as a whole, with the effect of shape modifications on the left monitor directly visible on the right.

Although it is still too early to report on experiences in the harsh ship design practice, the following conclusions emerge:

- The system works as anticipated. The smooth data sharing reduces ship design times, ensures model consistency and, as a result, reduced the failure probability
- The ratio between implementation effort and gained results is remarkably low
- No performance degradation due to network traffic was experienced
- The system relies on instant messages from applications to each other. It will be obvious that all applications should be switched on, and attached to the current design project, in order for these messages to be processed correctly.

These findings have motivated the partners to continue with these developments. In particular, the inclusion of piping is the subject of current investigations, because it plays a vital role in design (at damage stability) as well as engineering. *NA*

References

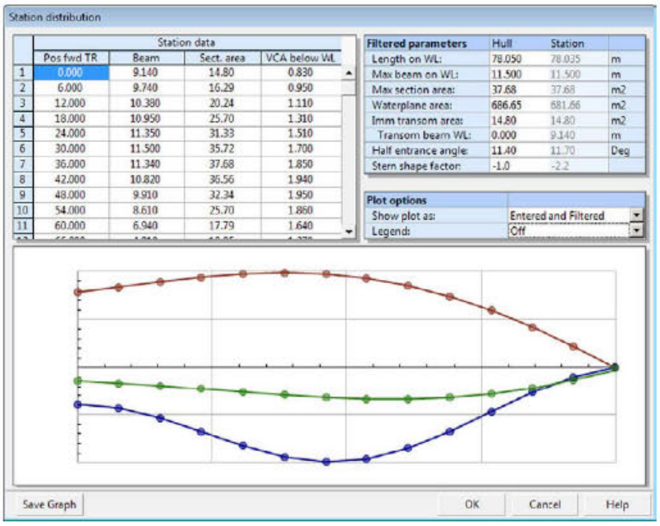
[1] VIJAY SRINIVASAN, 2008. Standardizing the specification, verification, and exchange of product geometry: Research, status and trends. *Comput. Aided Des. 40(7), 738-749.*

[2] WIM GIELINGH, 2008. An assessment of the current state of product data technologies. *Comput. Aided Des. 40(7), 750-759.*

[3] CHRISTOPH HOFFMANN, VADIM SHAPIRO, and VIJAY SRINIVASAN, 2014. Geometric interoperability via queries. *Comput. Aided Des. 46(1), 148-159.*

Two-tiered designing from HydroComp

US-based HydroComp has launched the latest version of its NavCad software that will see the software package now come in two editions



Station distribution (for Prismatic Wave Drag)

The NavCad resistance and propulsion prediction software upgrade has been aimed at those who are looking for a greater level of analytical capability. Offered as an optional "Premium Edition" upgrade, these special new capabilities are a significant addition to the existing hydrodynamic analysis features in the standard NavCad.

"For years, we have kept only one version of NavCad for the simple reason that it minimises development and maintenance costs for our customers. That being said, as part of a strategic multi-year plan we undertook to extend the scope of NavCad for our "power users" into higher order codes and capabilities," explains Don MacPherson, technical director, HydroComp.

MacPherson adds that the new modules have helped to evaluate a parametric range of bulb geometries and their life-cycle influence on fuel consumption, leading to a bulb design and construction that is demonstrating significant fuel savings for the owner.

Operating modes analysis is a tool to evaluate the performance of a ship across its entire duty-cycle. This could be for an individual voyage (making it a tool for tactical voyage planning), or it can be for a representative duty profile (for strategic design-side evaluation of propulsion system options). Ship operators would be an obvious user of the module, but also the designer that is looking to optimise the cumulative efficiency of the ship's system rather than optimising any particular component to a single design point. For the bulbous bow study, the implications of each bulb option were reviewed considering the full operating profile of the vessel, not just at one speed or design point.

The prismatic wave drag (PWD) wave-theory code is a unique tool for hull form resistance prediction that does not require a systematic series or empirical method. It, allows a user to predict drag for vessels that are outside the scope of available test series, such as long and slender hulls, or for the effect of local geometry such as bulbous bows. The genesis of the PWD code was really to address the absence of performance data for long, fast, slender hulls in the published literature.

"We also knew that we wanted to allow users to be able to evaluate resistance using a more refined definition of the hull. Many conventional wave-theory approaches were considered, but all had some shortcomings. One part of the HydroComp software brand is that the tools must be well behaved and quantitatively strong (our signature)," says MacPherson.

Any type of systematic study, like HydroComp's bulb design analysis, benefits from automating calculations to reduce manual entry and increase calculation effectiveness. The latest "Scripting" capability provides a simple programming (macro) language to quickly set up scenarios for changing data (like bulb geometry) and repeating calculations (like a PWD prediction).

The scripting can also be run as a connected resistance and propulsion solver, whereby another piece of software, such as a hull design tool, can collect the necessary data and run NavCad in the background.

In addition, HydroComp has released its PropCad 2015 edition. The company says that a substantial effort has focused on data entry and visualisation in the latest update. As a result, PropCad has moved to a table-driven interface that allows users to quickly enter and modify data in their designs. The content of the interface has been consolidated so that principle dimensions, radial distributions, and 2D section offsets are now all visible on the main screen.

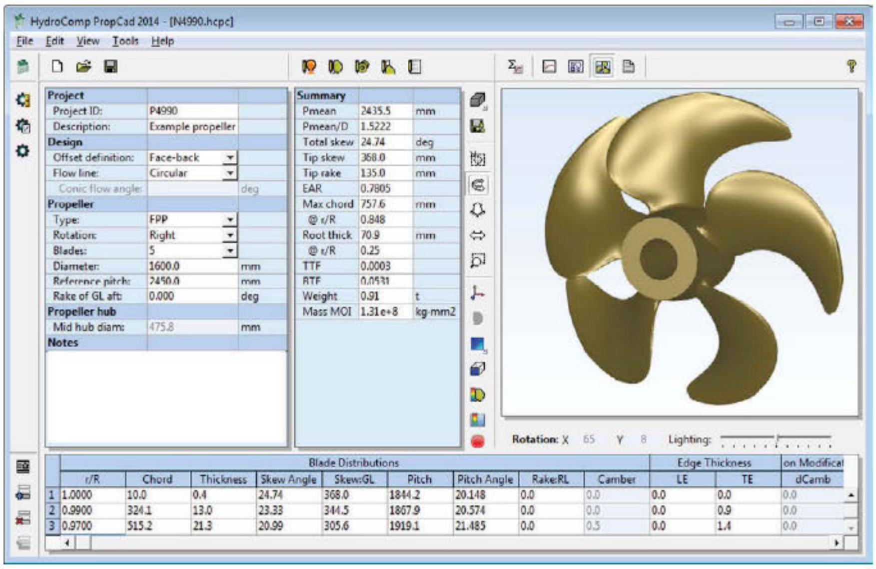
A new summary table displays the derived characteristics of the design, including weight, mass moment of inertia, total skew, and mean pitch. The display mode enables graphing of any radial distribution, such as chord, skew, or pitch angle. One-click graphing allows quick visualisation of blade outlines, thickness profiles, and 2D section offsets.

PropCad 2015 features an improved, fully parametric builder that allows users to define radial distributions of parameters from HydroComp's library propellers, from user-generated distribution files, or by entering the data directly into the sections spreadsheet. In 2015, the builder includes pre-sets for standard propeller designs. The Builder includes new options, including radial control of leading and trailing edge thickness, chordwise position of maximum thickness for Gawn-type sections, a

CAD-friendly tip correction, and additional control of cup (with the ability to set the cup sweep angle, enable face-only cupping, and allowing cup around the tip).

PropCad's table-driven entry supports cell formulas for on-the-fly calculations while improved data tools allow users to quickly visualise and smooth user-entered data. The 3D window includes hardware-accelerated anti-aliasing, smoothed 3D renders, new visualisation modes, and video recording. Users can also now add root fillets between the blade and hub, detect required hub length, and automatically set the blade position relative to the hub.

In addition to new features, PropCad 2015 includes updates to existing classification societies and 3D CAD exports. China Classification Society, ClassNK, and Swedish/Finish rules for propeller thickness have been added to PropCad 2015. Additionally, ice class designations are available for ABS Steel, Bureau Veritas/RINA, Lloyd's Register's LR Ship and LR Naval, and Swedish/Finnish rules. The Classification Thickness reports have been updated to include all intermediate calculations and data in addition to the required calculations for submittal and approval. *NA*

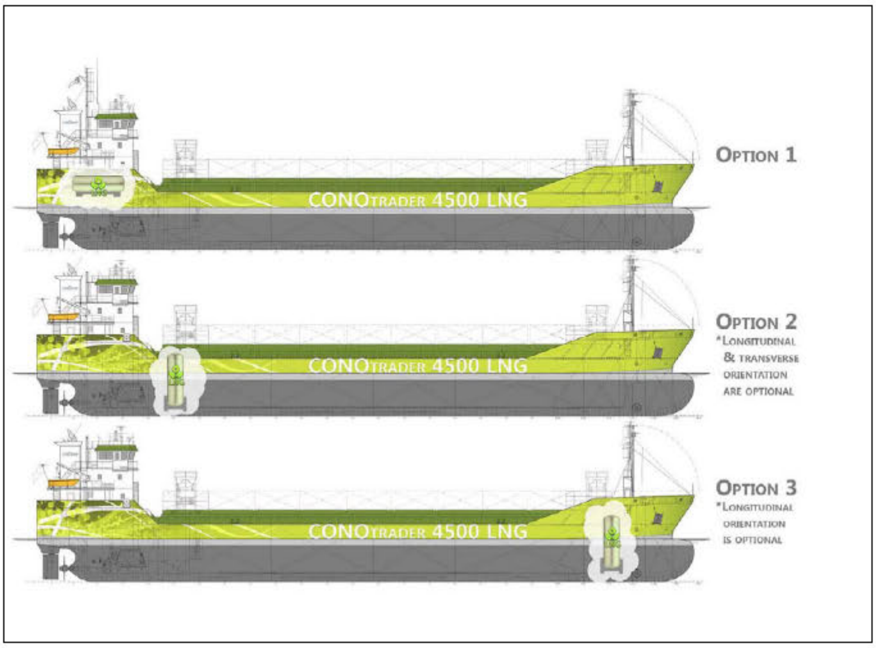


Main screen of PropCad 2014

Innovate to accumulate

Conoship held its mini symposium "Profitability by Innovation" earlier this year, which provided a variety of insights regarding innovations for the short sea shipping market. Conoship explains some of the topics discussed

The topics at the symposium ranged from innovative ship designs to innovative design tools and the latest innovations regarding ship systems. Even though the innovations that were presented were completely different, all of the innovations aim to increase a shipowner's profitability.



Conoships eCONOlogy Traders design

Koole tank system

Martijn van Poppelen of Koole Engineering presented the latest in tank design for chemical tankers, the ORCA system. The ORCA system is designed for independent, cylindrical tanks. Although independent tanks for chemical tankers are already in use in for example bitumen tankers, they are not commonly used for "conventional" chemical tankers. Applying cylindrical independent tanks could, however, be very beneficial as they result in:

- A minimal heat loss
- Lower temperature heating ducts (improved product quality)
- Contamination is no longer possible
- Easy stowage
- Better cleaning due to insulation
- A simpler to build ship's hull.

In the past a number of chemical tankers with cylindrical tanks have been designed, but none of these designs were successful, as many operators had doubts regarding a tanker with cylindrical tanks. These doubts mainly concerned the following questions:

- Are we loosing cargo capacity?
- How do we secure these tanks?
- Will it actually work?
- Will class accept this?
- How to deal with thermal expansion?
- Will the ship become heavy?
- What are the total costs?

In his presentation, van Poppelen showed that the application of cylindrical tanks is indeed feasible with the Koole tank system, as with this system for all these questions there is a satisfying answer. Koole Shipping has operated a number of tankers with the Koole tank system for the last couple of years. Many of the practical problems, such as class approval, were therefore already "tackled" by Koole for its own vessels. To further investigate the feasibility of the Koole tank system, a number of case studies have been carried out for larger chemical tankers, and other types of chemical tankers, as Koole only operates edible-oil tankers. The case studies, showed that:

- No cargo capacity is lost, as the depth can be sufficiently increased to reach the same volume;
- The tanks, and also larger tanks than applied by Koole itself, can be secured with the ORCA tank technology;
- Thermal expansion can be easily considered in the design of the tanks;
- Approval by class is possible, also for other types of chemical tankers and edible-oil tankers (approval in principle is in progress for a 5,000dwt and a 30,000dwt tanker);
- Ships do not become heavier when the ORCA system is applied. In most cases the tank weight (stainless steel) is reduced and the steel weight of the ship slightly increases; and
- Total building costs are lower, due to the reduction in stainless steel and a more simple to build ship's hull.

All in all, the ORCA system will provide lower operational and capital costs and thereby provide "profitability by innovation".

Digital cooperation between software packages

Herbert Koelman of SARC presented the latest developments in "digital cooperation" between very different specialised software tools for design, engineering and production preparation

for ships (see: CAD/CAM pages 40-42). Together with Numeriek Centrum Groningen and Conoship a new way of integrating common naval architectural software was developed. "Walls come tumbling down" between the various specialists, enabling them to co-operate in new ways during design and engineering, by sharing design data real life from anywhere and from each other's applications. This improved way of working stimulates innovation and reduces design time and costs, improving the profitability of design and engineering companies.

Innovation and profitability – The Human Element

On behalf of Lloyd's Register, Engel-Jan de Boer pointed out the importance of the 'human element' in shipping. It is known that 80% of all marine errors and accidents are caused by humans. Many of these errors and mistakes are caused by poor consideration of "the human factor" in the design of ships and shipboard equipment. Preventing these errors and mistakes through an increased focus on the human factor requires innovation. It will improve onboard safety and workability, which will increase a shipowner's profitability.

Innovation of design approaches, and perhaps even more important, a new way of thinking is required to increase the focus on the human factor. Improvements cannot be reached by implementing new and more regulations. Already there are (too) many regulations. For Lloyd's Register as a class society it is clear that everyone in the industry has to look further than compliance with the regulations.

Historical evidence has shown that simply complying with the rules does not prevent accidents, as most rules come into action as a corrective measure to prevent the accident from happening again. As an industry we must look further than compliance and following the reactive regulations, regulations will not prevent mistakes. To obtain substantial improvements, the task should be fitted to the human, instead of making the human fit for the task. Designing ships, equipment, processes and procedures should be done by taking the characteristics, abilities, attitudes and likely behaviour of humans into account.

The return on investments of "human factors" is significant. In shipping it could for example result in manning reductions. Designing for operation and maintainability can result in a reduction of capital expenditure of 0.25% - 5% and 3% - 6% of operational and maintenance lifecycle costs. Workstation redesign can result in an increase of 15% in productivity. Human factors exist, but they are important as ignoring human factors can create errors with significant impact.

A realistic vision of the maritime (training) future

Joost van Ree of VSTEP presented a vision for the future of training in shipping, and for the future of shipping in general. VSTEP expects the future of shipping to be unmanned:

- 2015 – First autonomous prototypes
- 2017 / 2018 – Rolls-Royce demonstrate fully autonomous vessel
- 2025 – Fully automated ships entering service
- 2035 – Most ships delivered with autonomous capability
- 2050 – Some segments e.g. Container, fully automated and unmanned.

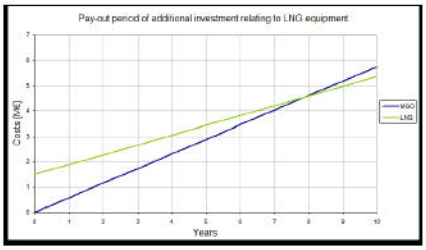
Even though the future might seem far away, it is already here. The required building blocks for unmanned shipping are available. Large shipping companies for example have, or are, developing control centres from which they can control and organise their fleet's logistics, ETA's, fuel consumption and maintenance programmes.

In the meantime, training will remain necessary and will become more and more realistic. Virtual reality will gain a more prominent place in marine training, and will shift from training centres to the actual ship. With techniques such as Google Glass, or the Occulus Rift it becomes possible to carry out training programmes on board the actual ship by plugging into the ship's operating systems to train (for example during quiet waiting periods) with virtual reality glasses on how to react to simulated complex (emergency) situations, working with the real bridge equipment of a ship.

Conoship – Profitability by Innovation

The symposium was concluded by Conoship's Guus van der Bles, who highlighted a number of innovations which Conoship will bring to the market to improve shipowners' profitability in the near future. Van der Bles started by presenting the possibilities to save fuel on cargo vessels with an innovative 'DoubleWing' eCONO Wind Unit for wind propulsion, a technology that was developed in the America's Cup, the 'Formula 1 of sail racing'. On top of that, a prototype of a TurboSail eCONO Wind Unit is under development, based on patents of Jacques Cousteau. This can lead to a mean propulsion power saving of about 35% on routes between Rotterdam and the Baltic, according to feasibility studies by TU Delft.

Profitable savings are further possible with the innovative ConoDuctTail, applied to a series of concept designs of eCONOlogy Traders between 2,200 and 5,000dwt, resulting in fuel consumption of 1.7 to 3tonnes/day at an ECO-speed of 10knots. The ConoDuctTail combines an increased propeller diameter combined with a nozzle integrated in the ship's hull through an extensively optimised tunnel shaped aft ship.



Savings table

Furthermore, Conoship will continue to develop hull forms which improve 'habitability' and 'workability', with an innovative hull design for Walk-to-Work (W2W) ships as for example applied on the NAM vessel and the Dutch Pilot Station Vessels. To conclude, Conoship presented results of an R&D project: the eCONO SWASH-TRI hull which was used as a basis for a futuristic design of a ConoComfortCruiser, developed together with MARIN and TU Delft. The eCONO SWASH-TRI hull combines excellent seakeeping behaviour with a very large deck area. *NA*

BV raises the standards

French classification society Bureau Veritas has seen an increased demand in the area of standards for inland waterways

Bureau Veritas (BV) has seen business in South America, Africa and Eastern Europe grow, along with changing technology and regulations in Europe focused on LNG propulsion, strength and stability.

BV has also revised its rules for inland vessels to introduce standards for LNG and fuel cells and separate the class rules, to be applied globally from European regulation.

The main rules for the transport of dangerous goods on European waterways are included in the ADN agreement; the version in force is the ADN2015. Since 1 January 2015 the transport of LNG (UN1972) is authorised onboard an inland tanker. The prescriptions are those relevant for the carriage of refrigerant liquid gases. The main safety issues regarding the transport of refrigerated liquefied gases by inland vessels are:

- To keep the refrigerated liquefied gas(es) close to its low loading temperature
- The compatibility of the cargo tanks and piping system with the low temperature of the cargo
- Protection of the vessel's structure against brittle-fracture due to cold transfer.

Eric Lallemand, marine chief executive, Belgium, BV says that: "Actually the use of LNG (UN1972) as fuel is not authorised onboard inland navigation vessels. It is necessary to obtain a recommendation from the CCNR (Commission Central pour la Navigation sur le Rhine) and, in case of an ADN-vessel, also from the ADN safety committee."

There is a draft of the future Rhine requirements for the use of LNG as fuel; this draft is presently in discussion at the CCNR. The prescriptions would then come into force in December 2015. Those prescriptions are based on the OGF (interim guidelines). BV, as a classification society, has issued its own prescriptions: "Safety Rules for Gas-Fuelled Engine Installations" (Rule Note NR 529-May 2011).

In addition, Lallemand says that more often now fuels cells are being considered as a source of energy for inland vessels. BV is fully involved in two such projects: a day trip passenger vessel (1,000 passengers) and a shuttle passenger vessel (25 passengers). There are currently two vessels that utilise fuel cells for fuel; one is in operation in Germany and the other in The Netherlands. Lallemand notes that BV expects these types of projects will increase in the future.

Loire Princess the latest paddle-powered vessel for CrosiEurope

In 2014, 69 newbuildings were delivered, almost half of them product tankers for service outside Europe, while 12 were passenger ships. In 2015 that number is set to rise to 102 new vessels.

CrosiEurope is carrying out its latest project for passenger vessels with *Loire Princess*, which will be classed by the French classification society. It will be able to carry 120 passengers and is propelled by paddle wheels, the first such vessel in Europe in over a century. It can operate in very shallow areas and further vessels are expected to follow. *Loire Princess* was constructed a St-Nazaire (mecasoud) for CrosiEurope and will measure 88.8m length overall, 15.3m breadth and 3.2m depth. The main propulsion for the vessel is done by the lateral paddle wheels, with a low draught the vessel and other vessels in the series will be able to operate where other vessels with deeper draughts cannot.

Wisby Tankers have also made a significant step in its fleet development with the construction of 50 tank barges that will be constructed in Croatia, alongside three LPG barges, seven tank barges. *Sirocco* is the first in the series of the LNG barges that is owned by Chemgas Shipping, and delivered in May last year. Chemgas is also conducting a study into the construction of an inland vessel capable of transporting LNG as cargo. *NA*

Sirocco the first in a new series of vessels for Wisby Tankers

First CNG tanker set for 2016 delivery

Compressed natural gas has some advantages over its colder cousin, LNG, in that there is no requirement for expensive to build and operate reliquefaction plants. However, the precise challenges in building this type of vessel remain unclear. CIMC ORIC and its consortium partners have risen to the challenge

The world's first CNG carrier will be powered by a Wärtsilä dual fuel engine and will be capable of operating on gas or HFO

In recent years the development of LNG for marine use has gathered pace with new bunkering facilities and new vessel designs produced to meet the increasingly stringent pollution regulations in some parts of the globe.

Compressed natural gas (CNG) has, until now, been ignored as a cargo or marine fuel, but the first CNG tanker is now under construction in China for CIMC ENRIC, which is listed on the Hong Kong stock market, and the vessel will be operated by Indonesia's state owned energy company Perusahaan Listrik Negara (PLN).

"We expect that this CNG carrier will be a model for other Indonesian owners as the government's policy is to promote energy efficient and cleaner sea transportation through the use of gas fuelled engines," said Suryadi Mardjoeki, head of oil-based fuels and gas division, PLN.

LNG must be stored at -163°C or the fuel will return to its gaseous state increasing pressure in the storage tanks. The energy density of LNG is 2.4 times that of compressed natural gas (CNG), but LNG must be stored and transported in expensive cryogenic tanks.

Both CNG and LNG are composed mainly of methane but, unlike LNG, CNG must be stored under pressure at around 20-25MPa, usually in cylindrical tanks.

No CNG tanker has been built before and the Jiangsu Hantong Ship Heavy Industry Co, which has been contracted to build the tanker with the expected delivery date of 2016, says that due to the lack of previous experience of this vessel design there is no reference vessel and "no existing rules to follow".

"The CNG will be compressed and stored inside high pressure cylinders in the cargo holds, it's easier to unload CNG to a shore station, and there's no need for the very expensive reliquefaction or regasification equipment, which will reduce the investment for the receiving station. This is the main difference with a normal LNG or gas carrier," the yard explained.

Operating a service between the Indonesian port of Gresik, in East Java, and Lombok Island, some 300nm east of Gresik the vessel is being designed by CIMC ORIC and will be owned by the designer's sister company CIMC ENRIC.

CIMC ORIC marketing manager Frank Lian told *The Naval Architect* that the major challenges that the company has faced in the development of the vessel has been the complexity of the cargo storage system.

"The cargo hold and cylinder bottoms need a more complex structure, they need to be strengthened (cylinder spacing [between cylinders] 650mm and the inner space must have a height of 1,200mm).

TECHNICAL PARTICULARS	
CNG Tanker	
Length, oa	110.92m
Length BPP	104.12m
Breadth	17.6m
Depth	9m
Design draught	5.2m
Main Engine	MCR 3,000KW 750RPM
Service Speed	13.9kn
Class	ABS ✠ A1 compressed Natural Gas carrier, ✠ AMS, ✠ ACCU, UWILD, GFS (DFD) RRDA, CPS

Cylinders will be stored vertically giving the vessel a high centre of gravity," explained Lian. He went on to say: "Solving the heat dissipation problem was a major challenge, combining the ventilation and cooling systems."

Resistance and propulsion tests have now been completed as have manoeuvring and sea keeping model tests that were carried out by two different institutes, but the computational fluid dynamics calculations were completed by CIMC ORIC's specialist computing section.

Main engine power will come from a 9-cylinder Wärtsilä 34DF, dual fuel engine and the Finnish company will also supply a propulsion package including a controllable pitch propeller and gearbox.

"This will be the first dual-fuel powered vessel owned by an Indonesian shipowner. The Indonesian government's policy is to promote the utilisation of natural gas as a marine fuel because of its environmental advantages," said a Wärtsilä statement.

The consortium of CIMC ERIC and its sister company CIMC ORIC and Indonesia's Enviromate Technology International (ETI) were the only consortium that made a bid for the contract. Other consortium's including Japanese company Mitsui OSK Lines with Enersea and Marubeni Corp with SeaNG and cylinder manufacturer Tenaris with South Korean company Hyosung decided not to bid for the contract. *NA*

Measuring Lucy's resistance

The *Lucy Ashton* paddle steamer was fitted with jet engines and made several passes on Gareloch in order to test the relationship between model tests and the full scale reailties. Richard White reports

Over several centuries naval architects have worked to find ways of determining ship resistance. Testing scale models under controlled conditions was an obvious route, but although experimental procedures were developed that allowed a high degree of repeatability of data from towing test runs, the data itself was misleading.

Froude recognised that resistance could be split into two main components, wavemaking as one and various frictional components as the other, and established the relationship between model speed and full scale speed for comparison of wavemaking resistance.

Hull friction in full size was difficult to measure and its relationship to a model in a test tank proved hard to pin down. Using one vessel to tow another was the obvious way, but to get accurate and repeatable data was extremely difficult, despite dedicated and expensive trials programmes.

Froude himself towed one warship from an outrigger on a larger warship. After great difficulties, 'we fought with beasts' recalled Froude; data of usable, though debatable, accuracy were obtained. Comparable work was done in France and Japan. Practical difficulties were enormous, primarily in keeping water disturbance from the towing vessel influencing the towed vessel, in measuring towline forces and ship speed and in avoiding surge in long towlines. From these and other trials various people developed so-called friction lines – graphs for relating model size to full size - and

Richard White - the former Ship and Boat International, editor

fierce controversies arose as to whose method was the most accurate.

By the mid-20th century usable empirical formulae had been developed, but uncertainty remained, and inaccurate estimates of propulsion power or speed on measured mile trials could be expensive in penalties for the shipyard and operating economics for the shipowner.

But, finally a solution was available, in the form of the unlikely combination of a superannuated paddle steamer and four jet engines. A major research programme was undertaken, directed by BSRA, supported by British industry, fully reported at a 1951 RINA/IMARE conference by Sir Maurice Denny and published in the 1951 RINA Transactions. Analysing the mass of data from the full scale runs and relating it to scale models in towing tanks took time, so the scientific results were presented in a RINA paper by Conn, Lackenby and Walker in 1953.

Lucy Ashton was a Clyde paddle steamer built by T B Seath in 1888 for a railway company. Its long life was spent in the 'doon the watter' passenger service along the Clyde, finally as an anti-aircraft gun platform during World War II, and its next appointment was to be with a breaker's yard. Its technical attractions for the trials under the auspices of BSRA were its suitable size and shape (length 190ft, beam 21ft, depth 7ft, Cb 0.685, Cp 0.705, Cm 0.972), its speed range of about 5 to 15knots, and as a side wheel paddle steamer its freedom from appendages or hull form compromises for propeller drive. At the maximum speed the Reynold's number would be 3.75 x 10e8, and it was calculated that the total resistance would be in the region of 5.5tons.

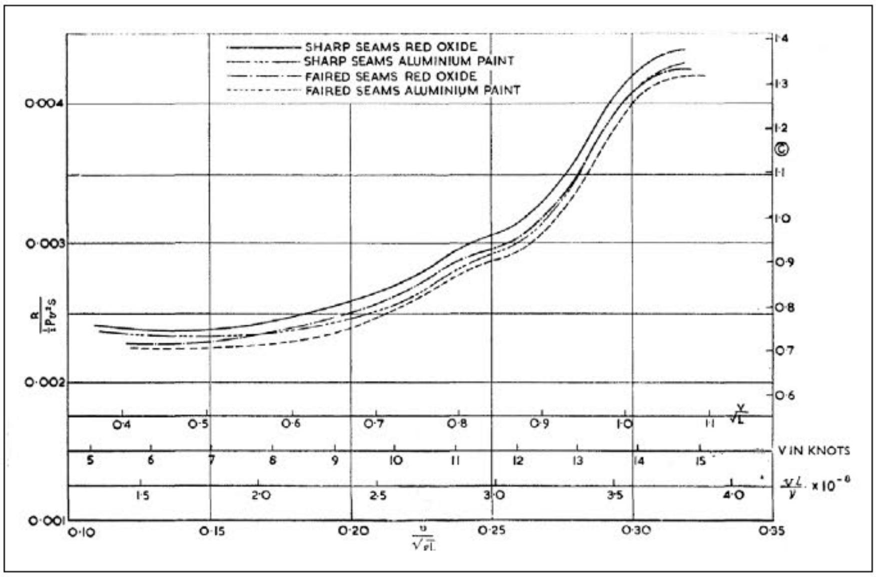
For the trials *Lucy Ashton* was cut down to a bare hull, with just a sound-insulated control cabin on deck. Sand ballast was loaded to give the desired draught and trim, together with a tank for nine tons of fuel, which was thought to be enough for a day's test programme but later increased by three tons.

The engines would provide only forward thrust, so some means had to be found of slowing down this slippery hull at the end of a run. The effective solution was water brakes; steel plates that could be hinged down from the fenders to create a high resistance. A steel gantry was erected across the deck. On the gantry were hung four jet engines in cradles, suspended so that thrust could be measured by load cells.

Two superimposed engines each side were far enough outboard to avoid interference from the jet efflux, though crews of chase boats had to keep a respectful distance or risk being toasted.

The Ministry of Supply provided four Derwent V turbojets. These were an early jet engine used to power fighter aircraft, a few

Lucy Ashton as modified for experiments



Comparison of resistance curves for the four naked hull conditions

iterations from Whittle's pioneering units whose development had been taken over by Rolls-Royce. Fuel consumption was high at about one pound of kerosene fuel per pound of static thrust per hour. Thrust for each engine was 3,600lb, sufficient to drive *Lucy* to the planned speed.

Following conversion *Lucy Ashton* was taken to the Gareloch, a loch off the Clyde, and run repeatedly over the measured mile where the water depth was nearly constant at 17 fathoms. Runs were timed by observers with stopwatches, and by a combined theodolite and movie camera which filmed the transits.

At the end of a run the speed through the water was checked by lowering a pitot head, allowing a current allowance to be made. Wind speed was measured during the run using both hand held and electric anemometers. As a separate experiment, the thickness of the hull boundary layer was measured at two positions in the forward half of the vessel under the flat of the bottom by means of Pitometer logs.

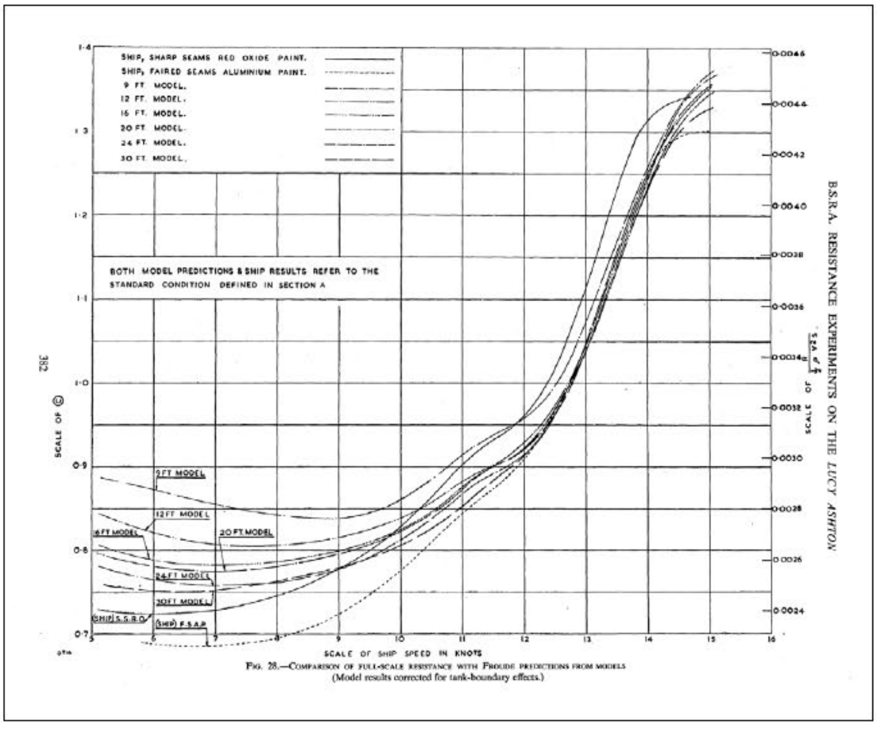
"Measurements of the hull resistance of *Lucy Ashton* over a wide speed range were attempted with the fundamental aim of securing information for the comparison of ship resistance with the resistance predicted by model tests." Great pains were taken to eliminate, or minimise and quantify, anything that could influence the test results. For example, the vessel's wind resistance was assessed first by anchoring and measuring forces in the mooring, then by using this data to calibrate wind tunnel tests with a detailed model. Engine thrusts were recalibrated regularly.

Information on both riveted and smooth hulls was relevant in the 1950s. *Lucy* was lightly plated, about 6mm with flush butts and lapped seams, so trials covered two conditions, one with sharp plate edges, and the other with the hull filled and faired to smoothness. For each condition two surface treatments were tested: red oxide paint and a smoother bituminous aluminium preparation. With the latter coating the effect of fouling on resistance was also measured. The red oxide coated hull was subjected to two further sets of tests, one with dummy twin screw bossings added, the other with twin screw A-brackets and shafts. *Lucy* was taken to Denny's yard in Dumbarton for these modifications between sets of trial runs on the Gareloch.

A major aim of the research was to compare the full scale measurements with models of *Lucy Ashton*'s hull, 9ft, 12ft, 16ft, 20ft and 30ft long.

In the analysis results for the smooth hull were set against the various formulations for the friction line in model testing – Schoenherr, Prandtl-Schlichting, Telfer and Froude. With some caveats a general conclusion was that, "of the skin friction formulations used those due to Schoenherr and Prandtl-Schlichting appear to be the most compatible in that not only do the model results correlate satisfactorily in themselves, but the smooth ship prediction leads to roughness allowances which appear to be in accord with the analysis of the roughness measurements made on the ship." Froude's conclusion that viscous and wavemaking resistance were independent and additive was also upheld.

Comparison of small scale resistance with Froude predictions from models
(Model results corrected for tank boundary effects)



Model length ft.	Skin friction correction	Speed, knots		
		6	10	14
9	Froude	+24·6	+ 8·94	+0·8
	Schoenherr 0·0004 roughness	+22·2	+10·6	+2·7
	Schoenherr smooth	+ 4·9	− 4·9	−7·0
	Telfer	− 3·2	− 5·9	−6·3
12	Froude	+17·7	+ 7·0	−0·6
	Schoenherr 0·0004 roughness	+17·4	+ 9·4	+2·7
	Schoenherr smooth	0	− 5·9	−7·1
	Telfer	− 3·7	− 5·7	−5·9
16	Froude	+12·5	+ 5·4	0
	Schoenherr 0·0004 roughness	+13·5	+ 8·0	+2·2
	Schoenherr smooth	− 3·8	− 7·2	−7·5
	Telfer	− 5·3	− 5·9	−5·1
20	Froude	+11·5	+ 5·0	+1·2
	Schoenherr 0·0004 roughness	+14·4	+ 9·0	+3·2
	Schoenherr smooth	− 3·0	− 6·8	−6·5
	Telfer	− 4·5	− 4·7	−3·9

"*Lucy Ashton*" resistance preditctions from model experiments

(1) The table shows the percentage excess of the predictions over the resistance as measured for ship with faired seams and aluminium paint. (2) The resistance of the ship with sharp seams and red oxide paint was greater than for the condition in Note (1), the excess being 4% at 6knots, 7% at 10 knots and 5% at 14knots. (3) The model resistance is without trip wire.

The biggest models did not prove to be the best in tank testing. For example the 30ft model gave anomalous results, traced to blockage of the rather small tank cross section which led to the development of better blockage corrections. Indeed, when the Teddington No.1 tank was built in 1911, the tank in which much of the comparison work was done, the recommendation had been a maximum model length of 5.5m. With the accuracy of the various model sizes verified, the calibration and recalibration of tanks at different locations could be done with more confidence.

Lucy also caused people to think rather harder about the nature of hull roughness. Clean hull ship resistance was shown to differ from uniform sand roughness, attributed to the wavelength of the roughness and not just the peak to trough measurement. The aluminium paint finish showed about 5% less resistance than the red oxide, while the difference between sharp plate edges and the faired hull, both with the oxide coating, was about 3% in favour of the latter. After the main trials programme had been concluded the ship lay idle for about a month after which there was a growth of short 'grass' on the hull, plus some small limpets. At a typical service speed total resistance had gone up by about 28%, vindicating a traditional rule of thumb of about half a percent per day increase.

A lively discussion followed the presentation of the analysis. Questions about the accuracy of trials measurements were ably answered, and some present queried whether the size of ship and its seventy year old hull form was suitable for extrapolation to ships being designed in the 1950s, but the general conclusion was that the work had been skilfully planned and carried out.

Lucy Ashton was broken up, and the jet engines went back to the Ministry, but the work they did, and the follow-up studies they inspired, have helped to give data from model towing tanks the accuracy and reliability they have today. Even as CFD takes over much of the role formerly played by towing tanks, model testing is still a valuable ship design tool. *NA*

May's foundation feature will be on the design of shallow draught vessels.

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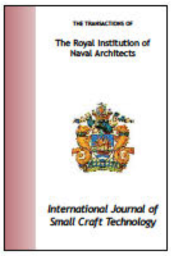

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