MARITIME IMPACT

ISSUE 01–14

THE MAGAZINE FOR CUSTOMERS AND BUSINESS PARTNERS

RESPONSIBILITY

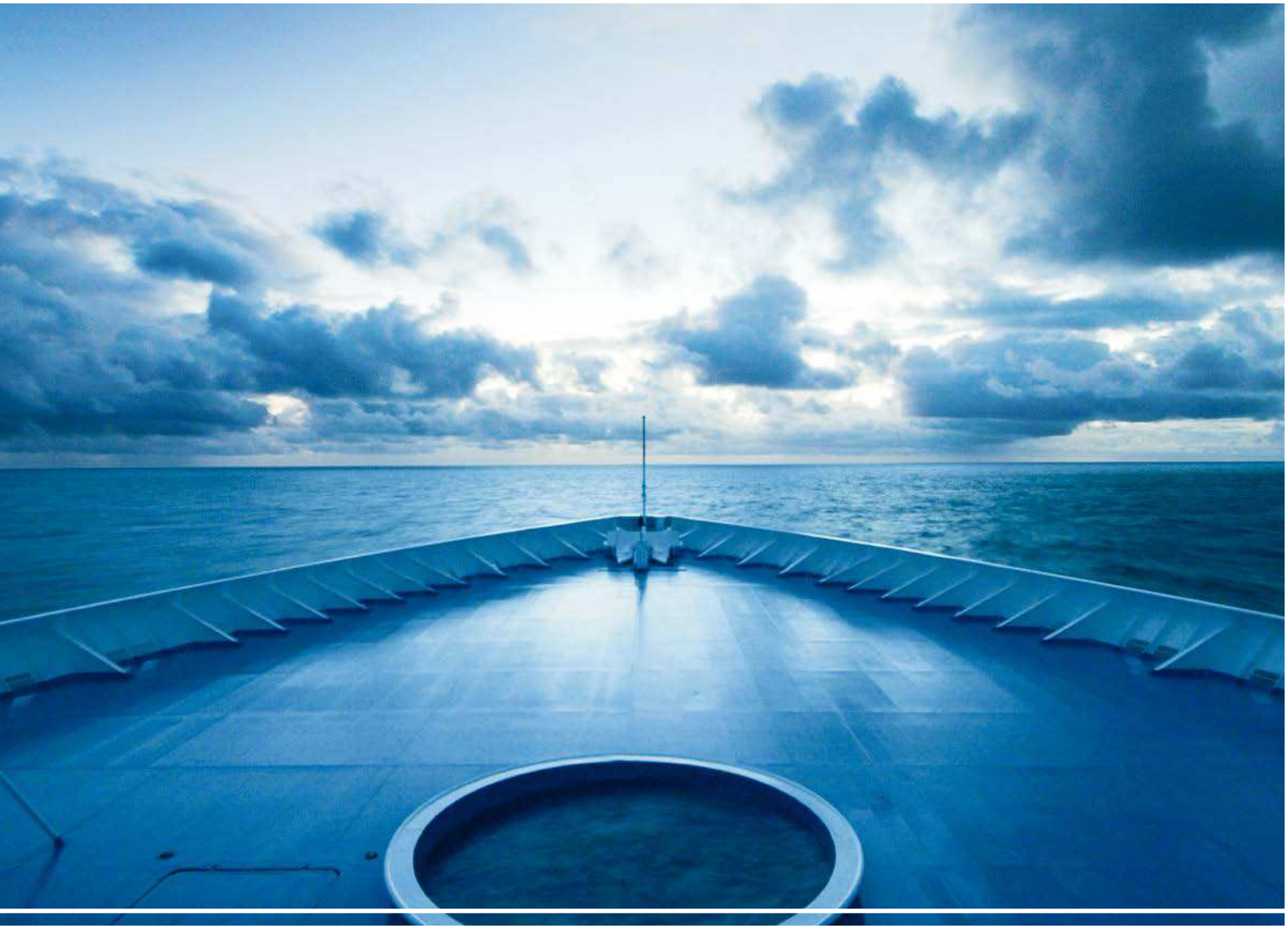
SUSTAINABLE FUTURE

INTERVIEW
CEO Henrik O. Madsen on DNV GL's values and strategies

SAFE OPERATIONS
What the maritime industry can do to improve its track record

TRIM OPTIMISATION
One of the most attractive levers for increased energy efficiency

DNV·GL



TAKE PERFORMANCE TO A NEW LEVEL

To compete in today's maritime market, you need the best possible safety, quality, energy efficiency and environmental performance for your global fleet.

Our global team is your ideal partner for all vessel types and offshore structures, including ship newbuildings and vessels in operation, offshore units and installations, certification for materials and components and, last but not least, maritime advisory services. We deliver the unique competence and technological expertise that you can expect from a global player ready to serve all your needs.

DNV GL global services: Classification • Verification • Technology and innovation • Operational performance • Environmental performance • Safety and risk control

Visit us at SMM, stand no. 207, Hall B4.GF.
www.dnvgl.com

SAFER, SMARTER, GREENER

DNV·GL

Tor E. Svensen
CEO of DNV GL Maritime

Dear Reader,

I am very pleased to introduce the first issue of our new DNV GL magazine for our maritime customers. As we embark on a new chapter of our history, we hope that *MARITIME IMPACT* will be a place where we can share the best that DNV GL has to offer and provide an interesting and enlightening mix of the most important issues facing the maritime world today.

2014 is a true milestone for DNV GL. We celebrate not only the first year of our new organisation but 150 years of our deepest root. These have been a remarkable one and a half centuries. Even though our focus has remained true over this span, to safeguard life, property and the environment, we have been able to adapt to changing customer expectations, market trends, new regulatory requirements, and many new technologies.

At the heart of all of this is the question of whether a class society can create value for customers in the shipping industry. And at DNV GL both our history and our future are focused on offering services that enable our customers to advance.

Through 2014 and moving into 2015 one of our most important ongoing tasks is to develop a common rule set – one that combines the best of the existing rule sets of the two classification societies with modern risk-based principles. This is a massive task, but we see it as essential for the future of DNV GL. The rule set is the signature of a classification society and forms the foundation of our organisation.

The maritime industry has undergone a watershed over the last few years; with owners increasingly focused on bringing ships to market that are innovative in design, maintain high value, have low operating costs and are energy efficient. The merger of DNV GL means that we can bring greater technological expertise, experience and enhanced innovation capabilities to bear on these projects with our partners.

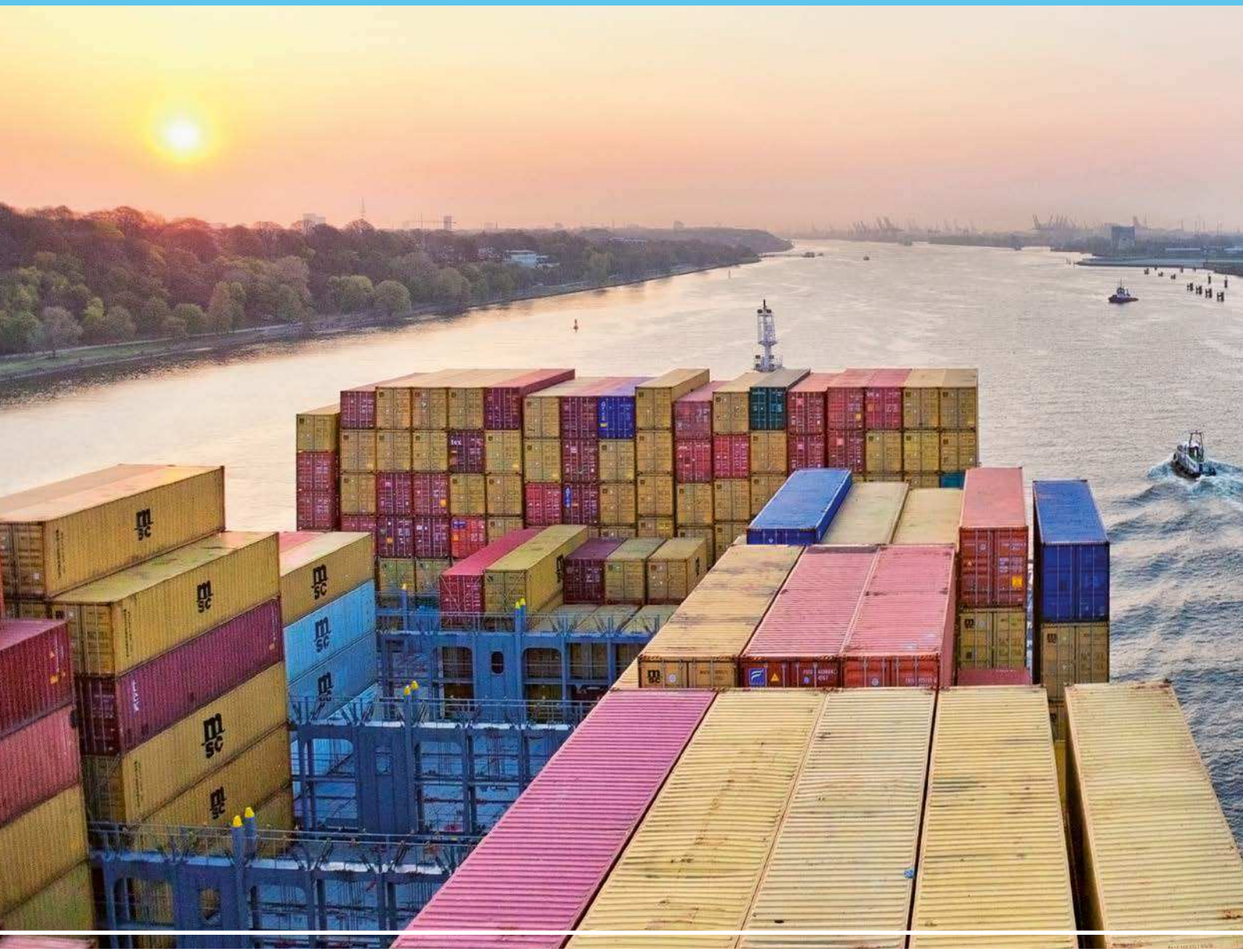
In this issue we present several of these innovations, showcasing how operational, software and design changes, in both newbuildings and existing vessels, can maximise efficiency, ease regulatory compliance and improve safety for ships and crews alike.

As we celebrate 150 years of service to the shipping and offshore industries this year, we are focusing not just on our past but on the future – on developing initiatives such as these alongside our ongoing research and innovation – so that our customers can benefit from our long-term commitment to safety, quality, technology and the environment.

Tor E. Svensen

THE BROADER VIEW

With the amalgamation of Det Norske Veritas and Germanischer Lloyd, Hamburg will be home to the world's largest classification society – DNV GL.



In the summer of 2012, as the merger negotiations began to take shape, the management teams of Germanischer Lloyd and Det Norske Veritas agreed that Hamburg should be home to the newly formed maritime business area of DNV GL. The customers of the merged company are now supported from Germany, where they can benefit from the combined resources and expertise of DNV GL to master the challenges of a difficult business environment.

"The shipping hub of Hamburg was a natural choice for the headquarters of DNV GL's maritime business. Germany has a very strong maritime sector still, with Hamburg as its hub, especially in terms of shipowners, the lines and in finance, not to mention its wider economic importance," says Tor E. Svensen, CEO of DNV GL's maritime business.

As a thriving centre of global sea trade with a history spanning many centuries and a wealth of commercial, engineering and industrial expertise, Hamburg provides ideal conditions for a world-class maritime advisory company which drives innovation and brings a broader view to the world of shipping.

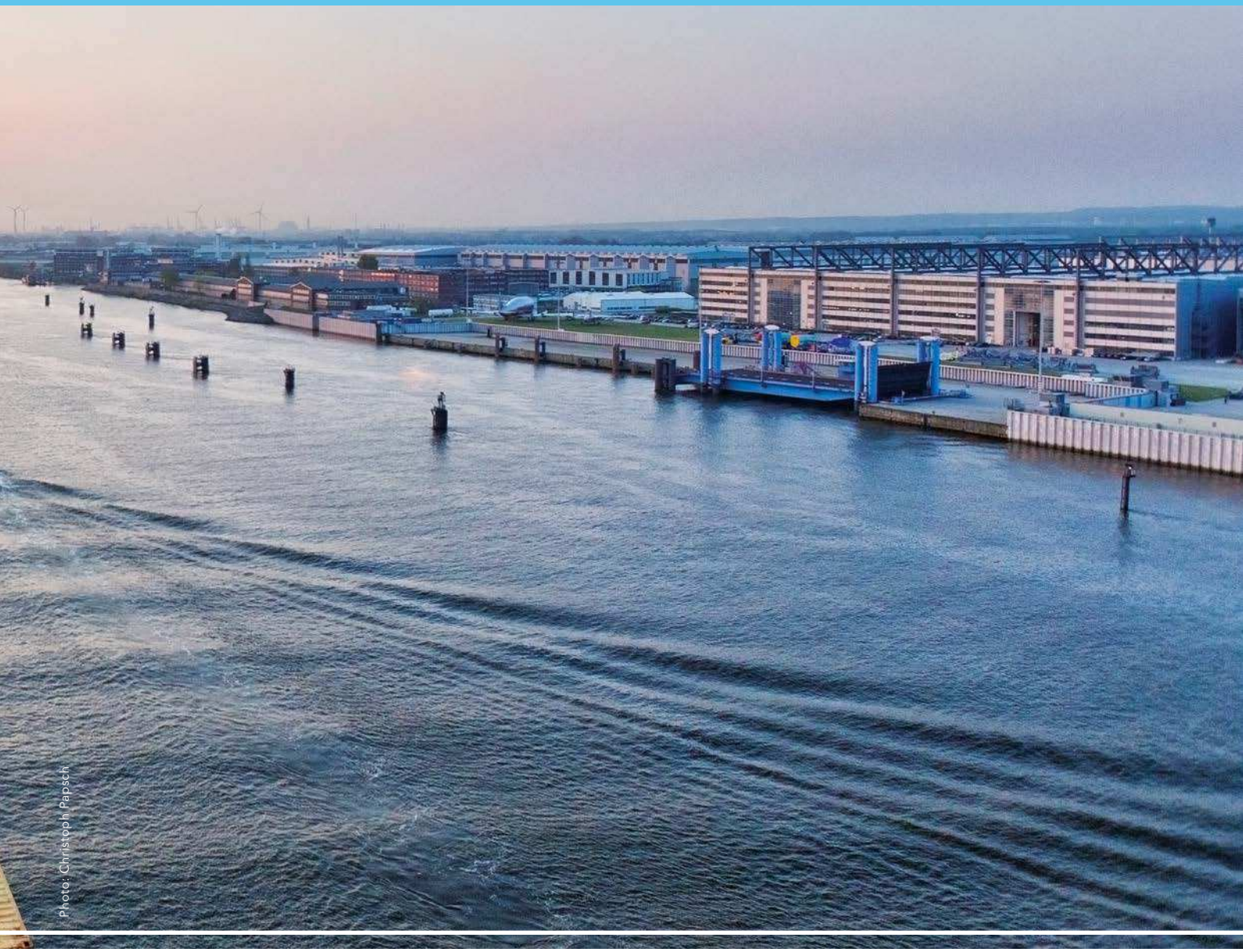


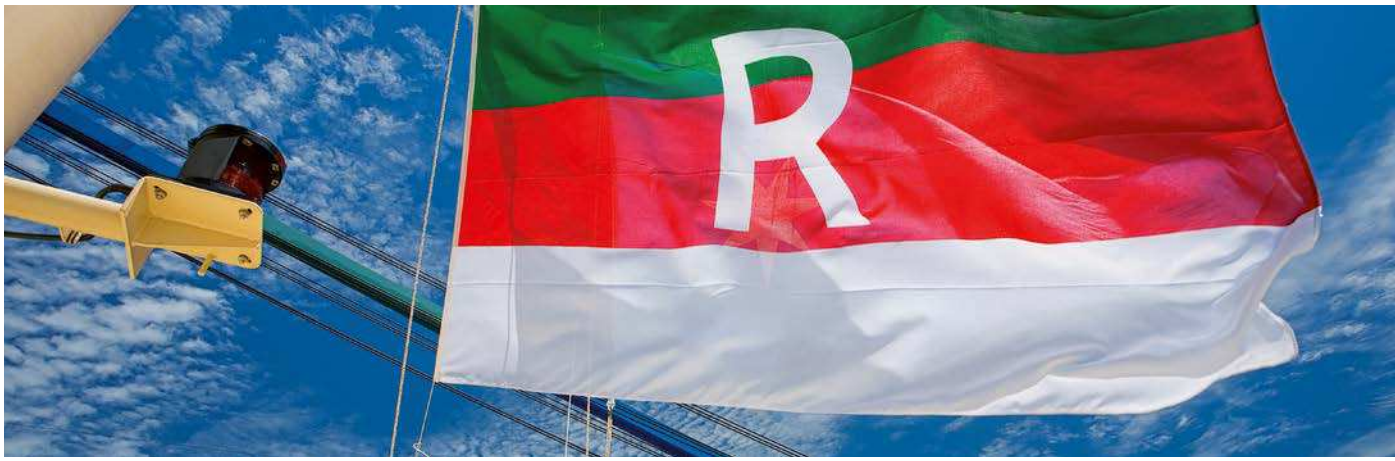
Photo: Christoph Papsch

CONTENTS

12

20

34



40

Standards

IN BRIEF

More than 1,000 distinguished guests gathered at the floating Høvik venue to celebrate DNV GL's double anniversary.

Celebrating a double milestone

To mark the 150th anniversary of the foundation of Det Norske Veritas (DNV) and the first anniversary of its merger with Germanischer Lloyd (GL), DNV GL hosted a gala event in Oslo in the presence of dignitaries, government officials and customers on 14 June.

Over 1,000 guests gathered for the celebration at the Oslo Opera House followed by an evening dinner at DNV GL's headquarters in Høvik.

In his welcome address, President and CEO Henrik O. Madsen said: "Today we celebrate, but it is also a moment to reflect and thank our partners and friends all over the world, who have been on the long journey together with us. Without their support we would not be where we are today."

Norwegian Prime Minister Erna Solberg praised DNV GL's "proud history of safety and sustainability", thanking DNV GL for its "important contribution to Norwegian society". Chairman of the Board Leif-Arne Langøy said: "Trust is our business rationale. As society pushes for a safe and sustainable future, there is a need for institutions like DNV GL that develop recognised standards and build trust."

Norway's Prime Minister Erna Solberg with DNV GL's CEO Henrik O. Madsen (r.) arriving at the party.

ECO Assistant: 5 years – 700,000 tonnes of CO_2 saved

One of DNV GL's most widely used software products, ECO Assistant has improved the profitability and sustainability of over 500 vessels across all ship types, with verified fuel savings.

Over only half a decade in operation, ECO Assistant has already saved in excess of 150 million dollars in fuel costs, with a resulting reduction in CO_2 emissions of 700,000 metric tonnes – the amount of carbon removed from the atmosphere by over 100,000 acres of forest over the same period.

The recent upgrade to ECO Assistant version 4.0 added several new features including eLearning to speed up crew uptake, streamlined reporting and document preparation for regulations, loading computer integration and a fuel calculator to estimate realistic power demand and fuel consumption.

Seatrade awards honour DNV GL and its CEO

DNV GL Group President and Chief Executive Officer Henrik O. Madsen received the coveted Lifetime Achievement Award at the Seatrade Awards in London in April.

Recognised for his "inspirational leadership", the award was presented in the presence of HRH the Princess Royal as well as 400 industry leaders and professionals from around the world.

At the 2014 Seatrade Asia Awards, DNV GL received the Environment Protection Award for its efforts to safeguard the environment and reduce the maritime industry's carbon footprint. The award reflects the industry's recognition of DNV GL's environmental best practices.

Left: Dr Henrik O. Madsen, Group President & CEO, DNV GL, Her Royal Highness The Princess Royal and Koji Sekimizu, Secretary-General, International Maritime Organization (IMO) (f. l.) **Right:** Derek Novak, Vice President Operations, Pacific Division, ABS, Steen Lund, Regional Manager for DNV GL Maritime South East Asia & Pacific and Chris Hayman, Chairman, Seatrade.

New partners: DNV GL's Remi Eriksen (r.) and Stein Eggan, Marine Cybernetics.

DNV GL acquires Marine Cybernetics

DNV GL has acquired Marine Cybernetics, the leading company for third-party testing of computer control systems. The acquisition expands DNV GL's scope of services in the offshore and maritime industries.

Marine Cybernetics was established in 2002 as a spin-off from the Norwegian University of Science and Technology (NTNU). Based in Trondheim, Norway, the company introduced the concept of hardware-in-the-loop testing (HIL) to the maritime and offshore industries. HIL testing significantly reduces the risk of accidents, off-hire costs and non-productive time due to software-related issues.

Energy management study reveals potential

"High savings potential is still waiting to be unlocked," is Julia Kühnbaum's conclusion from the recent Energy Management Study she prepared with her team from Shipping Advisory.

A year after SEEMPs became mandatory for the shipping industry, the study aimed at understanding in detail how the shipping industry has handled the need to increase energy efficiency in a challenging market environment amid tight budgets. Numerous ship managers, owners and operators running more than 2,000 vessels burning around 25 billion US dollars worth of fuel per year participated in the study.

While leading players have reaped energy savings of 10 per cent and more through operational and managerial measures (in addition to slow steaming), and in some cases better charter rates and fleet utilisation, the majority of respondents achieved as little as 1–3 %. Results indicate that these companies focused on SEEMP compliance rather than establishing efficiency throughout their organisations. "There is a lot to learn from industry best practices," concludes Kühnbaum.

Photos: DNV GL

IN BRIEF

Planning for LNG – tomorrow's ship fuel

LNG bunkering stations will soon be a common sight.

One year ago the DNV GL LNG Ready service was officially launched. Supporting shipowners to prepare newbuilds and existing vessels for LNG operation.

Since the launch of the service, the team has used a structured approach to help more than 25 customers interested in LNG as a ship fuel, providing technical and financial decision support and involving more than 35 different vessel designs. In most of these cases, HAZID / Risk Assessment studies have already been performed, and several designs have received Approval in Principle. The highlight of the year was an order for 17 LNG Ready containerships received by Hyundai Heavy Industries (HHI) in Korea from United Arab Shipping Company (UASC) worth over two billion US dollars. Several more positive announcements can be expected this year.

In addition, DNV GL has assisted clients in increasing their in-house technical and operational competence in LNG by providing seminars and workshops involving DNV GL field experts.

"With LNG Ready we transfer our LNG experience and know-how through advisory services and training courses," says Dr Gerd-Michael Würsig, Business Director of LNG-fuelled ships at DNV GL. Martin Wold, DNV GL's project manager for the LNG Ready service, continues: "The projects completed and the positive client feedback prove that our expertise has a real impact on our client's decision-making process."

COMPIT Award 2014

DNV GL has named Marcus Bole the winner of the DNV GL 2014 COMPIT Award.

The British computer-aided design expert from AVEVA Solutions in the UK was honoured for his paper's contribution to the promotion of innovative approaches in ship design at the COMPIT Conference which took place in Redworth Hall, County Durham, last May.

His paper, Regenerating Hull Design Definition from Poor Surface Definitions and other Geometric Representations, addressed inconsistencies in existing models and the difficulty of moving between design platforms.

From left: Stefan Harries, Marcus Bole with the DNV GL 2014 COMPIT Award, and Volker Bertram.

Lui Tuck Yew, Singapore's Minister for Transport (r.), with DNV GL's CEO Henrik O. Madsen.

DNV GL and Singapore collaborate in R&D

DNV GL and the Maritime and Port Authority of Singapore signed a memorandum of understanding on 28 February to promote maritime research, development and innovation.

The signing ceremony took place at the DNV GL 150th anniversary celebrations. The project will focus on LNG research and technology, green ports, eco-friendly shipping, and organising maritime thought-leadership forums to promote green shipping.

Following its inaugural appearance at POSIDONIA, DNV GL is looking forward to welcoming its customers to SMM Hamburg.

DNV GL debuts at POSIDONIA

Greece hosted the maritime world at the POSIDONIA Exhibition 2014 and with 20,000 visitors and 1,800 companies from 96 countries, it was one of the most successful ever. DNV GL took the chance to introduce itself at one of shipping's top events, in the number one ship-owning nation.

Among the prominent social events held throughout the POSIDONIA week from 2 to 6 June was DNV GL's customer reception at the Ecali Club, following the fair's opening ceremony on Monday night. Some 800 guests, including dignitaries such as the German and Norwegian ambassadors, customers, media figures and other stakeholders, were welcomed to the seated buffet dinner. Henrik O. Madsen, Group CEO, Tor E. Svensen, CEO Maritime, Remi Eriksen, Group EVP and COO, and Knut Ørbeck-Nilssen, President Maritime, as well as Nikolaos Boussounis, Regional Manager East Mediterranean, and Athanasios Reisopoulos, Regional Business & Market Development Manager, all greeted the guests. The reception is a very popular event among DNV GL's clients. The weather cooperated and the evening was a thorough success.

At DNV GL's annual press conference, Tor E. Svensen, CEO of DNV GL Maritime, gave an update on the status of the merger, presented the Future of Shipping report and examined the potential of the Connected Ship to improve safety in shipping through online monitoring and decision support. Nikolaos Boussounis, DNV GL Regional Manager East Mediterranean, announced plans to open a new regional centre offering direct access to technical experts (DATE), and to expand the Plan Approval department. Stefan Deucker, Regional Manager Maritime Advisory, looked at retrofitting options to keep existing vessels competitive in a tough market.

DNV GL also announced several new joint projects. Together with GTT, Hyundai Heavy Industries and GasLog, DNV GL is developing a new eco-friendly, energy-efficient LNG carrier for the trading patterns of the future. The World Maritime University (WMU) and DNV GL's Maritime Academy will jointly offer an innovative, blended-learning postgraduate diploma for managers at selected worldwide DNV GL maritime academies. And Greek shipowner W Marine Inc. has ordered a series of post-Panamax bulk carriers based on the Green Dolphin 84S design developed by SDARI and DNV GL's support.

The shallow-draft, fuel-efficient Green Dolphin 84S design by SDARI and DNV GL is able to lift larger cargo lots on a shallower draft and is more efficient in a highly competitive market.

Photos: DNV GL, Hazlan Abdul Hakim – iStockphoto

BUSINESS AREAS MAY CHANGE – VALUES ARE HERE TO STAY

Henrik O. Madsen, President and CEO at DNV GL, explains the recently merged classification society's strategy and looks at the future of shipping.

Taken the 150 years of DNV GL history, what is the key to success?
Henrik O. Madsen: I do not think you can succeed with a company like this if you do not have a very strong purpose and vision and values. For us the purpose has always been to safeguard life, property and the environment. I think having management and staff who live their purpose with passion is a key success factor – and one of the reasons I felt drawn to DNV. Now, 32 years later, I am still here. I could never work for a company whose only purpose is to maximise shareholder value. Also, safety is always at the forefront of our work, closely linked to our strong sustainability concept which determines our direction. On occasion of our 150th anniversary, we started a major initiative to explore themes of strategic relevance to our vision. We will use the findings to engage our stakeholders in a debate about the transition to a safe and sustainable future while empowering our customers to become safer, smarter and greener.

Before we look at the future, we are curious about DNV GL's recent history. Are you satisfied with the results of the DNV GL merger?
Madsen: We had nine months to prepare from the signing in December 2012 until September 2013 and I think we used that time quite well. The organisation was defined very quickly, managers were briefed, and a strategy was communicated to all

"Viking Lady", the Norwegian PSV, uses fuel cell and battery technology for propulsion.

staff in November last year. In parallel, the organisation continued to focus on delivering high quality services to customers, and the level of engagement and commitment among our people remained high. Throughout the merger period our motto was: "Try to keep it simple". We have relied on our own people – no consultants – because who could do a better job than our own employees? The post-merger integration is progressing as planned and the new company is performing well in its first year of operations.

Hamburg is the home of DNV GL's maritime business. What was the reason for this decision?
Madsen: The decision to make Hamburg the maritime headquarters of the new group was made very early in the merger process. Our long-standing, strong relationships with our business partners in Germany will continue to be a top priority for us. We remain committed to the German market, to German owners, and we very much consider Germany our home turf. It is very important for us to maintain our strong regional connections and to have clusters for innovation all around the globe. Hamburg is and remains one of our hubs for innovation, primarily for the maritime segment but also for renewable energy.

How do customers benefit from the merger?
Madsen: Our customers' expectations have increased, so it is important to deliver. We are offering them much-needed benefits in terms of technical advice, risk management and knowledge transfer. With our combined capabilities, DNV GL is able to provide independent services along the whole shipping and energy value chain in more than 100 countries. In the maritime segment alone we now have about 5,000 employees. We are able to take the broader view and work beyond borders, share our expertise and transfer best practices to our customers in various industries worldwide. Another benefit is that we will spend about 125 million euros on R&D and innovation investments and capabilities that will benefit customers and other stakeholders. In addition, we are working on longer-term projects such as our common rule set for ships. We hope to have a draft ready by the end of year. Our aim is to deliver the best of quality and service.

Will the harmonisation of DNV's and GL's classification rules bring about any extra work for shipowners?
Madsen: Our intention in bringing the two rule sets together is certainly not to place any extra burdens on shipowners. This is a massive task, but we see it as essential for the future of DNV GL. The rule set is the signature of a classification society and forms the foundation of our activities for the future.

Once our common rules enter into force in 2016, we want them to represent the best of what both organisations have developed over our long histories and the most advanced class rules ever. In line with our overall strategic goals, the rule set should enable innovation in technology while improving safety.

We will be looking to combine a new advanced approach with the more traditional prescriptive guidance, so that while construction remains >

Photos: DNV GL, FellowSHIP

> sufficiently predictable, we allow for alternative methods of fulfilling the requirements. We want to enable our customers to meet the challenges of the future in the best way possible while maintaining our role as the standard bearer for safety in the industry.

DNV GL is expanding further. What are future growth markets?
Madsen: Our maritime, and oil and gas business areas continue to deliver strong results and recently achieved eight and nine per cent growth, respectively, exceeding our expectations. Our energy arm is also performing very well and we will focus on investments in renewables, building upon the knowledge and expertise throughout the group. We will make sure to always support innovative solutions that create value and growth for our customers.

Are acquisitions an integral part of growth?
Madsen: Generally, our strategy is that we have enough on board now but there are still technologies which we believe will be useful in the future and where we need to develop competence. So we decided in March in favour of a 27 per cent ownership in StormGeo, a global provider of weather and asset risk management for the offshore, shipping, renewables and aviation sectors. On the renewables side StormGeo's expertise is core to decision support. We also recently acquired Marine Cybernetics, which has unique technology and services for third-party testing of computer-based control systems. This is a game-changing platform for ensuring safe, reliable and efficient offshore and maritime operations. We also acquired a company which has developed a niche technology for accelerated testing of solar panels in California.

DNV GL has identified six key topics for the future. One is the future of shipping. What is it about?
Madsen: These six topics form part of our efforts to broaden our view of the relationship between technology, business and society. The report on the future of shipping addresses our ambition for shipping in 2020 and 2050. Research shows that work on board a ship is ten times more dangerous than working in a land-based industrial plant in a developed country, something the shipping industry should not be satisfied with. This is why shipping has to go for safety.

DNV GL has been promoting LNG as a ship fuel for years. Are you pleased with the development?
Madsen: Yes, very much so. Our experience with LNG has grown over the years and with it the conviction that LNG could make a significant contribution to the sustainability of the maritime industry.

LNG has also been spurred on by current developments, primarily sustained high bunker prices, the incoming sulphur reduction targets, and regulations such as the EEDI. At the same time shipping's direct customers and the broader public have turned their attention to the impact of global trade and have started to ask for more responsibility and awareness for the environment along the logistic chain, giving added impetus to LNG's growth.

Foundation for the future: DNV GL's new common rules enter into force in 2016.

What are the most pressing issues?
Madsen: To expand LNG shipping networks internationally we need to push the introduction of a standard bunkering solution so a vessel leaving one port can safely and easily bunker at the next. Adoption by ports and shippowners seems to be happening organically and should accelerate over the coming years.

What can classification societies do to support this?
Madsen: I think what we can do is enable the technology and the regulatory framework from an operational perspective. We can help flag states and local governments make sure that owners opting for LNG can count on safe and efficient systems.

On the advisory side we offer our LNG Ready service which guides owners through the assessment of the technical and commercial feasibility of LNG as a fuel for their newbuilds.

> "Six topics form part of our efforts to broaden our view of the relationship between technology, business and society. Shipping has to go for safety."
>
> **Henrik O. Madsen,**
> **President and CEO at DNV GL**

What about other alternative propulsion concepts?
Madsen: We are committed to LNG but it is not the only alternative fuel. For instance, Westfal Larsen Shipping and Stena Line both ordered or converted vessels to run on methanol. In hybrid technologies we have been surprised by the rapid development of batteries. DNV GL was the first classification society to develop rules for ships with batteries on board, a good option for platform support vessels (PSVs). The advantage is in redundancy in case of engine failure. DNV GL's new battery forum now has about 80 industry participants. As the PSV "Viking Lady" shows, the technology of choice may well be LNG and batteries. A recent project for a ferry designed for thirty-minute trips uses batteries only, which are charged overnight and then partially recharged at each port stop. So we can expect quite a few battery-powered ships in the future.

Is classic optimisation still more promising than a truly alternative drive concept?
Madsen: Let me say I am happy that shipyards have adopted so much new technology. Many existing ships still offer potential for optimisation, such as coatings since 70 per cent of all resistance is caused by friction. We can expect some radically new ideas to come around, and we really want to support energy conservation, so we definitely support technologies such as batteries.

HENRIK O. MADSEN

- Dr Henrik O. Madsen began his career at DNV in Oslo in 1982 as Chief Scientist in Structural Reliability Analysis. He has headed all major business areas at DNV and the Research division. He has also served as Regional Manager in Japan and Denmark. In May 2006 Dr Madsen was appointed President and CEO of DNV. Following the merger of DNV and GL in September 2013, Dr Madsen became President and CEO of the new combined company DNV GL.
- Dr Madsen has a PhD in civil and structural engineering from the Technical University of Denmark, where he was also Professor of Structural Mechanics. He has published several books and more than 80 papers on his fields of expertise. Dr Madsen is a member of the World Business Council for Sustainable Development and its Focus Area Core Team for Energy and Climate.

Photos: DNV GL, Nightman1965 - Fotolia

OUR FIRST YEAR AS A MERGED COMPANY

From its deepest roots in the maritime sector, DNV GL has been promoting safety, providing innovation, and protecting the environment for 150 years. Always adding new dimensions to its business, DNV GL expands its horizons by offering customers a broader view.

On behalf of IMO,

the International Maritime Organization, I am pleased to congratulate DNV GL on its 150th anniversary.

Det Norske Veritas was formed 150 years ago and Germanischer Lloyd is of a similar age. These two significant classification societies merged last year, combining their proud history of knowledge and experience to provide solutions to the future challenges faced by the shipping industry.

Many maritime administrations put their trust in DNV GL, and have delegated tasks to them in relation to the certification of ships according to IMO Conventions and Codes. DNV GL is authorised by more than 80 administrations to issue certificates on their behalf and attends most IMO committee and sub-committee meetings, either as representatives of IACS or as advisors to national administrations. DNV GL advises shipowners on how best to comply with the globally applicable IMO regulations. IMO is pleased to acknowledge 150 years of hard work for the industry and many decades of close collaboration. It is, indeed, a remarkable anniversary.

The shipping industry will face many significant challenges and transitions in the years to come. And, in my view, the application of new technology and innovation will be crucial in addressing them. Shipping places a great deal of trust that DNV GL will continue to provide new tools to improve safety and enhance performance throughout the maritime industry.

And, as a pioneer in so many aspects of the shipping and offshore business, not to mention renewable energy and business assurance, DNV GL's outstanding technical expertise and vision is relied on not just in the maritime industry but by many others, too.

"Shipping places a great deal of trust that DNV GL will continue to provide new tools to improve safety and enhance performance throughout the maritime industry."

Koji Sekimizu, Secretary General, International Maritime Organization

We look forward to many more years of collaboration for a safer, smarter and greener future and wish you all the best of luck for the years to come.

Finally, we hope that our common work will secure the path for the maritime industry to be, at all times, a safe, sustainable and significant part of the global economy. Congratulations once again.

Koji Sekimizu, Secretary General,
International Maritime Organization

DNV GL through the times

Maritime

1864

Det Norske Veritas (DNV) is established by Norwegian insurance companies as a national alternative to foreign classification societies.

1867

Germanischer Lloyd (GL) is founded in Hamburg by a group of 600 shipowners, shipbuilders and insurers.

1870

Steamships are introduced in the 1870s, and most of the sailing ships are phased out by the 1920s.

1872

Samuel Plimsoll starts the process leading to compulsory load lines on every British ship, put into force in 1891.

GL's headquarters move to Berlin, where they will remain until 1945.

1864 – 80

First phase of growth, both in shipping in general and in the DNV-classed fleet.

Photos: Fotolia, IMO

DNV GL through the times

1883 – 93

1883: Norway has the third-largest fleet in the world, measured in registered tonnage.

1888: The first DNV surveyor is stationed in China.

1893: GL adds its first motorised ship, the gaff schooner Frieda, to the registry.

1900 – 07

1900: Close to 100 per cent of the DNV-classed ships belong to Scandinavian shipowners.

1907: DNV loosens its ties to the insurance clubs and becomes a regular certification and classification society.

1910 – 12

1910: The Norwegian parliament votes on regulations for compulsory Norwegian load lines.

1912: Following the Titanic disaster, safety at sea becomes the subject of increasing public concern and grows from simply safeguarding the ship to safeguarding passengers.

1914

The first International Convention for the Safety of Life at Sea (SOLAS) is adopted in response to the sinking of the Titanic.

GL has some ten per cent of the world's merchant fleet in class.

1920

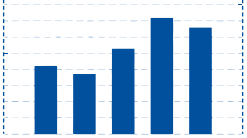
From 1920 to 1940, diesel engines are introduced as propulsion on new ships. DNV is quick to adopt this new technology and "engineering surveyors" are recruited.

1927

KEMA is established as the Dutch electricity industry's Arnhem-based test house by provincial and large municipal authorities that own electricity companies and a number of private power generators.

1953

As the first classification society to do so, DNV publishes new rules, based on an analytical and theoretical scientific approach.



1954

DNV takes a significant and pioneering step by establishing a dedicated research department.

1964

DNV is finally united in one headquarters. The DNV fleet grows to almost 20 million gross tonnes (GT), twice as much as in 1960.

GL is the first classification society to develop rules, new test methods and a class notation AUT, for unattended machinery spaces.

1967 – 68

1967: The golden age for both shipping and DNV. The internationalisation and expansion of the society take off.

1968: IACS is founded in Oslo, GL holds the chairmanship for the first two years of the association's existence.

Energy

1969

KEMA already possesses the biggest short-circuit laboratory in the world and starts the construction of a new lab, still known today as the world's biggest short-circuit laboratory.

1984

Based on analysis harnessing the increasing power of computers, GL introduces the COLL notation, the first which indicates the collision resistance of a ship.

Certification

1989 – 90

The fall of the Berlin wall unites the East German class society DSRK, founded after the separation of Germany, with GL.

1990

The ISO standards are introduced and DNV quickly grows its management system certification activities.

KEMA expands its activities internationally and acquires ABB's power test laboratory in Chalfont, in the United States.

1997

Managing risk is introduced as DNV's corporate promise, reflecting DNV's core competence of identifying, assessing and managing risk.

2002

The number of DNV-classed vessels passes 5,000.

2009

KEMA acquires Gas Engineering Services from Gasunie and sells part of its testing and certification activities to the German company DEKRA.

2010

DNV acquires Behnke, Erdman & Whitaker (BEW) Engineering to strengthen its position within solar, wind, power transmission and grid integration.

DNV opens its Clean Technology Centre in Singapore.

2010

The Deepwater Horizon accident in the Gulf of Mexico.

GL Noble Denton is launched. The new company formed after the merger of oil and gas independent technical advisor Noble Denton with GL.

2011

A report is submitted with DNV's conclusions of its forensic examination of the Deepwater Horizon blowout preventer.

DNV acquires 74.3 per cent of the shares in KEMA, creating a world-leading consulting and certification company within the cleaner energy, sustainability, power generation, transmission and distribution sectors.

2012

The DNV Group is established with three separate operating companies: DNV Maritime and Oil & Gas, DNV Business Assurance and DNV KEMA Energy & Sustainability.

DNV and GL announce their merger agreement.

1927

Working as part of the Association of International Registers, GL adds the classification of non-military aircraft to its activities. This lasts until the end of World War II.

1938

As the Netherlands' electricity infrastructure continues to develop, KEMA grows with it. In the 1930s, the short-circuit lab is built to carry out tests at high voltages.

1940

During World War II, DNV is divided in two; one half in Newcastle, UK, and one half remains in occupied Norway. This leads to a close co-operation with Lloyd's.

1945

After the war, this co-operation culminates in a proposal by Lloyd's to buy DNV, and thereafter to a liberalisation process in DNV and the work aimed at developing new class rules. The co-operation between Lloyd's and DNV is subsequently terminated in 1952.

1945 – 49

1945: Provisional GL headquarters are established in Hamburg, following the loss of the Berlin HQ.

1948: The International Maritime Organization (IMO) is created.

1949: GL's decision to return to Hamburg is made permanent.

1951

Georg F. Vedeler is appointed Managing Director of DNV. He introduces a scientific approach to ship construction. His vision is to build safer ships in a more profitable way.

1970

DNV enters the oil business, in both the offshore installations and cargo sectors, including pipelines and vessels. This develops into a new important market.

1973 – 76

GL begins to provide technical services to the oil and gas industry, including assessing the design and supervising the installation of the "Nordsee" offshore research platform and the first German oil platforms.

1975 – 79

The Berge Istra (**1975**) and Berge Vanga (**1979**) accidents occur.

1977: Wind energy services are first added to GL's portfolio.

1978: DNV becomes an independent foundation.

Internationalisation

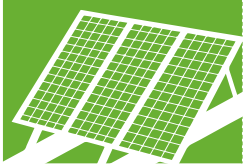
1980

The Alexander L. Kielland platform disaster in the North Sea occurs. Regulations are subsequently improved.

1981

DNV Petroleum Services is established, adding marine fuel management to DNV's expertise.

Sustainability



2004

DNV becomes the first company to be accredited by the United Nations Framework Convention on Climate Change to validate climate change mitigation projects under the CDM (Clean Development Mechanism) scheme.

2004

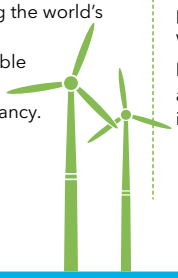
Risk-based-certification is introduced, representing a revitalisation of management system certification.

2005

DNV acquires Cortest Columbus Technologies (CCT) – specialising in corrosion control, pipeline and plant integrity analyses and material evaluation for the pipeline industry.

2007– 09

GL acquires Hélimax, Windtest and merges with Garrad Hassan creating the world's largest renewable energy consultancy.



2008

DNV acquires Global Energy Concepts, a US-based wind power consulting firm with 95 employees.

DNV is approved to accredit hospitals in the US.

Photos: Fotolia, IMO

2013–14 DNV GL's first year as a merged company

On 12 September, the DNV and GL merger is official. The first ever merger of two IACS classification societies creates the world's largest fleet in class of some 260 million GT. The new organisation boasts some 16,000 employees worldwide, offering leading services across many industries, including the maritime, oil and gas, renewable energy and business assurance sectors.

The leadership of the DNV GL Group views the merger as a fountain of youth that will bring forth the dynamics of new opportunities – by opening up a much broader view.

On this horizon, the DNV GL Group has identified six "themes for the future" with the following titles: "A Safe and Sustainable Future", "From Technology to Transformation", "Adaptation to a Changing Climate", "Electrifying the Future", "Arctic – The Next Risk Frontier" and of course "The Future of Shipping", which bundles together the activities of the maritime business area.

Fostering safety awareness will yield better results than rules and regulations alone.

Photo: Gary Blakeley - Fotolia

A NEW SAFETY MINDSET

Despite genuine progress, the shipping sector lags behind other industries in terms of safety. Where can the industry turn to improve its track record?

A more wide-spread willingness to share lessons learned could help improve the industry's safety record.

According to statistics published by IHS Fairplay for the 2003-2012 period, there were about 900 crew and passenger fatalities per year in ship-related accidents, or 1.6 fatalities per 100 ship-years. Other studies indicate that the number of fatalities due to individual accidents is approximately the same as for ship-related accidents. Based on available data, about six crew fatalities occur per 100 million work hours in ship and individual accidents.

More recently, comparisons of data from various sources, such as IMO GISIS, IHS Fairplay, insurance companies and flag states, have revealed a tendency to underreport accidents. Since these data were estimated to cover only 30 to 50 per cent of accidents in shipping, the actual fatality rate could be much higher, especially since only the most severe accidents are likely to be registered.

While maritime safety has improved significantly over the last decades, the industry's performance still lags behind land-based industries. In fact, the current crew fatality rate in shipping is 10 times higher than the 0.6 fatalities per 100 million work hours for industry workers in OECD (Organisation for Economic Co-Operation and Development) countries. There is a growing consensus that the industry is not managing its risks effectively enough and needs to be more aware of emerging challenges and risks. These include handling of increasingly complex technology, regulations not rooted in the reality of impact assessment, and the quality of data used for decision-making.

Obviously, the industry must ask itself whether its tools, methods, competencies and regulatory framework are adequate for managing these challenges and improving its safety performance.

A mature safety culture

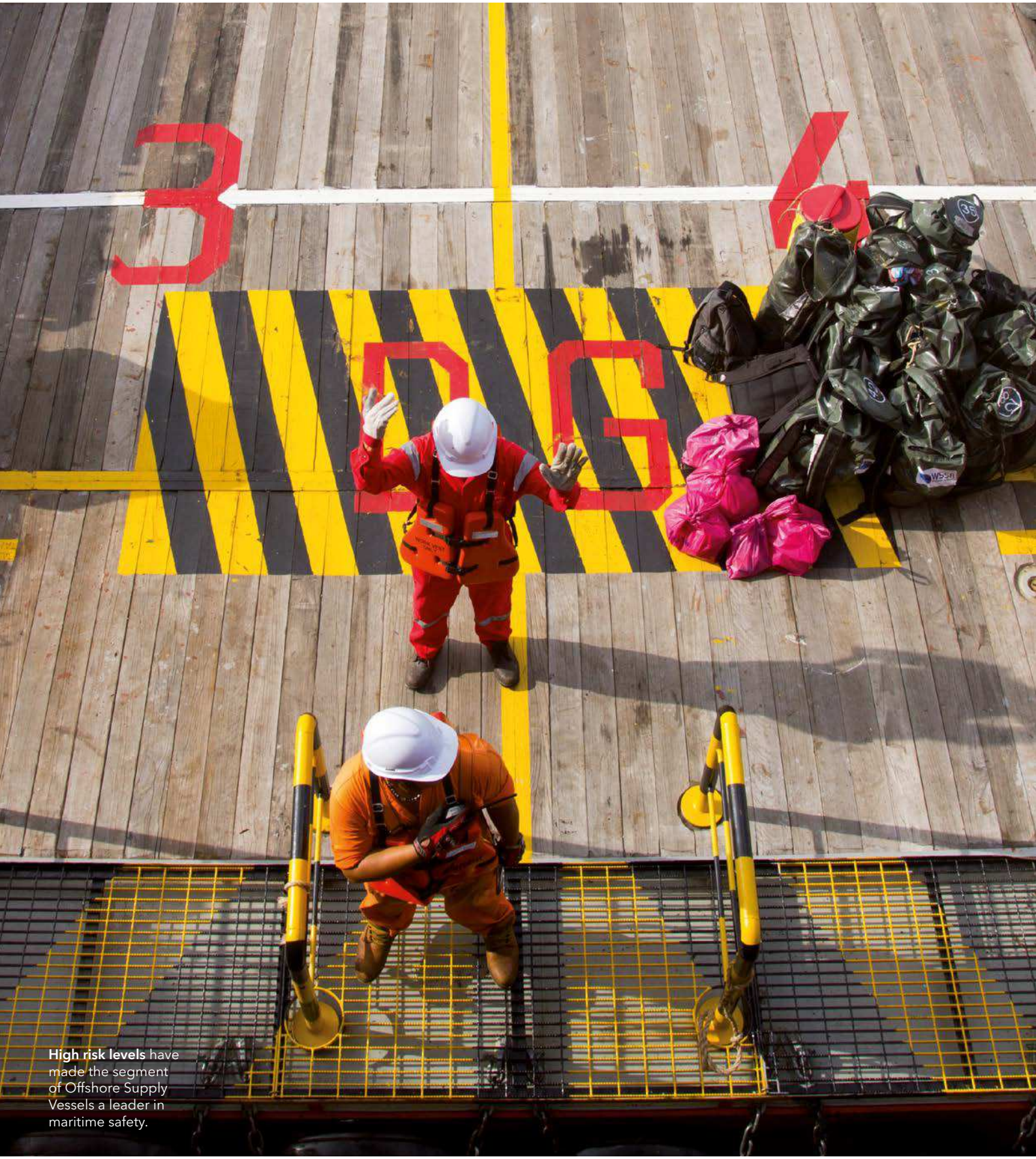
While accident statistics are a common safety assessment method, they have two pitfalls: the first is the reactive nature of statistics; the second is the fact that today statistics often rely on a relatively low number of samples, which compromises credibility.

Trying to prevent accidents by looking at past events breeds a reactive culture that applies safety improvements only after the damage has occurred. The small number of reference incidents on record makes it difficult to define safety levels based on major accidents. These shortcomings can be avoided by building a safety culture which encourages employees to take ownership of their safety ecosystem by actively anticipating and evaluating risks.

To improve its safety performance, the shipping industry must overcome a number of hurdles related to system complexity, inadequate training, and organisational challenges. Despite improved training regimes and better system reliability, there are still too many accidents. Hoping to manage safety risks more successfully, companies have adopted new procedures, including checklists, documentation, reporting systems, etc.

Yet studies indicate that depending on such systems in the absence of a robust safety culture erodes trust, encourages complacency, and leads to misinterpretations of the purpose and objectives of safety management systems. But building a mature safety culture is a complex process. >

Photo: claffra - Fotolia, IMO



High risk levels have made the segment of Offshore Supply Vessels a leader in maritime safety.

LIVES LOST AT SEA

STATUS: Lives lost at sea include fatalities due to ship and occupational accidents in international shipping. Based on statistics from IHS Fairplay for the 2003–2012 period, on average there were 900 crew and passenger fatalities per year, corresponding to 1.6 crew fatalities per 100 ship-years. In addition, several studies report that the number of fatalities due to occupational accidents is approximately the same as for ship-related accidents. Based on available data, we estimate that about six crew fatalities occur per 100 million work hours.

AMBITION: The current crew fatality rate in shipping is 10 times higher than for industry workers in OECD countries (Organisation for Economic Co-operation and Development), which is 0.6 fatalities per 100 million work hours. Seafarers have the right to a safe workplace and passengers have a right to safe transportation. The shipping industry should set targets to achieve parity with safety levels in land-based industries by 2050.

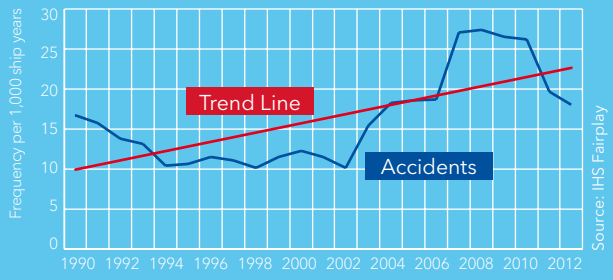
Reduce fatality rates

90%

below present levels

SAFETY TRENDS AND MAJOR ACCIDENTS

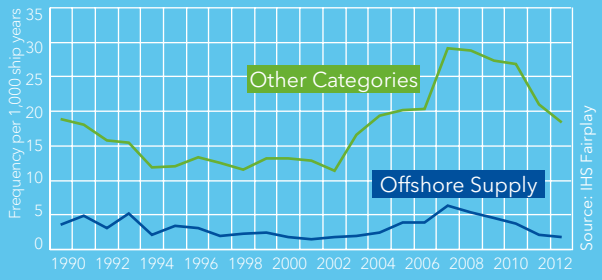
In spite of recent improvements, the overall accident trend line for most vessel types continues to rise, indicating a need to take further action.



All vessels, excluding the categories Fishing and Miscellaneous (1990–2012)

BIG DIFFERENCES BETWEEN VESSEL CATEGORIES

Stringent safety requirements in the Offshore Supply segment prove that safety performance can improve even in the most hazardous environments.



Selected vessel categories; "Other Categories" refer to the categories General Cargo, Tankers, RoRo, Bulk, Container

"Costa Concordia" stands for the most spectacular shipping accident in recent years and revealed disturbing shortcomings in on-board safety culture.

> A comparison of safety management systems developed by the shipping vs the aviation industry reveals two main differences: the role of human error and a willingness to share lessons learned with the rest of the industry.

Human error – a cause or a symptom?

Incidents are often attributed to human error, either through violation of procedures or improper use of equipment. In fact, in more than 50 per cent of all maritime incidents the direct cause is a navigational error, despite advances in navigational aids. In view of this, by accepting the fact that humans are prone to error and their mistakes indicate a weakness in the system, we can improve the system to address the underlying causes that led to human error.

Unlike the shipping sector, the aviation industry, by analysing the underlying causes of accidents and their contributing factors, has developed a stronger culture of accident investigation, applying lessons learned to minimise risk. The maritime industry, too, often tends to blame accidents on human error, making it difficult to issue safety recommendations that result in long-term improvements.

In a review by the World Maritime University of 41 casualty investigations, unsafe acts or conditions were identified as causal factors in 76 per cent of all cases. Furthermore, investigations had often been terminated prematurely without acknowledging other factors contributing to unsafe actions.

To improve its safety record, the maritime industry needs to evaluate and assess preconditions and contributing factors of human performance. This requires a focused mindset at all stages of a vessel's life, from design to operation, as well as when evaluating successes and failures.

Safety through learning and anticipation

A company with a strong safety culture places great emphasis on identifying potential risks, sharing information and learning from past experiences. This allows it to be proactive in anticipating and avoiding risks and managing crises.

To enable learning it is essential to enforce a vigorous reporting regime that captures every single incident. In addition the industry must foster a culture of sharing information on accidents, near misses, and incidents that could have had severe consequences. Combining these efforts will help the industry design appropriate training programmes and procedures.

In many cases, major accidents have occurred although the risks were known and safety measures were in place. But when multiple barriers fail, the cause is often a combination of inadequate barriers. Effective risk management requires a thorough understanding of all relevant risks so that reliable safety barriers are in place at all times. The offshore industry's structured approach to risk assessment, which maps threats to barriers and evaluates factors that weaken barriers, could serve as an example to the shipping sector.

The way forward

Major accidents remain a key concern of the maritime industry, and moving towards a risk-based approach would be essential. Blaming humans rather than modifying systems is counter-productive. Human performance is variable and must be accounted for when designing systems and procedures.

Advanced risk-based methods, including safety barrier management, are disciplines practised successfully by other industries. The maritime industry should draw on this experience to learn and develop a culture where openness is natural and reporting of accidents and incidents is the norm. A risk-based approach requires systematic reporting of incidents and thorough analysis of their root causes.

The current SOLAS requirements on reporting are conditional on the judgement of the flag state, "when it judges that such information may assist in determining what changes in the present convention might be desirable". An objective analysis of current regulations to identify specific weaknesses and limitations would certainly help the maritime industry bring its safety thinking up-to-date, demonstrate its commitment to understanding the causes of accidents, and protect human life and health more effectively.

DNV GL Expert
Kay Erik Stokke, Group Leader Maritime Advisory Møre
Safety, Risk and Reliability
Phone: +47 70 11 51
E-Mail: kay.erik.stokke@dnvgl.com

The age of GPS, broadband connectivity and communication satellites revolutionises the shipping world.

SMART INTEGRATION

Information and communication technology (ICT) is pervasive and essential in the shipping world as in daily life today. But the industry hasn't remotely reached the limits of what is possible.

The range of software tools available for shipping today is impressive. For example, the efficiency gains achievable in ship design, and optimisation by using advanced simulation software running on high-powered computers are nothing short of fantastic. Yet, backed by GPS and satellite-based communication, ever increasing computing power and speed, and more sophisticated software applications, new opportunities abound to make shipping even safer, more efficient and more cost-effective.

Modern ICT can help ship crews and owners know more about how their vessels are performing, when to schedule maintenance work, and how to avoid equipment failure. Advanced sensors and actuators and smart, real-time condition monitoring systems can make ship operation, navigation and maintenance more transparent and efficient than ever, helping those in charge make better decisions. Advanced networking technology linking ships with each other and with onshore offices improves remote ship monitoring and route planning and can achieve tighter integration of ship traffic into global supply chain networks. All this is part of a concept DNV GL calls "The Connected Ship".

Big data, smart decisions

In navigation support, the trend is towards integrated bridge systems with comprehensive information and control functions, such as positioning, navigation automation and course keeping, and all that with user-friendly operator interfaces. It may even be possible one day for one officer to perform all key functions alone without extra assistance. Experience shows that having crucial decision support available at a glance in difficult operations such as anchor handling is highly effective and benefits safety. Software has long achieved the same status as other onboard assets and requires certification as part of DNV GL class rules.

As more and more onboard equipment comes with software of its own supplying streams of data to centralised control and decision support systems, data volumes increase exponentially. Developing technology capable of processing the resulting "big data" and handling the increasing scope and complexity of systems is thus a core concern.

Modern ship engines replace the camshaft with an electronic valve control system.

Integrating the logistics chain

System automation and replacing mechanical elements with sophisticated electronics, such as "virtual camshafts" in ship engines, improves operational performance and reliability while reducing the costs and risks associated with human error. The vision of the autonomous ship, while controversial, is within reach. But even without unmanned ships, ICT plays a key role in improving competitiveness and sustainability.

Life on board benefits from advanced ICT, as well, with broadband Internet allowing crew members to communicate with their families and use online resources to stay informed, enjoy more entertainment options and educate themselves.

ICT-based innovation in the transport sector goes beyond shipping. In-port processes could benefit tremendously from advanced ITC concepts, improving coordination between ships and road and rail logistics, from arrival planning to cargo handling. The future is wide open for advanced ICT solutions.

DNV GL Expert
Gabriele Manno, Senior Researcher Maritime Transport
Phone: +47 907 04 172
E-Mail: gabriele.manno@dnvgl.com

Photo: MAN Diesel & Turbo SE

Optimising a ship's trim helps minimise water resistance and cuts fuel costs.

TRIM OPTIMISATION – WHAT IS BEHIND IT?

Rising fuel prices and tightening IMO regulations for energy efficiency have made the fuel efficiency of ships a key topic in our industry. All standard references, such as the IMO GHG report or the OCIMF study for emission-mitigating measures list trim optimisation as one of the most attractive levers for increased energy efficiency.

Trim optimisation is quite popular – and for good reasons: it is easy to refit and generally gives short payback times (typically a few months). But customers are faced with a growing array of vendors using all kinds of incomprehensible expressions. Simple advice: Don't be blinded by science, don't be impressed by a smoke screen of jargon. We will try to give a simple introduction to available options and the associated pros and cons.

The database is the key

Finding the best trim for a ship is by no means a trivial task. There is no single trim suitable for all speeds, displacements or water depths. The commercial trim optimisation tools available on the market vary in price, ease of use, fundamental approach and performance but have two key elements in common:

- A ship-specific database for resistance or power values as a function of speed, draft, trim and possibly other variables.
- A user interface displaying the trim recommendation. Virtually all systems use an intuitive traffic-light scheme for good, acceptable and poor trim options.

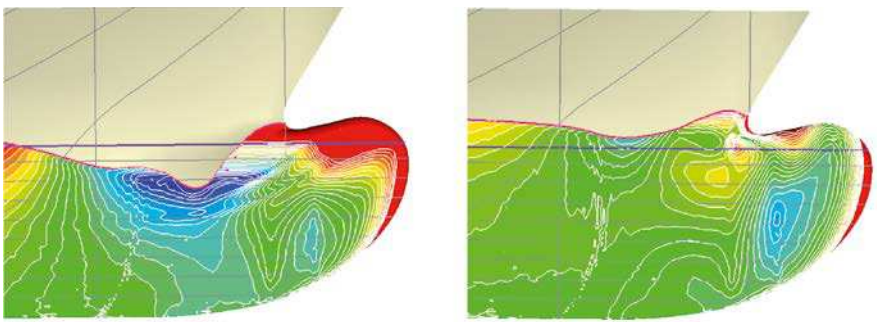
A ship's trim depends on a number of operational parameters. Trim optimisation methods account for speed, displacement (respectively draft), and in rare cases, water depth. Other factors, such as the seaway, are considered as secondary for trim optimisation. In certain cases, such as ferries, or ships trading in shallow waters (e.g. the Baltic Sea), including water depth as a parameter makes sense. In very shallow water, aspects of safe manoeuvring overrule energy efficiency considerations.

The hydrodynamic data should consist of a dense matrix of speed, trim and draft values across all relevant operational combinations. Typically this requires 300 to 400 sets of trim, draft and speed data for deep water, and three to five times as many if shallow-water variations are a concern. The discrete data sets are then linked by smooth interpolation (multi-dimensional response surface in jargon), allowing consistent interpolation for whatever operational conditions are specified by the user.

While each trim optimisation tool must have a hydrodynamic database, the approach chosen to generate this knowledge basis is ultimately decisive with regard to the attainable accuracy and cost benefits of a trim optimisation system.

CFD vs onboard measuring hardware

There are two fundamentally different concepts for trim optimisation tools. The first one uses a >



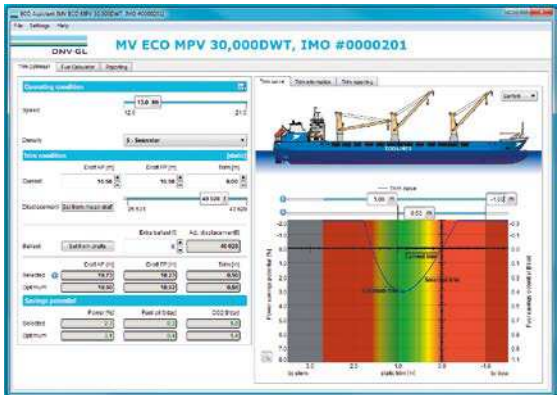
Fluid dynamics simulations reveal where energy is wasted.

Photos: DNV GL, Petzold – foto-dock.com

> hydrodynamic model derived from model tests or numerical simulations (CFD = computational fluid dynamics). This approach does not require any interfaces with onboard systems or sensors to monitor operational parameters, a fact that makes these tools much more cost-effective on most ships, especially when managing an entire fleet of sister vessels. However, the required geometry model may have to be re-engineered from available main dimensions or 3D scanning, Hansen and Hochkirch (2013).

Preferred solution

Model tests are an option in principle but establishing a well-populated database is much more time-consuming and costly than using CFD. In addition, model tests suffer from scale effects (different wave breaking behaviour than on a full-scale ship), a slight accuracy handicap. Generally speaking, CFD is preferable for trim optimisation.



A clearly structured user interface helps users reap the full benefit of ECO Assistant's trim optimisation features.

Legacy CFD tools use simpler flow models (potential flow, panel or Rankine singularity methods) but fail when it comes to breaking waves; they either do not model the propeller at all, or in very crude approximation only, leading to less accurate results. More advanced flow models deliver greater accuracy and thereby better trim recommendations and fuel savings. Such high-fidelity simulations (e.g. full-scale RANS simulations, viscous CFD, two-phase flow, volume-of-fluid (VoF) methods), more aptly called "numerical sea trials", are capable of modelling breaking waves, which is essential in conditions where a bulbous bow partially emerges or a transom stern partially immerses, Hochkirch and Mallol (2013). CFD can exploit the advantages of parallel computing. Well-populated databases can typically be generated within one or two weeks using high-performance computers, a unique advantage compared to model tests or onboard measurements.

The second group of trim optimisation systems rely on real-time readings from onboard sensors. While this approach does not need any information about ship geometry it usually requires rather extensive sensor data and involves some machine learning. The data acquisition systems installed on board must withstand changing ambient conditions, such as wind, waves, currents, water temperatures, etc., which affect the water resistance of the ship. Even the most sophisticated correction methods cannot fully compensate for these uncertainties.

By performing "machine learning" routines, the system is enabled to derive a smooth "curve" from the scattered data. The more parameters involved, the more time it will take the computer to learn. If any ship properties change during the learning period (e.g. due to fouling) the computer will never learn properly.

Typically the user trains the system at specific times, systematically varying draft, trim and speed on days where ambient conditions will not contaminate the data too much. Machine learning works best for ships featuring fewer changes in operational and ambient parameters, such as ferries or cruise vessels.

Integrated or stand-alone

Trim optimisation may come as part of larger nautical advisory systems, e.g. coupled with stowage planning, voyage optimisation and performance monitoring. A single user interface and automated data transfer are nice to have, but trim optimisation software is generally simple to use. An interlinked stowage planning tool is an attractive option since trim optimisation should be achieved without extra ballast.

Similarly, automated recording functions are quite useful. They serve a double purpose by delivering proof of energy-efficient operation (for SEEMP documentation, national and port authorities, or between charterers and shipowners, charterers and cargo owners, etc.), and by encouraging frequent system usage.

Trim optimisation is a highly advisable approach to improving a ship's energy efficiency. CFD-based trim optimisation is the most cost-effective option, particularly for fleets of sister vessels. On the other hand, out-dated potential flow methods should be avoided.

DNV GL Expert
Frank Hennig, Product Manager ECO Solutions
Technology, Knowledge & Governance
Phone: +49 40 36149-8510
E-Mail: frank.hennig@dnvgl.com

DNV GL's combination of hull, trim and performance optimisation tools can achieve substantial fuel savings.

DNV GL's ECO Solutions

Rising regulatory and commercial pressures such as bunker costs are changing the competitive environment of shipping. While every segment in the market has different perspectives, energy efficiency has moved into pole position when yards compete for customers, owners secure financing and charter contracts, and operators strive to improve their bottom-line. DNV GL offers a comprehensive suite of solutions. Customers benefit from the Maritime Advisory service portfolio of special ECO solutions which help mobilise the full potential of ship designs and operations.

ECO RETROFIT

Covering the broad range of retrofit options, the modular ECO Retrofit approach helps to evaluate, identify, prioritise and implement the best retrofit measures tailored to customer needs, vessel and budget:

- Bow form – optimise the bulbous bow with consideration of relevant design constraints
- Engine and auxiliary systems – improve the efficiency of the ship's operating systems based on real energy demand
- Propeller – recommend the best-suited propeller for highest efficiency
- Propulsion improving devices (PIDs) and appendages – evaluate and support decisions of the best-suited PID

ECO ASSISTANT

ECO Assistant combines trim optimisation and fuel consumption data in one easy-to-use, stand-alone software tool for all types of ships. The ship's individualised system provides the optimum trim along with benchmark consumption, based on as few as two operational parameters:

- Optimum trim and fuel consumption indication for any operating condition resulting in real savings
- SEEMP-ready monitoring and reporting of trim performance
- Interfacing capability with all suppliers of loading computers
- Quick familiarisation with the programme thanks to easy e-learning
- Proven and effective state-of-the-art tool with more than 700 installations on board and ashore

ECO LINES

ECO Lines provides a truly optimised hull form that typically delivers several per centage points of improvement in fuel efficiency and delivers maximum value for the shipowners' investment:

- Basis for discussion of targets and design constraints between shipowners, the design team and the shipyard
- Consideration of operating parameters, such as speed and draft, to define the best-suited operating profile
- Full evaluation of typically some 20,000 hull design variations to find the best match for the operational profile
- Aft body variation for best possible hull/propeller interaction
- Detailed analysis and optimisation via fully viscous RANS analysis
- Discussion basis for selection of the most attractive design for the customer's purposes, and expert support for the model testing programme

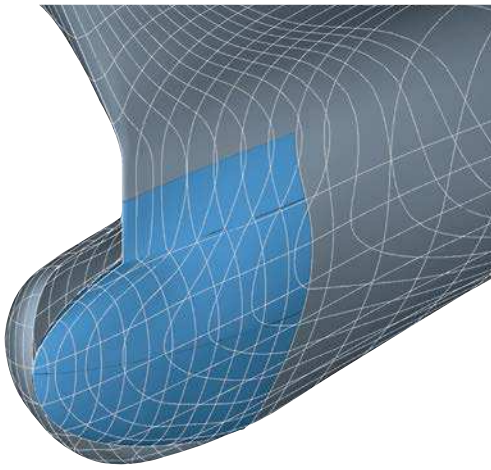
ECO INSIGHT

Fleet performance management aims at optimising ship performance based on the analysis of operational data from on board vessels. ECO Insight follows a flexible and scalable approach based on modules while covering all major ship performance topics such as voyage, vessel, engine and systems performance:

- All major fleet performance topics organised in a logical structure
- Best-practice approach to noon and snapshot reporting, including data plausibility checks
- Regular standardised reporting in a Web-based portal; ship vs fleet comparisons
- Optionally integrates a CFD-based ship model using ECO Assistant technology
- Optional advice, issue awareness and troubleshooting add-ons available

Photo: Hapag-Lloyd

THE INDUSTRY CATCHES ON



Bulbous bow refits are a very promising way of optimising the fuel efficiency of younger ships. DNV GL's expertise in the field has achieved amazing results.

Conserving energy and lowering emissions are currently core concerns for shipowners and ship designers alike, and they must be addressed by cooperating closely. But exchanging the global merchant fleet to cut noxious emissions and improve the operational efficiency of ships is not something that can be achieved overnight. Retrofitting ships in service is therefore a popular option. According to a survey conducted by the German bank HSH Nordbank, 42 per cent of the participating shipowners set great store by retrofitting measures.

The options are manifold

"There are roughly 40 different retrofits a ship can undergo," says Dr Jan-Henrik Hübner, Global Head of Shipping Advisory Practice at DNV GL Maritime Advisory. The most important measures tend to be the straight-forward ones, he observes. "Nearly all shipping companies resort to slow steaming. Another important measure is to train the crews thoroughly so they will focus on efficient ship operation," says Dr Holger Watter, a professor at the "Center for Maritime Studies" at Flensburg University of Applied Sciences. Investing in software-based approaches such as trim optimisation is one of the more affordable solutions. Trim optimisation tools help achieve the best possible ship position in water by providing advice for distributing the cargo on board and taking in ballast water.

"We perform retrofits on nearly all vessels of our fleet, but the scope of these measures depends on the age and future chartering potential of each individual ship," explains Dr Hermann J. Klein, Chief Executive Officer at E.R. Schiffahrt. A successful strategy, especially for younger ships: "Modifying the propeller, bulbous bow and engine of a large container vessel will cost around 1.8 million dollars but will save up to 4.4 million dollars per annum."

The energy savings potential of bulbous bow redesigns and refits was underestimated for a long time, even among experts. "Every other shipowning company is contemplating bulbous bow retrofits. More than half of the top-20 container shipping

(PARTIAL) SHIP HULL OPTIMISATION – TOOLS EMPLOYED

The results of any optimisation project depend on the software tools employed and the skill and experience of the project engineers. Many so-called hull optimisation projects fall short for a variety of reasons:

- Mislabelling: A simple improvement, e.g. guided by CFD (computational fluid dynamics) analyses, is falsely called "optimisation".
- Choice of optimisation objective: A single design point is chosen instead of focusing on annual fuel consumption; then, e.g. only the resistance is minimised rather than the power requirement; or the use of inadequate software instead of high-fidelity CFD code introduces errors into the hydrodynamic assessment of variants.
- Restricted form variation: The investigated form variations depend on the fundamental (parametric) model. An inadequate set-up of the parametric model may then prevent identification of superior designs.

DNV GL Maritime Advisory employs a range of state-of-the-art tools in its optimisation projects:

- FRIENDSHIP-Framework for parametric hull modelling
- FS-Flow – fully non-linear wave resistance code based on potential flow theory
- FINE/Marine as high-fidelity viscous CFD code
- FS-Equilibrium for hydrostatic analyses (as required for constraints in ship stability)
- FS-Optimizer – a toolkit for design space exploration and optimisation offering a variety of optimisation algorithms

The redesign of a ship's bulbous bow is one option to improve the energy efficiency of vessels.

Photos: DNV GL, Marco2811 – Fotolia

companies have begun recalculating their ships' bow designs. I expect up to three quarters of them to decide in favour of a retrofit eventually," says Hübner.

State-of-the-art optimisation for a realistic operational profile rather than a single design point opens the door to significant further fuel savings, including refits. This has been demonstrated in many projects by DNV GL Maritime Advisory. The company completed 16 bow refit projects in 2013, and nine in the first quarter of 2014 alone. Word is spreading in the industry that this is a winning ticket.

A bow refit for a 12,000 TEU containership

One owner realised the benefits of a bulbous bow refit for its entire fleet of 12,000 TEU containerships. The task was to find the best solution for the owner's current operational profile. The company supplied a full year's worth of actual operating data for the ship design. The database of speeds and drafts was condensed to six representative clusters of speed/draft combinations with associated weights ranging between 10 per cent and 25 per cent. The next objective was to reduce the combined fuel consumption for these six operational states, accounting for their time share in a year of operation.

A parametric model was set up for the bow section, employing 28 free parameters. The high number of parameters ensured that a vast number of possible bow shapes could be created. A harmonious fit with the rest of the hull was imposed by applying suitable constraints on the hull/bow intersection. Some 7,500 bow variants were investigated. The optimisation achieved substantial improvements for all considered operational conditions, yielding expected annual fuel savings of ~10% for the actual operational profile.

These savings are higher than typically achieved by bow-only optimisation projects (4–5%), but not uniquely so. As for full hull optimisation projects, the numerical results have been validated many times against "numerical sea trials" (high-fidelity CFD simulations for full-scale ship) and model tests with good agreement. They can thus be considered as reliable.

Depending on the fleet size, employed repair yard and assumed fuel oil price, there are variations in payback times, but all realistic scenarios indicate repayment times between five and 13 months, making refits with optimised bows a good business decision by anybody's standards.

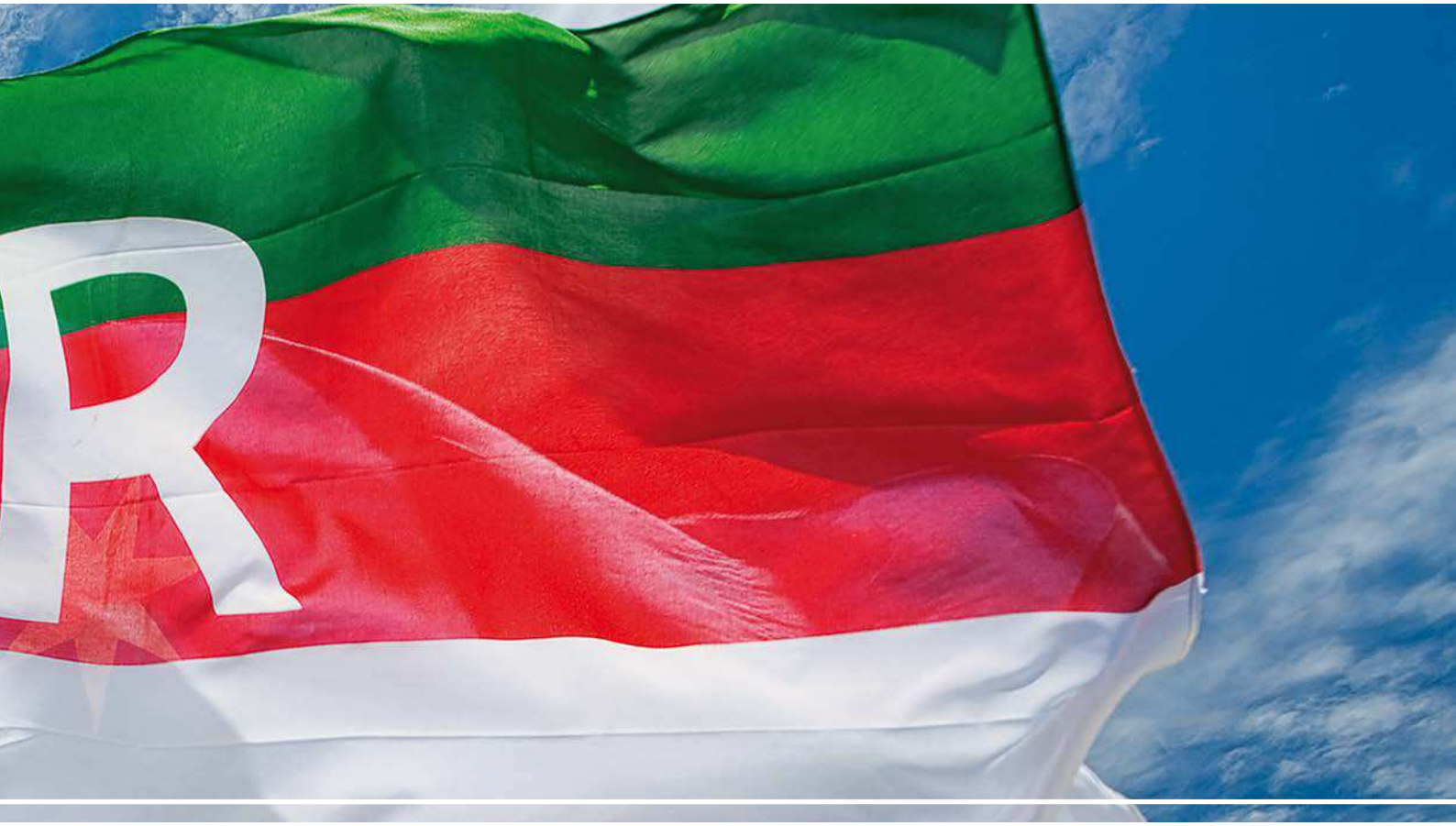
DNV GL Expert
Fridtjof Rohde, Head of Department
Design Concept Advisory
Phone: +49 40 36149-8771,
E-Mail: fridtjof.rohde@dnvgl.com

ADVANTAGE WITH SHIPMANAGER

Rickmers Shipmanagement chose DNV GL's ShipManager™ software for increased efficiency, quality management and improved decision-making.

When Rickmers Shipmanagement made the decision to fully modernise the software supporting their ship management systems, it was not a foregone conclusion that they would choose DNV GL's ShipManager software, despite the fact that 90 per cent of their fleet is classed with DNV GL. "We did a full market analysis study and extensive pilot testing," says Björn Sprotte, Global Head Maritime Services at the Rickmers Group. "We were looking for a scalable, modular-based system that could be rolled out fairly quickly and was easy to use. Furthermore, the system had to be easy to implement, also on third-party vessels," he says.

Although DNV GL is an obvious choice for ship management software, Rickmers made a point of analysing a number of alternatives thoroughly. Mr Sprotte points out that people have tended to have a preconceived notion about ShipManager, which was



Rickmers Shipmanagement relies on DNV GL's software tool ShipManager.

Photo: Rickmers Group

previously called GL ShipManager. "Everybody ties the software to class – they think it's only for vessels classed with DNV GL," says Mr Sprotte. "But that was not the main trigger for us. We rather looked at the system itself, which needed to be, and in our view is, independent of the class."

When the analysis proved ShipManager to be the best solution for Rickmers Shipmanagement, the decision was finally made and the first phase of the implementation started towards the end of 2013.

Ship-centric management

Rickmers Shipmanagement – with its offices in Hamburg and Singapore – provides technical and operational ship management services for ships owned by the Rickmers Group or third-parties. They follow the concept of "ship-centric management" where the vessel is regarded as a production unit within an organisation. Providing safe, efficient and reliable ship operations is the overall objective for all activities – and ShipManager software is one of the tools they use to support this.

"Our plan is to grow our activities and attract new customers. We therefore need a partner to prepare, develop and configure a system that will support our business processes," says Mr Sprotte. "We were looking for an efficiency driver on board and on shore, and professionalisation of the systems. Our goal is to increase the number of ships without having to add significantly more manpower to administration. Thus, a good system should support our processes. The ShipManager system will also help to promote our safety culture with a clear focus on prevention. Moreover, it will support the management in allocating the available resources in the best possible way to meet the expectations of our customers."

As an example of efficiency improvements, he refers to facilitating the reporting on safety and operational performance which is a requirement for many customers today.

Software on board and on shore

The new system is readily available to all users. "In the new system with ShipManager Analyzer we >

"Rickmers Savannah" is one of the initial 50 vessels operated by Rickmers Shipmanagement which will use ShipManager.

> can refer to a fleet view at any time. Management has a console and can see the trends immediately when they need to. This is a huge advantage compared to seeing reports only with delay once a month. We expect that we can respond faster to trends and provide better service to our customers."

"Continually analysing our performance is essential to improving our processes," says Mr Sprotte. "With ShipManager we do not need to transfer data back and forth via e-mails. There is a shared system – bridging the distance between our ships and the teams ashore. For example, we will link the maintenance and procurement processes closer together and allow our crews to track the status at any given time."

Unique offering

Rickmers Shipmanagement is currently using five ShipManager modules: QHSE, Technical, Analyzer, Procurement and Hull. The new modules will initially be implemented on about 50 ships, with further implementations planned. The company is also looking into expanding to more ShipManager modules.

"We needed a reliable and financially strong partner, and most importantly we needed a good system."

Björn Sprotte, Managing Director, Rickmers Shipmanagement

ShipManager

As a world-leading provider of maritime software, DNV GL offers an innovative and broad spectrum of services and expertise. ShipManager covers the maritime industry's needs within technical management, hull integrity management, QHSE, dry docking, procurement, stock control and crewing.

TECHNICAL

ShipManager Technical software enables central, fleet-wide management of equipment, supporting operation, condition monitoring, maintenance and life cycle documentation.

HULL

ShipManager Hull is an advanced hull integrity software solution that supports inspections, repairs and thickness measurement processes based on vessel-specific 3D ship models.

PROCUREMENT

ShipManager Procurement streamlines all maritime procurement activities for spares, services, consumables, etc., keeping everyone informed about the current requisition status.

PROJECTS

ShipManager Projects allows you to manage and document a dry docking project from work item collection and quotations management through to the actual dock work.

QHSE

ShipManager QHSE helps you manage and comply with shipping industry regulations, such as ISM/ISPS, SOLAS, TMSA, classification rules, vetting inspections and Port State Control.

CREWING

ShipManager Crewing supports the full crewing and crew management process, helping you man your vessels, make smart use of your crew pool and comply with rules and regulations.

FINANCE

ShipManager Finance is a flexible and powerful finance system based on Microsoft NAV 2013, with a full range of integrated functions for management accounting and controlling.

ANALYZER

ShipManager Analyzer, a business intelligence tool, extracts data from operational systems for decision support, fleet-wide reporting, comparing costs and performance, etc.

The company has been using the ShipManager Hull module since 2010 and is now looking forward to having a system that unites all modules. Rickmers Shipmanagement has been working closely with DNV GL, giving feedback and making suggestions that have resulted in a unique offering on the market.

"We see DNV GL as a partner rather than a pure supplier," says Mr Sprotte. "The system will need to exchange data with our financial systems. Finding a partner that can support this was one of the critical factors when we selected the product."

The modules currently being implemented are standard modules that require only configuration but no customisation. "There are always small things that need to be adjusted," says Mr Sprotte. "But ShipManager offers a solution that fits to our best-practice-driven processes very well."

DNV GL Contact Info
Web: www.dnvgl.com/shipmanager
E-Mail: maritime.software@dnvgl.com

WHY RICKMERS SHIPMANAGEMENT CHOSE DNV GL SOFTWARE

- Extensive market analysis led to ShipManager
- Innovative and modular system that fulfils the requirements
- Support for the safety culture
- Trustworthy and financially strong partner in DNV GL

WHAT RICKMERS SHIPMANAGEMENT GAINED BY IMPLEMENTING DNV GL SHIPMANAGER

- Increased efficiency that supports fleet growth
- Better support for management decisions
- Transparency and availability of data when needed
- Support for maintenance, procurement, reporting, etc.

Photos: Rickmers Group

MITIGATING RISKS, MINIMISING COSTS

Highly innovative offshore vessel: The renderings show the new design UT 777, which is being developed by Rolls-Royce Marine. DNV GL will assist the designer.

ISLAND NAVIGATOR UT 777

Length:	Approx. 169 m
Moulded breadth:	28.0 m
Moulded depth:	11.7 m
Positioning capability:	DP3
Class:	ICE1B
Accommodation:	91 persons

Rolls-Royce is designing an innovative offshore vessel to stringent class requirements. DNV GL's Maritime Advisory applies advanced load analysis techniques to ensure structural integrity.

In January 2014 Rolls-Royce Marine won an order to provide an integrated design and ship equipment for a highly innovative offshore vessel for the Norwegian shipowner Island Offshore. The new design, called UT 777, is being developed by the offshore ship technology team at Rolls-Royce in Ulsteinvik, Norway, in close cooperation with the owner. The new vessel will be able to tackle harsh weather conditions in the North Sea and undertake a variety of subsea tasks, including top hole drilling, subsea construction and inspection as well as maintenance and repair work in deep waters. It can also be adapted to perform light well intervention tasks.

The vessel is to be built in Japan by Kawasaki Heavy Industries and is scheduled for delivery in 2017. It will be classed by DNV GL and comply with standard ship rules and relevant offshore standards. In addition, it will have the voluntary FMS notation, which requires sophisticated fatigue analyses and adherence to strict specifications for fatigue-critical areas.

TECHNICAL FEATURES

- To be equipped for top hole drilling and maybe also adapted for light well intervention services.
- Enclosed module handling tower to secure a safe and comfortable working environment when operating in harsh conditions.
- The highest level of positioning capability, powered by the seven thrusters, which secures more redundancy than similar existing offshore service vessels.
- Applies the highest comfort class as an offshore service vessel.
- Increased dimension compared with similar existing offshore service vessels owned by Island Offshore.

Three operational conditions

DNV GL Maritime Advisory will assist the designer, Rolls-Royce, with direct wave load and strength calculations to ensure the vessel will withstand the extreme loads generated by the wave environment in the North Sea basin. A global FE model of the entire ship has been established to accurately calculate the ship's response to these waves. Transferring the hydrodynamic loads directly to the FE models makes it possible to define 100-year extreme stresses and evaluate their effects on yielding and buckling. The ship's extreme responses are evaluated for three operational conditions: the transit condition when the vessel is sailing, a 100-year survival condition at field, and an operational condition that combines operational loads with wave loads up to a certain sea state.

Fatigue life calculations are based on wave load analyses for the respective operational and loading conditions, using local fine-mesh models and site-specific wave environments. The FMS notation specifies fatigue requirements for various details of a ship design depending on accessibility for inspection and criticality for hull integrity. For areas that are inaccessible for inspection, the FMS notation prescribes a design fatigue factor (DFF) of 5 or 10, depending on the level of criticality. This means that the design fatigue life must be 5 or 10 times the intended operational life of the ship. This stringent requirement calls for thorough consideration of the fatigue properties of the respective structural sections. Some of the details are predefined by the class notation while others result from the global FE model.

Yet, there is a complexity limit beyond which predictions are approximate at best. A significant number of factors influence the calculated fatigue life, and even direct calculations using wave loads and fine-mesh FE analyses cannot fully eliminate uncertainty in a fatigue life analysis. What sophisticated fatigue calculations in the design phase of a vessel and adherence to strict DFF requirements can do is minimise the risks and costs related to fatigue cracking, provided that the relevant industry standards are upheld in the production process. This will reduce both the overall risk for the owner and the total cost of maintenance.

DNV GL Expert
Ketil Aamnes, Vice President, Regional Manager
Region Norway
Phone: +47 481 78 841
E-Mail: ketil.aamnes@dnvgl.com

Photo: Rolls-Royce

The progressive reduction in propulsion power imposed by the EEDI regulation to protect the environment may be in conflict with the demands of safety. A scientific study by DNV GL investigates the implications.

According to a study commissioned by IMO, by the year 2050 the Energy Efficiency Design Index (EEDI) and the Ship Energy Efficiency Management Plan (SEEMP) will cut global CO_2 emissions by roughly 30 per cent, compared to Business As Usual (BAU) (Fig. 1).

While this is good news, flag states and shipowners' associations have raised the question whether the progressive reductions in propulsion power required by the EEDI wouldn't eventually deprive ships of the power reserves needed to manoeuvre safely in adverse sea conditions. This prompted the International Association of Classification Societies (IACS) and several ship owners' associations to develop a guideline for determining the minimum propulsion power required for safe manoeuvring in heavy seas. A definition of "adverse weather conditions" was also proposed.

Forecasting the manoeuvrability of a ship in adverse conditions is an extremely complex task. Only the two most straight-forward assessment approaches proposed by the IACS (Level 1 – minimum power lines assessment" and Level 2 – simplified assessment) were accepted as an interim solution until the end of 2014, limited to bulk carriers and tankers. The proposed numerical determination of the added resistance in waves according to Level 2 was recognised by IMO but not approved as an alternative to model trials. The Level 3 approach (comprehensive assessment) has not been recognised by IMO.

Defining adverse conditions

Using for example the 2007 Pasha Bulker incident (see box insert, see page 42), several definitions of adverse weather were proposed to IMO. MEPC 65 eventually decided to make the wave height functionally dependent on ship length so that a lower significant wave height applies to ships less than 200 metres in length, and a higher value for larger ships. An agreement which wave and wind conditions are considered to be relevant in this context was, however, not reached.

To overcome the lack of information linking accidents with wave data, collision damage reports from the EU-funded HARDER project were evaluated. They suggested that 99 per cent of all collisions occur at significant wave heights of less than 4.5 metres. Since most accidents occur in coastal waters, significant wave heights for manoeuvring in adverse conditions can be defined accordingly. >

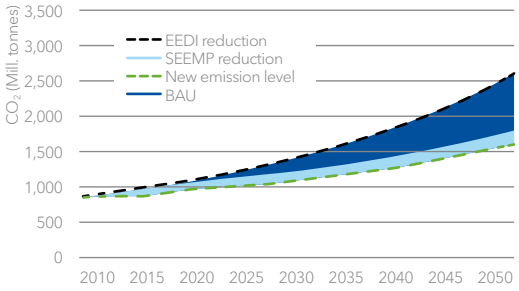


Fig. 1 – World fleet: CO_2 projection for the global fleet, averaged scenario A1B-4 and B2-1. The absolute quantity of CO_2 emissions will continue to increase due to the growth in trade volume and fleet size (source: IMO).

WILL THE EEDI LEAVE SHIPS HELPLESS IN HEAVY SEAS?

Safe manoeuvring of vessels in severe weather must be assured by allowing sufficient propulsion power.

Photo: fresh_water - Fotolia

ENERGY EFFICIENCY DESIGN INDEX (EEDI)

The first proposal for a CO_2 index applying to new ships was submitted by Denmark in April 2008. This index sets out the costs for sea transport, expressed by the CO_2 emissions in relation to the benefit of sea transport, expressed by the product of deadweight and the speed of the ship.

The rules applying to the energy efficiency of new ships, the so-called Energy Efficiency Design Index, entered into force on 1 January 2013 for selected ship types (container carriers, gas tankers, refrigerated ships, bulk carriers, tankers, dry cargo ships).

A globally valid energy efficiency standard had thus been implemented worldwide for the first time. The version for LNG tankers, RoRo ships, RoRo passenger ships as well as cruise ships with unconventional propulsion plants (electrical drive) were passed in May 2013 and will enter into force on 1 January 2015.

The EEDI is calculated for each newbuild and must not exceed the required index, which is prescribed by a reference line. This requirement is tightened progressively in 10 per cent increments every five years beginning in 2015.

> Unfortunately the current data basis is insufficient; onboard observations and statistical information on wave heights in coastal regions are needed.

Minimum power lines

Computing each new ship's behaviour in adverse conditions would be excessively time-consuming. As a workaround the industry developed so-called "minimum power lines", a simple function of ship size and type, whereby any new ship's propulsion power will be considered sufficient if it is above the applicable minimum power line. The lines were derived from the same data sets as the EEDI reference lines, such that 90 per cent of the ships evaluated would meet the new requirement. Fig. 2 gives an example for bulk carriers.

After some discussion, the method was limited to tankers and bulk carriers for the EEDI introductory phase since other ship types are typically equipped with stronger engines. The formula for determining the minimum power is easy to use but fails to address manoeuvrability.

Tests have shown that modern ships with a slightly reduced service speed, especially medium-sized containerships, have difficulty meeting the requirement. A more time-consuming verification process would be required for these ships, the so-called Simplified Method. Therefore it was decided to exclude containerships from the minimum propulsion power requirement during EEDI implementation Phase 0.

As a result of all this, tankers and bulk carriers must achieve an EEDI below the reference line and satisfy the minimum propulsion power requirement. But since the EEDI is primarily a function of propulsion power and deadweight, the progressive tightening of the EEDI requirements as planned conflicts with the minimum power requirement.

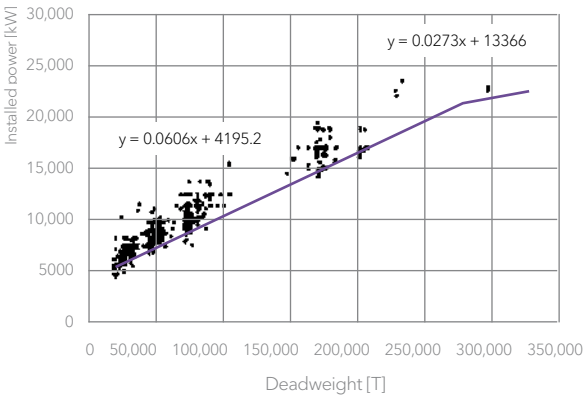


Fig. 2 Bulk carriers above 20,000 dwt: Derived minimum propulsion power line for bulk carriers (Source: IACS).

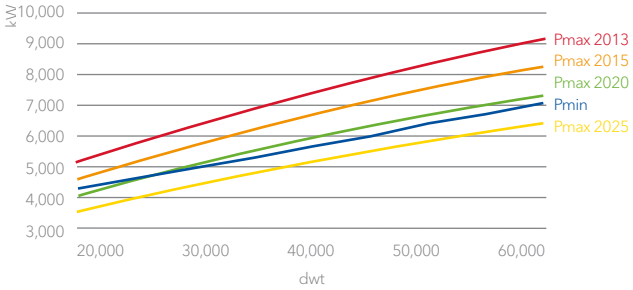


Fig. 3 Bulk carrier power requirements from EEDI regulations: Required propulsion power expressed in relation to the reference line (Pmax) and guideline for safe manoeuvring (Pmin). The example applies to small bulk carriers with an average reference speed of 14.34 knots.

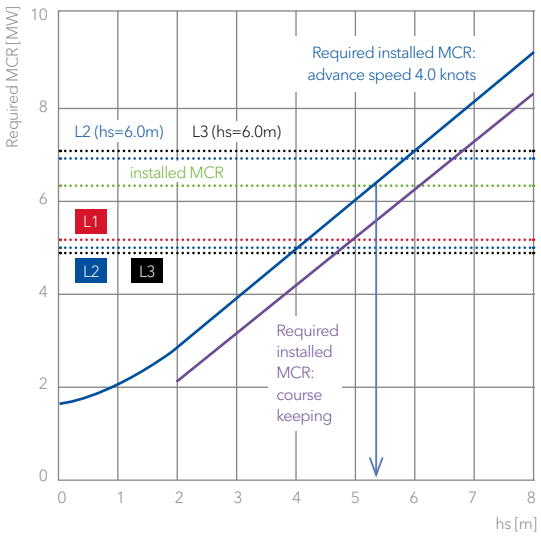


Fig. 4: The required installed propulsion power ("installed MCR") is shown in Level 1 (L1) as a function of the significant wave height separately for the requirements of a minimum speed of 4.0 knots for course keeping. For comparison, the minimum power according to the method of minimum propulsion power (independent of wave height) and the propulsion power values calculated using the simplified assessment (for the required significant wave height of 4.0 metres and for a significant wave height of 6.0 metres) are shown as horizontal lines.

The required propulsion power for course keeping is lower for this ship than the power needed to maintain the advance speed; this is typical for ships with an adequate rudder area. The applicable wave height for the IMO Guidelines was chosen so that the requirements of the L2 and L3 methods could just be met at the minimum propulsion power limit.

PASHA BULKER INCIDENT

An especially well-documented case of grounding in adverse conditions is that of the bulk carrier Pasha Bulker in Australia in 2007. The vessel lay at anchorage off Nobbys Beach, New South Wales, when the weather began to turn for the worse. The wind reached Beaufort 9, with waves eight metres high.

Once the anchor had been weighed, the ship came under way. Although the master attempted to steer the ship away from the coast, the ship was only able to steam approximately parallel to the coast.

After a final attempt to turn into the wind, the ship drifted towards the coast and ran aground. None of the other 49 ships that anchored in the area were grounded. The report provided no details about the manoeuvrability of the ship.

Photo: Tim/Wikipedia

Fig. 3 highlights this conflict for small bulk carriers with an assumed reference average speed of about 14 knots: as of 2025, if not earlier, the minimum propulsion power required for a small bulk carrier to ensure safe manoeuvring will exceed the propulsion power allowed under the EEDI rules. A modification of this regulationt seems necessary.

The simplified assessment method accepted by the IMO assumes that a ship has sufficient installed propulsion power if it achieves a required minimum advance speed in defined head waves and wind, and that this amount of power will also suffice for course-keeping. The required minimum advance speed depends on the rudder area and the lateral and frontal windage areas so that ships with smaller rudder areas or with larger lateral windage areas should attain greater advance speed.

In the case of the small bulk carrier introduced above, the simplified method satisfies the requirements of the simplified assessment method. However, at a significant wave height of six metres, the vessel would no longer meet these requirements.

The challenge remains

The comprehensive assessment method assumes that a ship has sufficient propulsion power when it maintains the required minimum advance speed while keeping the required course in waves and wind from any direction.

Fig. 4 summarises the results for the small bulk carrier example. It clearly shows that the power required for course-keeping is lower than the power needed to maintain advance speed. Applied to the small bulk carrier examples, the various methods yield consistent results: while the IMO requirements are met at significant wave heights of four to five metres, this is not the case with waves above five metres.

The dilemma of EEDI power reduction vs power requirement for safety has yet to be resolved. The significant wave heights initially discussed would most probably make most of the existing ships appear to be unsafe. On the other hand, the current values only apply to a maximum wave height of 5.5 metres and are possibly not strict enough to ensure manoeuvrability. A broader data basis is needed to resolve this issue. Several publicly co-funded R&D projects, including PerSee and SHOPERA, are under way to improve the forecasting of ship manoeuvrability in realistic sea states.

DNV GL Expert
Dr Pierre C. Sames, Director, Technology and R&D
Phone: + 49 40 36149-113
E-Mail: pierre.sames@dnvgl.com

TRAINING AT DNV GL

For the complete range of training courses offered by DNV GL Maritime Academy please visit www.gl-academy.com.

14. – 18.07.14
Superintendent Workshop – Managing Day-to-Day operations
Madrid, ES

15.07.14
Basics of a Quality Management System According to ISO 9001 for Shipping Companies
Piraeus, GR

15. – 16.07.14
HAZOP Leader Course
Singapore, SG

17.07.14
Maritime Security – Developments and Best Management Practices
Genoa, IT

18.07.14
Media Handling for Senior Management
Singapore, SG

21. – 22.07.14
ISM – A Risk Management Approach
Mumbai, IN

21. – 22.07.14
Vetting Inspections for Bulk Carriers
Rome, IT

23. – 24.07.14
Energy Efficient Operation of Ships – Masterclass
Genoa, IT

28.07.14
STCW 2010 Implementation Workshop
Szczecin, PL

29. – 30.07.14
Internal Auditor ISM-ISPS-MLC for Shipping Companies
Gdynia, PL

01. – 02.08.14
Security Awareness Training for Seafarers with Designated Security Duties
Mumbai, IN

05. – 06.08.14
Implementation of an Environmental Management System According to ISO 14001 for Shipping Companies
Szczecin, PL

05. – 06.08.14
Maritime Labour Convention (MLC 2006) Course
Antwerp, BE

12. – 13.08.14
Handling and Transport of Dangerous Goods
Dubai, AE

17.08.14
Navigational Audits
Dubai, AE

17.08.14
Complying with the MLC 2006
Dubai, AE

18.08.14
LNG Carriers
Singapore, SG

19.08.14
LPG Carriers
Singapore, SG

20. – 22.08.14
Hull Structure and Strength – Concept and Rules
Mumbai, IN

28.08.14
Damages to the Hull Structure
Istanbul, TR

29. – 30.08.14
Internal Auditor ISO 50001 for Shipping Companies
Mumbai, IN

01. – 02.09.14
Designated Person Ashore (DPA) Training Course
Copenhagen, DK

02. – 04.09.14
Company/Ship Security Officer (CSO/SSO) Training Course
Piraeus, GR

03. – 04.09.14
ISM Internal Auditor – Survey Simulator Workshop
Gdynia, PL

05.09.14
Ship Structural Design
Singapore, SG

09. – 11.09.14
Hull Structure Course
Rotterdam, NL

09.09.14
Introduction to Energy Efficiency
Mumbai, IN

09. – 10.09.14
ISM Internal Auditor
Piraeus, GR

10.09.14
Damages to Machinery and Repairs
Hamburg, DE

11.09.14
Asbestos – A Hidden Hazard on Board Ships
Hamburg, DE

11.09.14
How Lean is Your Safety Management System (SMS)?
Hamburg, DE

12.09.14
New EU Regulation on Ship Recycling
Hamburg, DE

16. – 18.09.14
Bulk Carrier Hull Inspection – Survey Simulator Workshop
Gdynia, PL

17.09.14
Introduction to the System of Maritime Regulations
Hamburg, DE

17. – 18.09.14
OHSAS 18001 for Shipping Companies
Istanbul, TR

22. – 23.09.14
ISM Compact Course
Rotterdam, NL

EVENTS & EXHIBITIONS

Please visit www.dnvgl.com/news-events for a constantly updated list of events, conferences and exhibitions.

07. – 11.07.14
IMarEST European International Submarine Races (eISR)
Gosport, GB

12. – 13.08.14
Americas Offshore Support Journal Conference
Houston, USA

25. – 28.08.14
ONS 2014
Stavanger, NO

09.09.14
TradeWinds Offshore Marine Forum
Oslo, NO

09. – 12.09.14
SMM
Hamburg, DE

10. – 11.09.14
2nd Offshore Oil and Gas Engineering Conference
Houston, USA

15. – 18.09.14
Rio Oil & Gas 2014
Rio de Janeiro, BR

21. – 23.09.14
Dry Bulk Europe
Amsterdam, NL

22. – 25.09.14
3rd Annual Offshore Support Vessels Middle East
Dubai, AE

24. – 27.09.14
Monaco Yacht Show
Monte Carlo, MC

28. – 30.09.14
NuTTS
Marstad, SE

10. – 11.09.14
Global Liner Shipping Asia Conference
Singapore, SG

25. – 26.09.14
Ballast Water Management Technology
Miami, USA

08. – 09.10.14
Asian Offshore Support Journal Conference
Singapore, SG

10.10.14
Asian Dynamic Positioning Conference
Singapore, SG

14.10.14
2nd GreenPort Cruise
Barcelona, ES

15. – 17.10.14
2nd International Conference on Maritime Technology and Engineering MARTECH 2014
Lisbon, PT

15. – 17.10.14
9th GreenPort Congress
Barcelona, ES

21. – 24.10.14
Shiptec China 2014
Dalian, CN

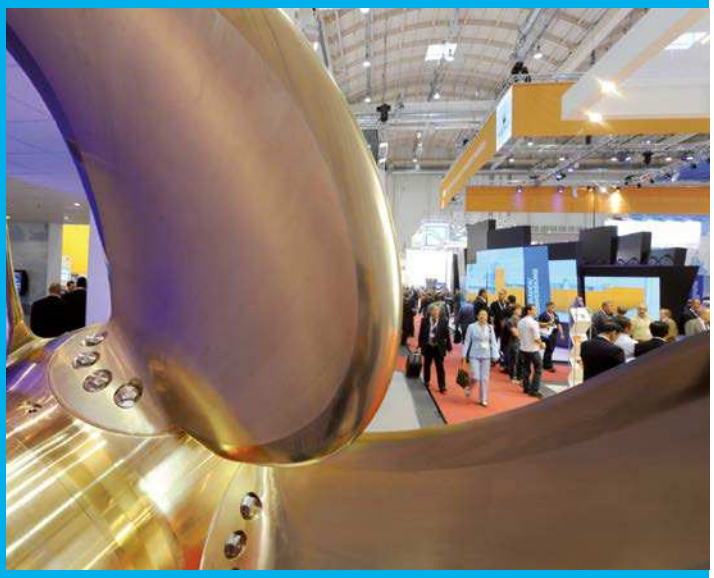
22. – 24.10.14
SNAME
Houston, USA

23. – 24.10.14
2nd INTNAM Symp.
Istanbul, TR

28. – 30.10.14
Seatrade Middle East Maritime 2014
Dubai, AE

October 2014
2nd Shipping Emissions Conference
London, GB

October 2014
LNG World Shipping Conference: Ship-Shore Interface
London, GB



SMM, the leading international maritime trade fair opens its doors from 09. – 12. September in Hamburg, Germany.

20. – 21.10.14
7th Annual Arctic Shipping North America Forum 2014
St. John's, CA

15.10.14
Brazil Offshore Finance Forum
Rio de Janeiro, BR

14. – 15.11.14
Hiroshima Workshop
Hiroshima, JP

17.11.14
IBJ Awards 2014
Rotterdam, NL

19. – 20.11.14
Tanker Shipping & Trade Conference
London, GB

25. – 26.11.14
5th Ship Propulsion Systems Conference
London, GB

25. – 27.11.14
Gas Fuelled Ships Conference 2014
Stavanger, NO

02. – 05.12.14
Exponaval
Valparaiso, CL

7.11.14
Eisbeinessen
Hamburg, DE

19. – 20.11.14
Hellenic Institute of Marine Technology – Annual Meeting of Marine Technology: Technological Conference and Exhibition, ELINT 2014
Athens, GR

03. – 05.03.14
The International WorkBoat Show 2014
New Orleans, USA

03. – 05.12.14
9th HIPER
Athens, GR

Photos: HMC (2), Rido – Fotolia

THE POWER OF INFORMATION

The maritime world is constantly in motion. New approaches to ship design, operation and management are developed, tested, implemented and superseded. At DNV GL, too, we are always working to provide you with services and information that can help your business adapt to changing markets, regulations and advancements.

EFFICIENCY FINDER

Our dynamic Efficiency Finder offers you various exciting perspectives on boosting performance. It uses a holistic approach to analyse your vessels' needs – could your ships use an upgrade?

www.dnvgl.com/ef

MARITIME CONTACTS

The whole of the DNV GL Maritime world at your fingertips. Our Maritime Contacts list offers access and details to all our maritime offices and a selection of relevant contacts and functions at DNV GL Maritime and is constantly updated.

www.dnvgl.com/mc

RESEARCH AND INNOVATION STUDIES AND POSITION PAPERS

DNV GL's sustained and significant investment in research and development means that we are constantly producing innovations and insights for the benefit of our customers.

www.dnvgl.com/mp

UPDATE – A NEW SIDE OF YOUR SHIP TYPE

Sharing our knowledge and experience to benefit our customers and the industry – DNV GL Maritime Update offers an in-depth focused look at the issues, news and technologies of a specific ship type.

www.dnv.com/mp

SERVICE OVERVIEW

DNV GL Maritime offers a unique range of services across the full spectrum of ship types and the offshore sector. For the broader view on our offerings delve into our new service brochures.

www.dnvgl.com/mp

THE APP

The new DNV GL Maritime app is packed with features and information, including, NEWS & EVENTS, CONTACTS, VESSELS, MARKET INSIGHTS and TRAINING COURSES. There have never been so many ways to interact with us and stay informed about the latest developments at DNV GL.
To download the app today simply visit the app store and search for "DNV GL Maritime".

Download on the App Store

ANDROID APP ON Google play

DNV GL

Driven by its purpose of safeguarding life, property and the environment, DNV GL enables organisations to advance the safety and sustainability of their business. DNV GL provides classification and technical assurance along with software and independent expert advisory services to the maritime, oil and gas, and energy industries.

It also provides certification services to customers across a wide range of industries. Combining leading technical and operational expertise, risk methodology and in-depth industry knowledge, DNV GL empowers its customers' decisions and actions with trust and confidence. The company continuously invests in research and collaborative innovation to provide customers and society with operational and technological foresight. DNV GL, whose origins go back to 1864, operates globally in more than 100 countries with its 16,000 professionals dedicated to helping their customers make the world safer, smarter and greener.

IMPRINT

MARITIME IMPACT, issue 01/2014; **Publisher:** DNV GL Maritime, Communications, Hamburg; **Editorial director:** Andreas Bodmann; **Managing editors:** Magne A. Røe, Simon David Adams; **Design and production:** printprojekt, Hamburg; **Translations:** Adreas Kühner; **Layout and prepress:** Lohrengel Mediendesign, Hamburg; **Print:** Media Cologne, Cologne; **Cover photo:** subman – iStockphoto.com; **Disclaimer:** All information is correct to the best of our knowledge. Contributions by external authors do not necessarily reflect the views of the editors and DNV GL.