MARITIME NEWS 2011/12

FORCE Technology / DMI News

Peter K. Sørensen
Vice President, Division for Maritime Industry

Although the financial markets have not yet stabilized and are thus still fluctuating, all of our niches have long since overcome the financial crisis and brought us into a situation where resources are more of a problem than work orders. This is indeed positive!

Talking about resources, the Division for Maritime Industry has decided to make some changes within the organisation. Last year, Stig Sand wrote this introduction to the magazine, but he has now become Director of FORCE Technology Group, Asia, whereas I have moved into his position as Vice President, Division for Maritime Industry. The reason for this change is mainly the development in Asia where we are opening a new office in Singapore.

The global economy and the expected growth rates in Europe, USA and Asia leave no doubt that a more profound engagement in Asia is the way to go. For decades, FORCE Technology has served the Asian market and built close relations to commercial clients, authorities and research organizations, and recently we decided to establish an office in Singapore. This is a very important step for us, not least because it coincides with the award of a number of major contracts. The first was the extensive simulation centre to the Singapore Police Coast Guard, the second was the recent simulation centre of the Singapore Navy, and in June, we were awarded the partnership with Singapore Port Authority and Singapore Polytechnic to build Asia's leading simulation training centre for civil applications (basic and advanced training, certification, port design, applied psychology and R&D).

During the last year, we have been so fortunate to take part in many exciting and challenging tasks defined by our customers. Offshore wind turbine installations have boomed and called for complicated simulation tasks including tow-out and emergency towing exercises. For many reasons, tugs are in focus these years. New designs appear with new control systems, more power and extremely good manoeuvrability. Realistic modelling of tugs (as own ships) are imperative for the value of simulations. We report on these subjects and describe the recent full-mission installations we have made in Australia, Poland and Singapore.

Our activities within applied psychology continue to spread. We have the pleasure of introducing one domain transfer after the other. Lately, as you can read in this magazine, an advanced management training course has arisen out of the in-house expertise within applied psychology, our simulation technology and the cross fertilization from different industries. Since applied psychology is such a success, we have decided to describe our competences within this field in its own newsletter. This will be sent out later this year.

The stories we have selected should illustrate how our advanced technologies interact with each other, and how the combined, cross-disciplinary technologies serve the overall purpose to create added value for our customers. We are always prepared to serve you…

Read about our new office in Singapore.

Read about our new emergency towing course and our ability to model complex features for our courses.

Read about our competencies within Dynamic Positioning and our range of services within Dynamic Positioning.

Read about our newly developed 3D rig for wind tunnel testing, which enables us to provide the full set of eighteen derivatives that describe motion in three degrees-of-freedom.

The strength of FORCE Technology is the unique combination of specialised know-how, modern facilities within hydro- and aerodynamics state-of-the-art simulators and top-class simulator training facilities. In our two towing tanks and five wind tunnels, we are testing and measuring everything related to ships, ports and bridges. The knowledge we gain from these tests can be used in our seven full-mission and part-task simulators where we train captains, masters, navigators and pilots and also perform engineering studies for ports and waterways.

At the organisational level, the Division for Maritime Industry is divided into three departments, Hydro- & Aerodynamics, Simulation, Training & Ports and Applied Psychology, but in the daily operation, we function across the organisational boundaries.

Hydro- & Aerodynamics
Our specialists within hydro- and aerodynamics are supported by advanced testing facilities such as the before-mentioned towing tanks and wind tunnels and several in-house developed numerical design tools combined with state-of-the-art commercial CFD codes in order to assist our customers in the development of their projects. The department has been entrusted with hydro- and aerodynamic consultancy for numerous prestigious projects and among our customers are leading shipyards, shipowners, oil companies, consultancies and civil engineering contractors. Our services include hull line optimization, propeller design and cavitation tests, manoeuvring tests, seakeeping tests on ships and offshore structures, wind forces on ships, offshore platforms, buildings and bridges, as well as wind environment investigations.

Simulation, Training & Ports
The Simulation, Training & Ports department is focussed on developing shiphandling simulators, simulator training of crews and port and ship engineering studies.

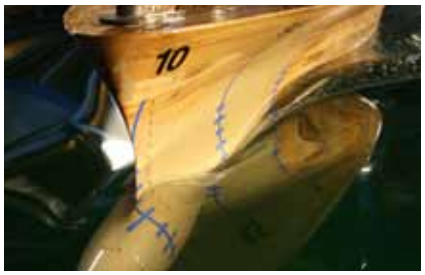
Our simulators range from desktop to full-mission solutions. Depending on customer requirements and specifications, we offer ship-handling simulators using the latest and most sophisticated COTS technology and simulation software developed in-house. The cornerstone in creating an optically realistic and professional simulation is the realism of the mathematical ship model DEN-Mark1. This model, which is considered to be the most accurate on the market for maritime simulation, is continuously developed and improved on the basis of the knowledge gathered in our department for Hydro- and Aerodynamics.

Our training courses are executed on the in-house developed flexible and renown SimFlex simulators. The training is carried out by experienced instructors using state-of-art pedagogical tools and our accurate ship models. We offer a wide range of maritime simulator training courses including extensive train-the-trainers programs. Further, we offer services that support you in the engineering phase of port construction and ship development.

Applied Psychology
Our department for Applied Psychology offers services to our customers within safety and occupational psychology, design psychology and consumer psychology. We help our customers design commercially successful products, services, environments and processes with focus on usability, positive user experience and better satisfaction of consumer requirements. Our method is based on a unique combination of applied psychological knowledge and the use of psychological, anthropological and ethnographic techniques.

DIVISION FOR MARITIME INDUSTRY

At the organisational level, the Division for Maritime Industry is divided into three departments, Hydro- & Aerodynamics, Simulation, Training & Ports and Simulation, Training & Ports, but in the daily operation, we function across the organisational boundaries.



The Division for Maritime Industry has more than 50 years of experience within the maritime world.

We offer extensive services and expertise within aerodynamic and hydrodynamic model testing, numerical fluid mechanics and computer-based simulations to our customers.

Within the field of simulations, we base our competencies on a combination of our hydro- and aerodynamic know-how and state-of-the-art graphical simulation reproduced through our market-leading SimFlex software. SimFlex is a joint designation for our ship simulator systems that span from PC to full-mission set-up.

For more than 25 years, we have been providing advanced maritime training to the shipping industry and our wide range of training courses targets experienced navigators and pilots as well as freshly graduated junior officers. Furthermore, we perform more than 30 port studies in our simulation facilities every year.

1 Full-mission simulator, 360°
Equipped with full size bridge consoles for control and monitoring. Real NACOS Radar, Conning and Ecdis system. Full HD visual system.

2 Full-mission simulator, 210°
Equipped with full size bridge consoles for control and monitoring. Real NACOS Radar, Conning and Ecdis system. Full HD visual system.

3 Full-mission simulator, 210°
Equipped with full size bridge consoles for control and monitoring. Real NACOS Radar, Conning and Ecdis system. Full HD visual system.

4 Part task simulator, 130°
Full HD projection theatre. Real size bridge consoles. Single NACOS Radar system. Ideal for engineering studies.

5 Tug cubicles, 2 pcs
Mini Tug bridges. Mostly used in conjunction with multi bridge setups, dealing with tug operations.

6 Full-mission tug simulator, 360°
Control and monitoring from a real life tug boat. 2 X Full HD visual system with 52' LCD screens. Perfect for tug operations.

7 Closed circuit wind tunnel
Dimensions:
Test section length x width x height:
2.60 x 1.00 x 0.70m
Max Flow Velocity: 70m/s.

8 Boundary-layer wind tunnel
Dimensions:
Test section length x width x height:
20.40 x 2.60 x 1.80 - 2.30m
Max Flow Velocity: 24m/s.

9a Wide boundary-layer wind tunnel
Dimensions:
Test section length x width x height:
15.50 x 13.60 x 1.70m
Max Flow Velocity: 7.3m/s.

9b Wide boundary-layer wind tunnel
Dimensions:
Test section length x width x height:
9.00 x 7.50 x 1.70m
Max Flow Velocity: 12.0m/s.

10 Climatic wind tunnel
Dimensions:
Test section length x width x height:
5.00 x 2.00 x 2.00m
Max Flow Velocity:
25.0m/s. Temperature down to -5 degrees Celsius at Max Flow Velocity.

11 Simulator assembly hall

12 Deep water towing tank
Length x breadth x water depth:
240 x 12 x 5.5m
Speed: From 0 to 14m/s, Accuracy:
± 0.2% of actual value
Maximum wave height: 0.9m.

13 Shallow water towing tank
Length x breadth x water depth:
25 x 8 x 0 to 0.8m.
Speed: From 0 to 2m/s, Accuracy:
± 0.2% of actual value.

14 Workshop
Workshop for construction of all types of models for towing tank and wind tunnel tests.

At our facilities in Lyngby, Denmark, we offer training and port studies in our seven full-mission and part-task simulators and testing and design evaluation in our towing tanks and wind tunnels.

All the simulators are equipped with Lilaas handles and real bridge equipment, as well as NACOS Platinum Integrated Bridge System.

FORCE TECHNOLOGY IN SINGAPORE

Stig Sand, Director, FORCE Technology, Asia

FORCE Technology is poised to take a very privileged position in Singapore. In a Call for Proposal by Singapore Polytechnic and the Maritime and Port Authority of Singapore, FORCE Technology was awarded the contract which includes the setting up of state-of-the-art simulation facilities at the Integrated Simulation Centre at Singapore Polytechnic.

Following the award, FORCE Technology will invest, manufacture, install and operate a series of market-leading full-mission simulators. Over the years, FORCE Technology has established very good business relations with Singapore and holds a considerable customer base.

Until recently all contracts have, however, been handled from Denmark, but the local market development and the award mentioned above now leads FORCE Technology to build up a permanent business base in Singapore. FORCE Technology will be working in close cooperation with Singapore Maritime Academy at Singapore Polytechnic and Maritime and Port Authority of Singapore to further develop its applied domain knowledge, engagement in advanced training, certification, research and innovation in the maritime field. One of the means of achieving this is to develop the Integrated Simulation Centre into a maritime simulator centre with a wide range of simulator capabilities to support the local maritime industry and to meet the needs of the international maritime industry.

The initial setup

During recent years, FORCE Technology has placed itself in the lead when it comes to realistic modelling of tugs. Realistic means superior graphics combined with extremely advanced mathematical models including effects such as detailed interaction between tug and assisted vessel, escort forces, visual representation of thrust and wash effects, just to mention a few. For decades, FORCE Technology has been known for its mathematical models and the unique link to in-house towing tanks and wind tunnels which all provide invaluable data for the simulators. In Singapore, FORCE Technology Singapore Pte Ltd. will be providing a full-mission ship simulator, a full-mission tug simulator and a variety of part task unit and cubicles. These will be offered to the Singaporean market and will play an important role in the considerable R&D programs to be detailed over the coming months.

FORCE Technology in Singapore

These years, Asia gives priority to the maritime sector in terms of R&D policies, funding schemes, public-private partnerships, etc. Consequently, we see a great opportunity to strengthen and extend our national R&D programs and subsequently to provide even more advanced state-of-art services to our global customers.

360 deg. tug simulator. The software in the simulators is base on the best mathematical model on the market, DEN-Mark1.

360 deg. full-mission simulator.

MORE SIMULATORS IN SINGAPORE

Jens U. Römeling, Senior Project Manager, Simulation, Training & Ports

ST Electronics (Training & Simulation Systems) has contracted FORCE Technology to design and deliver a full-mission simulator centre to be used by Singapore Navy.

Besides opening an office in Singapore, FORCE Technology has won a contract on the design and delivery of a full-mission simulator centre to ST Electronics (Training & Simulation Systems) (STEE - T&S) who will use the centre to train Singapore Navy.

ST Electronics is a technical conglomerate with its main competences within satellite & broadband communications (satcoms); e-government & e-enterprise and eco-enabling information communication technologies. Within the maritime segment, STEE - T&S provides innovative training and learning solutions in the areas of simulation, edutainment and training. Since STEE - T&S already holds a substantial amount of knowledge within maritime simulators, the installation of the simulator centre and the software installation and data generation are going to be performed in close collaboration between STEE - T&S and FORCE Technology.

Senior Project Manager from FORCE Technology Jens U. Römeling explains, 'A key feature in the SimFlex software, is the user-friendliness and the flexibility which allows for both minor and major changes in the software in order to fit the customers' needs. Since STEE - T&S is very experienced within maritime simulation, it seems logical that they contribute with their knowledge in a way that provides them with greater value for money.'

Singapore focus

Even though this contract is in no way related to the other activities undertaken by FORCE Technology in Singapore, it holds perspective for development of newly started FORCE Technology Singapore Pte Ltd and for the relations between STEE - T&S and FORCE Technology. Jens Römeling elaborates, 'It is still early days regarding the delivery of the simulator centre, but we expect the cooperation to run smoothly and are open towards further collaboration with STEE - T&S'.

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GREEN SHIP OF THE FUTURE

Christian Schack, General Secretary, and Magnus Gary, Coordinator, Green Ship of the Future

In Denmark, companies across the maritime industry have joined forces in a unique cooperation in order to develop strategies to make shipping more green.

FORCE Technology are coordinators on the joint industry project, Green Ship of the Future, which is an initiative that focuses on demonstrating green technologies from both existing ships and new buildings. This is done within four areas: machinery, propulsion, operation and logistics.

Green Ship of the Future was established in early 2008 and the cooperation is unique due to the many fields of knowledge that are involved, e.g. systems for recycling heat energy, optimisation of the hull, propellers and rudders, optimisation of the draft and speed for a given route and arrival time and monitoring the fouling of hulls and propellers.

The overall aim of Green Ship of the Future is to develop and demonstrate technologies that reduce emissions from ships and in particular airborne emissions which are sought reduced by 30% on CO2, 90% on SOx and 90% on NOx compared to 2007 figures.

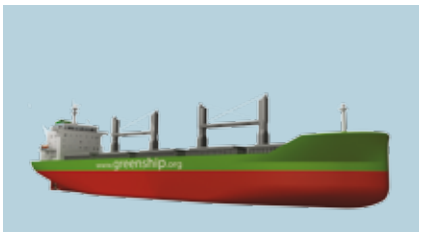
Implementing ideas in real life

During 2009, the partners of Green Ship of the Future decided to work together on a concept study of so-called 'low emission ships'. The purpose of the study was to investigate the possible overall emission reductions if the various available technologies from the Green Ship of the Future project were implemented already during the design phase of a new ship.

Studies were carried out for two different ship types, an 8,500 TEU container vessel and a 35,000 DWT handy size bulk carrier. The basis for the container vessel was an A-Type container vessel from Odense Steel Shipyard, while the basis for the bulk carrier was a Seahorse 35 bulk carrier from Grontmij CarlBro with a capacity of 35,000 DWT.

In the concept studies, only available and proven 'green' technologies were used, which meant that it was possible to build the ships as specified. The concept studies were carried out to benchmark the new technologies in relation to the goal of Green Ship of the Future and in relation to the coming international regulations on NOx and SOx emissions and most probably also CO2 emissions by the introduction of the Energy Efficiency Design Index (EEDI) for new ships.

The low emissions studies showed that with the new technologies implemented it was



Seahorse 35 applied with green technologies.

possible to save 7.2% on CO2, 79.1% on SOx and 98.6% on NOx regarding the 35,000 DWT handy size bulk carrier and 14% on CO2, 90% on SOx and 80% on NOx regarding the 8,500 TEU container vessel.

The green ship technologies developed by the partners in Green Ship of the Future are, in all, already installed on board approximately 200 ships, and several more ships are due to be equipped with a large number of the green technologies in 2012.

ECA study ready to be concluded

In early 2011, Green Ship of the Future initiated a study on how to meet the International Maritime Organisation's (IMO) emission levels for ships sailing in the Emission Controlled Areas (ECA).

The background was IMO's decision that all vessels sailing in ECA must reduce Sulphur level in fuel oil to 0.1% or clean the exhaust gas to an equivalent level by 2015. In the study, members of Green Ship of the Future have worked together on comparing various abatement technologies to fulfil the IMO decision.

The study is in its concluding stages, but the objective has been to set up practical solutions as well as uncovering the financial aspects regarding installation, operation and maintenance of the three most realistic alternatives

- Low-sulphur fuel/distillate
- LNG as fuel
- Scrubber technology

The basis for the project has been a newly built 38,500 DWT tanker from D/S NORDEN A/S.

Nord Butterfly, reference ship in the ECA study.

In the study, the use of low-sulphur fuel/distillate has functioned as reference case as to the feasibility of the other two investigated solutions. The alternative solutions have been evaluated by means of various scenarios considering operational profiles and fuel prices, and the evaluation has taken into account that the vessel will be sailing in both ECA and non-ECA waters.

In all, the group working on this project has consisted of Aalborg Industries, D/S NORDEN, Danish Shipowners' Association, Lloyd's Register, Maersk Maritime Technology, Maersk Tankers, MAN Diesel & Turbo, Schmidt Maritime and together with the Green Ship of the Future secretariat as coordinators. The project has been jointly funded by the Danish Maritime Fund and the participating companies.

Results from the study are to be presented in the beginning of 2012 at the Green Ship Technology Conference in Copenhagen.

New studies on the slipway

Today, the Green Ship of the Future initiative has grown to consist of more than 40 partners and comprise more than 20 projects, and the initiative is continuously looking for 'green' projects and project partners who are willing to join efforts in the search for greener solutions.

Since the low-emission studies were completed, the initiative has worked within two areas, both on testing and verification of the results and on spreading information about the results of the studies through conferences and articles. But also new and interesting projects are on the way.

'Low emission' Ro-pax

A new 'low emission' study will be driven by a large part of the companies in Green Ship of the Future and will investigate the possibilities of reducing emissions from a Ro-Pax ferry. The project is still in its early stages, but focus will

M/S Gotland, the reference ferry in the new Ro-Pax study.

be on the technical elements within machinery and propulsion and it is also expected that other areas affecting emissions will be investigated. The study will be performed on an existing Ro-Pax with an already known operation profile, making it possible to benchmark the emission reductions against existing data. The overall target of the study is to achieve the same numerical goals as with the two previous studies, i.e. making companies work together on finding ways to reduce CO2 by 30%, NOx 90% and SOx 90%.

In the study, Green Ship of the Future and its members are initiating new projects concerning HVAC, insulation, windows and lighting, but there might also be projects within investigating how the design of the cargo deck can decrease the loading time in port and thereby help decrease the overall ship speed at sea and still keep schedule with a reduction of emissions as a result.

The low emission Ro-Pax ferry study is to be led by the Danish OSK-ShipTech who holds more than 40 years of experience as consulting naval architects and marine engineers.

Expanding in numbers

As a consequence of the Ro-Pax study, Green Ship of the Future has expanded in size. From the original four partners, Green Ship of the Future today consists of more than 40 organisations from all parts of the Danish maritime cluster.

PERFORMANCE OF SHIPS IN SERVICE

Christian Schack, Head of Department, Hydro- & Aerodynamics

In recent years, the maritime world has focused on ship performance, but for the Maritime Division this topic has been on the agenda for more than 50 years.

In recent years, discussions at IMO have resulted in the development of an Energy Efficiency Design Index (EEDI). The EEDI has received support from governments, industry associations and organizations representing civil society interests.

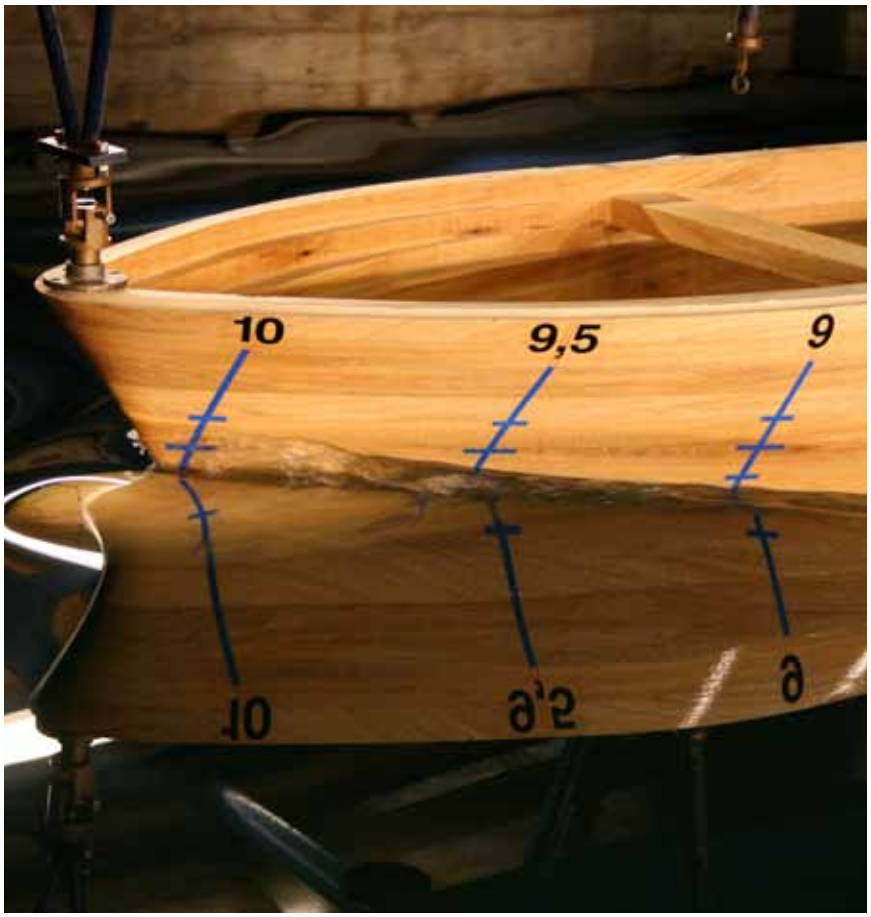
When talking about efficiency, any shipowner must investigate his operational set-up and evaluate how he can reduce fuel consumption. In that relation, the key function of EEDI is to deliver environmental effectiveness by generating significant reductions in greenhouse gas emissions from ships through enhanced energy efficiency measures.

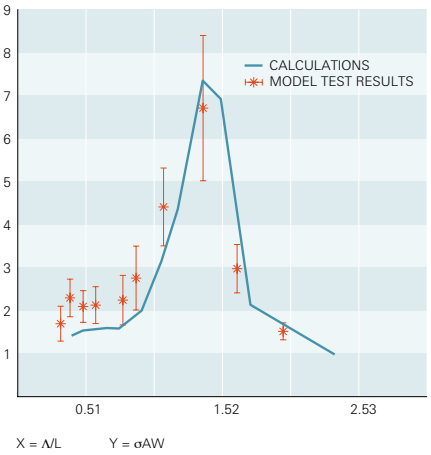
In the many years that FORCE Technology has worked on developing energy-efficient solut ons, this has been a key area for us. Our research within hull optimization, optimum rudder propeller interaction and our research in wave resistance, optimum trim or evaluation of the most efficient fuel-saving device has given us a massive insight into the efficiency and capabilities of fuel-saving devices and designs. In the following, we have described some of our projects and developments within this area:

Added resistance in waves
Instead of optimising ships for still water performance, Soizic Joncquez, Project Manager at FORCE Technology, has made a Ph.D. thesis of the implications of added resistance in waves. On the basis of her thesis, a new method and a computational tool have been developed and proven to be very effective. The Ph.D. thesis has been supported by Danish Centre for Maritime Technology (DCMT) (www.dcmt.dk).

Development of the SeaAssessor tool
The SeaAssessor tool determines a ship's propulsive capabilities on specific routes by simulating the routes with historic weather data and at various loading conditions and speeds. On the specific route, more than 4,000 simulations will be performed, thereby ensuring a true representation of the prevailing weather conditions on the route and giving an accurate probability of the voyage duration. The development of SeaAssessor has received funding from The Danish Agency for Science, Technology and Innovation.

Understanding the physics of trim
At FORCE Technology, we have performed trim test of around 50 vessels, among others tankers, container vessels, LNG carriers and Ro-Ro vessels. Our testing shows possible fuel savings





Added resistance in waves: The figure shows the added resistance coefficient for a bulk carrier for different wave encounter frequencies. The diagrams compares model tests and calculations with aegir.

Chief Naval architect Anton Minchev is the new chairman of the Specialist Committee on Performance of Ships in Service under ITTC.

The Maritime Division covers more or less all aspects of ship performance - from initial design evaluation to onboard systems. If it can sail, we have a method to optimize it.

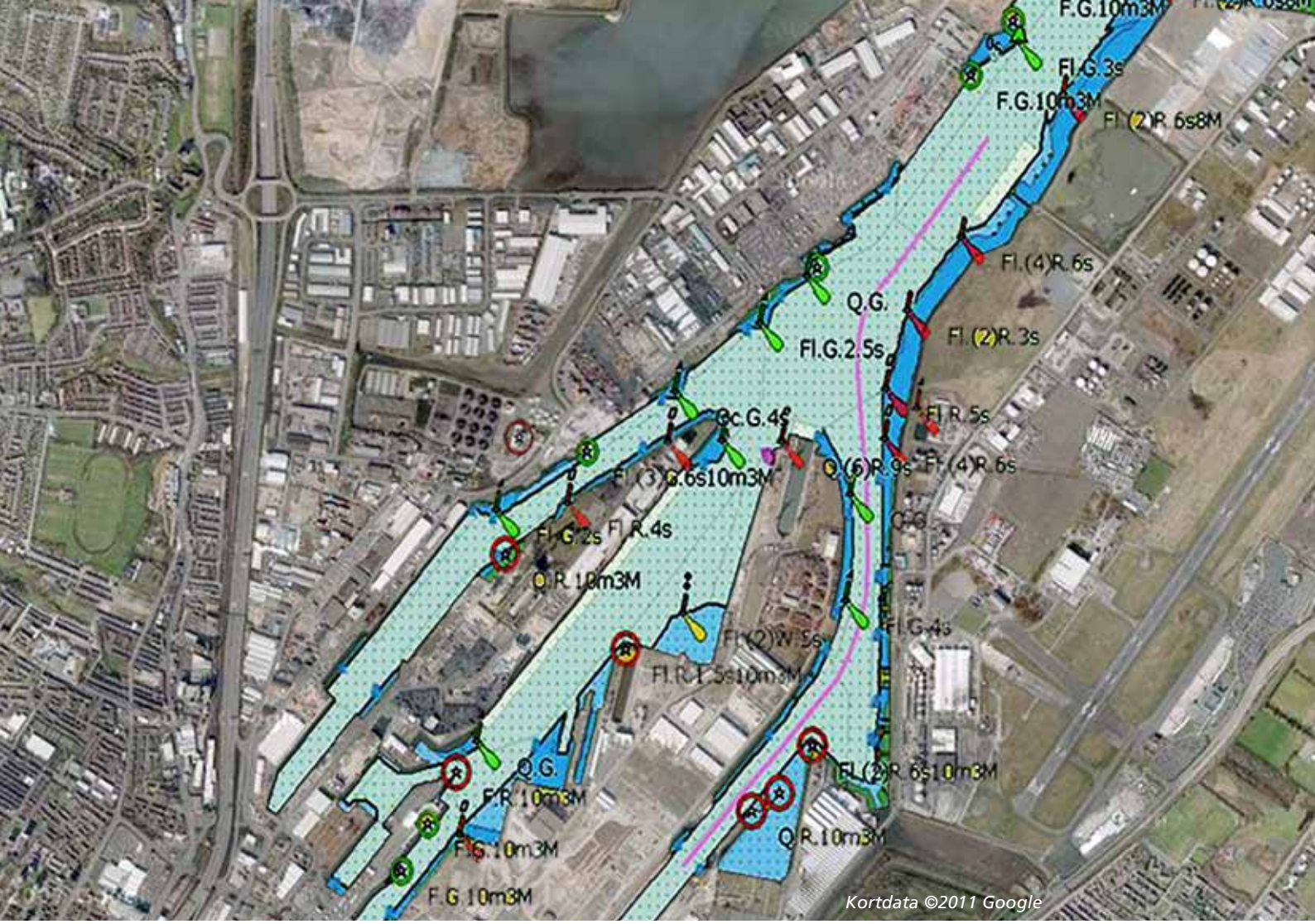
of 3-15% at specific conditions. In overall fleet operations, typical savings can be as high as 3 to 4%. The project has been supported by DCMT and results will be presented at Green Ship Technology Conference (GST) in 2012.

CFD Ship Hydrodynamics
Advanced Computational Fluid Dynamics (CFD) can be applied as a strong tool in the design phase of ships because detailed evaluation of design alternatives can be made early in the design process. Over the years FORCE Technology has been involved in a long series of

Fuel-saving devices
By means of RANS-CFD, we have determined the relative power or efficiency gain obtained by substituting an original conventional propellerrudder configuration of a given vessel with a different and more efficient rudder-propeller configuration (fuel-saving device). The knowledge gained from this project has become part of FORCE Technology's ECOfit concept which calculates the return on investment for design changes and new equipment on board existing vessels. The project has been supported by DCMT.

SeaTrend
Starting with the development of a generic ship propulsion model, a theoretical model has been turned into a commercial product with a large potential for monitoring hull and propeller fouling. The annual fuel consumption of a Panmax containership is up to 16 million USD. Between the ship's docking intervals, hull fouling may increase the fuel consumption by as much as 20% and propeller fouling may lead to increased fuel consumption of up to 5%. Therefore, monitoring of hull and propeller fouling is very important. The project has been supported by DCMT.

ITTC
To underline FORCE Technology's commitment within ship performance, Chief Naval Architect Anton Minchev has become chairman of the new ITTC committee, Specialist Committee on Performance of Ships in Service. The purpose of the committee is to improve the performance predictions for service conditions covering the whole life cycle of the ship, keeping in mind the EEDI and Energy Efficiency Operational Index (EEOI) development within IMO. The results from the committee's work will be presented at the next (27th) ITTC to be hosted by FORCE Technology in Copenhagen in 2014.



BELFAST TOW-OUT

Niels Arndal, Senior Project Manager, Simulation, Training & Ports

One of the great things of simulation studies is the possibility to perform trial & error exercises over and over again, until you are perfectly ready to perform the operation at sea. For example testing of procedures and possible tug configurations in order to identify the most optimal and safe operations.

Offshore Design Engineering Ltd. (ODE) was assigned by Vattenfal to ensure the tow-out of the A2Sea owned jack-up barge Sea Jack from the port of Belfast. Performing tow-out from the port of Belfast is a bit tricky as the barge has to pass near the oil berths placed in the bend of the Musgrave Channel.

Therefore, it was pivotal for ODE to be absolutely certain that it was safe to tow out the barge from Belfast and also find the most suitable tow-out strategy in relation to safety.

SimFlex Shipyard

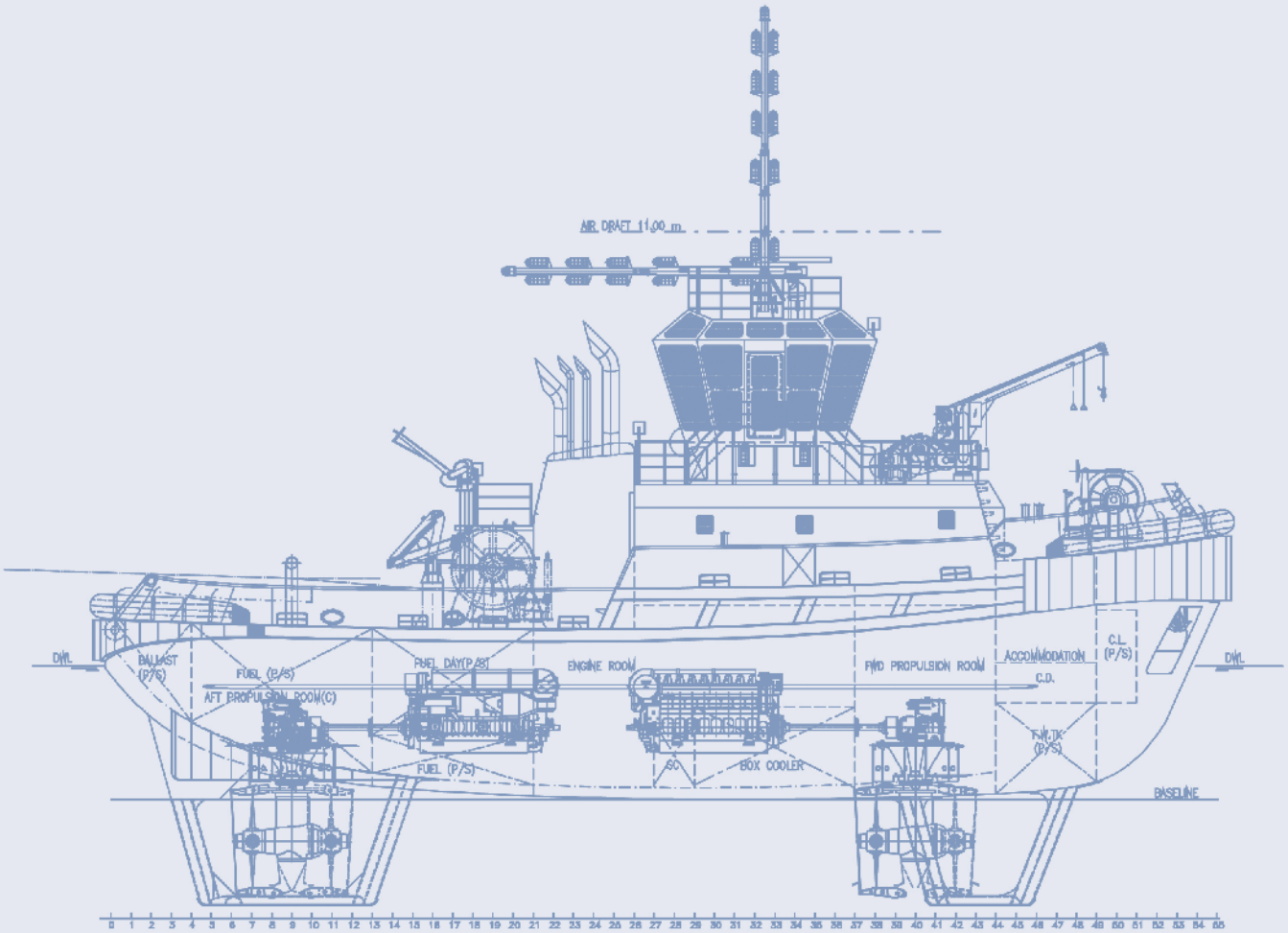
FORCE Technology was chosen to perform simulation studies of the tow-out using our in-house advanced full-mission tug simulation system.

A database modelling the Belfast Harbour and navigable surroundings was developed on the basis of available sea charts and input from the client. Also, three ships were developed for the project using the SimFlex Shipyard software a jack-up barge named 'Sea Jack', a conventional tug called 'Beaver' with 70 t bollard pull and a conventional tug called 'Sea Golf' with 40 t bollard pull; all part of A2Sea's fleet. Additionally, two ASD tugs were chosen from FORCE Technology's database of more than 500 ships.

All parties participate

Besides FORCE Technology's experienced captains and naval architects, ODE, Vattenfall, A2Sea, Belfast Harbour tug masters, Belfast Harbour Authorities and Svitzer participated in the simulations. The procedure of gathering all the involved parties ensures that decisions are based on an a common experience and understanding, and it is therefore easy to agree on the best tow-out strategy.

Normally it takes some time for everyone to obtain a common 'language' and get into a routine on a large project. But after three days in the four coupled simulators where the participants sailed in/out of Belfast Harbour several times, the communication was running smoothly as if they had worked together for months. Therefore, the testing of the different tow-out strategies and tug combinations also went smoothly, and the outcome of the simulations was that a combination of two conventional tugs connected aft and fore of Sea Jack and at least one ASD tug connected to the side was sufficient for a safe operation.



ROTOR TUGS

Aage Damsgaard, Technical Vice President, Division for Maritime Industry

The development and implementation of complex models accurately simulating the performance of advanced tug types continues. After having focused on different sizes of ASD and VSP tugs for several years, the latest addition is the 80 t BP Rotor Tug 'Geeste' operated by the German tug operator URAG.

The Rotor tug concept was developed by the Dutch company Kooren in the late 1990's and first used to handle the large-windage-area car carriers in the Bremerhaven locks. The Rotor tug can be described as a 'conventional' tractor tug with two azimuth thrusters fore, and the aft skeg replaced by a third azimuth thruster unit. This configuration of propulsion and steering units gives the high-powered Rotor tug extreme manoeuvrability and the ability to work efficiently in narrow spaces.

The main new items were the effects of the thruster-thruster and thruster-hull interaction on the force generated by each of the thruster units for this new arrangement of thrusters. This could pose a severe challenge to the naval architect who should build the mathematical models of the vessel. But using DMI's proprietary DEN-Mark1 modelling system, producing the first version of the Rotor tug model turned out to be fairly straightforward.

Tug controls

In order to enable the tug master to operate the Rotor tug in the existing tug simulators at FORCE Technology, sets of consoles with the three control handles and the winch control were assembled in-house. These consoles can be connected to any of five interactive tug simulators presently available at FORCE Technology. This flexibility enables simulations to be performed with any combination of up to five tugs of different types, i.e. conventional, ASD, VSP and Rotor tugs.

Fine tuning

The Rotor tug model was first developed under the EU FP6 project EFFORTS and was demonstrated at the concluding conference for that project. This was the first time the Rotor tug simulator was tested by an experienced Kotug Rotor tug master, and already on that occasion, the performance was very close to reality. On the advice of the experienced master, some fine-tuning of the model was done on the spot, and the final model was installed. Subsequently, the Rotor tug simulator has been used on several occasions for navigational studies and for assessment of the performance of different tug types for specific tasks. The portable tug simulator marketed by FORCE Technology is also available in a Rotor tug version, so Rotor tug familiarization training can be performed in the home office of the tug company.

EMERGENCY TOWING

Captain Arne Funch Mejer, Chief of Dansim, Simulation, Training & Ports

Some people do, while others don't. Salvage of a casualty ship in 10 meter high waves and wind force 10 is not an everyday challenge. Therefore, the German and the Swedish coast guards get their emergency towing crews trained in the market's most realistic simulators at FORCE Technology.

Oil pollution due to groundings is a well-known and recurring problem which has motivated a number of coastal countries to build and maintain fleets of specialized emergency towing vessels. The main objective of these vessels is to establish a towing connection to the casualty ship before she runs aground and hold her against the wind, waves and current until the risk of running aground has ceased.

In order to establish a towing connection, the emergency towing vessel has to navigate close enough to the casualty ship to throw a line across and then stay in very close proximity until the strong (and heavy) towing wire is pulled on board the casualty ship. As these situations often occur in heavy sea, wind and rain and/or snow, such assignments are highly complicated.

In order to accomplish such an assignment, expert ship handling and towing skills are necessary. This poses a paradox, as the number of occurrences is small, so real-life training is a very rare possibility for the crews manning the vessels. Simulator training is, therefore, an obvious solution to meet these training needs.

Developing models

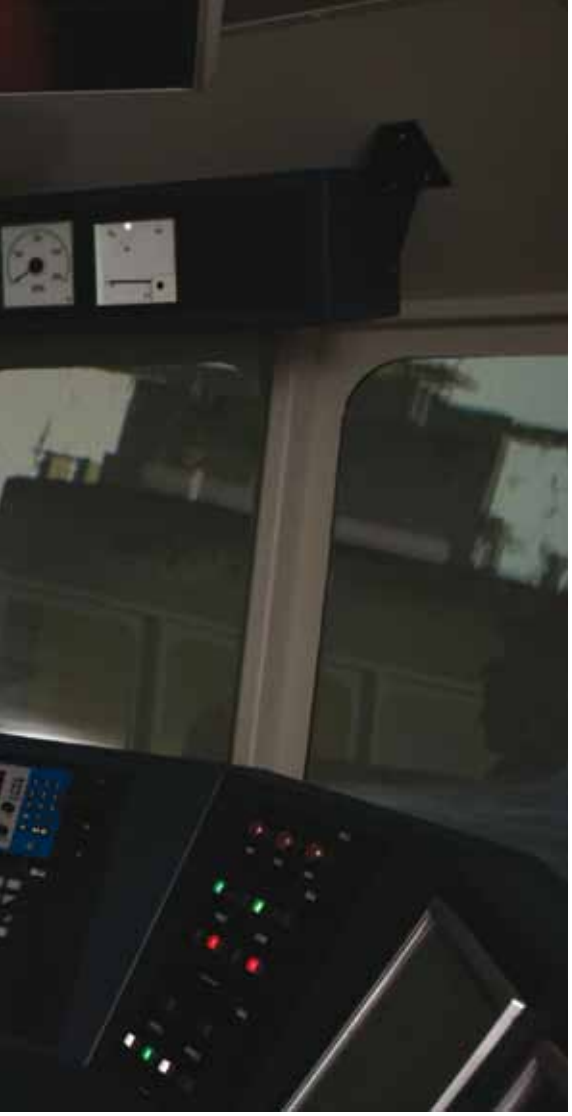
FORCE Technology has developed an ambitious series of emergency towing courses utilizing their renowned tug simulators. The courses have been developed in close cooperation with the German Havariekommando and the Swedish Coastguard.

Simulating the physics on the towing line under the effects of wind, waves, currentsand the ship-to-ship interaction is not an easy task, but the extent of realism in training is pivotal for the abilities developed and maintained in the crew.

For the courses, eight different simulator models of existing emergency towing vessels have been developed, using the unrivalled mathematical model DEN-Mark1. These models have been approved after extensive tests and comparisons to the real vessels' maneuvering characteristics.

Variety of casualties

In the courses, the participants have performed emergency towing on a range of different casualty ships such as a Baltic Sea ferry, a cruise ship, a bulk carrier, a container vessel and a large tanker - all of which have been developed specifically for the courses.



In this exercise, the crew is easing closer to the 100,000 DWT tanker which is lying with the bow 6 metres below the surface.

Other new developments that have been carried out in order to guarantee a realistic towing experience are:

- Modelling of towing wires of different dimensions, weights and breaking loads
- Visual representation of the towing wires/hawsers
- Casualties with e.g. the bow almost under water
- Realistic movements in high waves
- Effect on towing capacity caused by wave action

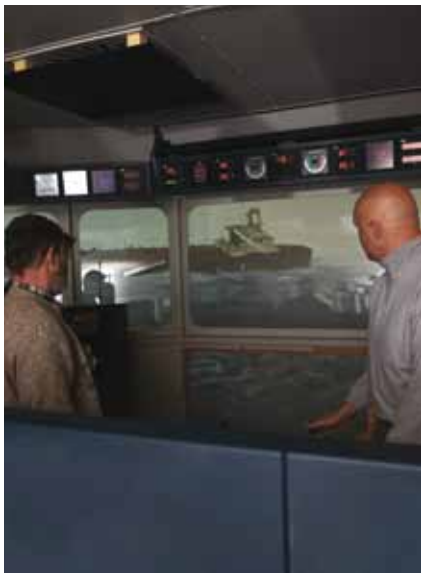
Demanding exercises

The participants are taken through a number of exercises including recovery of emergency towing gear, connection with different towing gear combinations, towing in the casualty's bow or stern and with vessels in imminent danger of grounding or colliding with a wind park. These simulations are carried out during day light/night, poor visibility due to rain/snow and in rough to very rough weather conditions.

The variations in tasks and weather conditions makes it possible for the participants to try different approaches to the casualty and test different towing strategies, thus providing experience with recognizing and choosing the optimal strategy when performing the emergency towing in real life.

Until now, 26 bridge teams have passed the course, and feedback from the participants has been very positive.

By means of our renowned mathematical model DEN-Mark1, FORCE Technology has developed a precise reproduction of the characteristics of the towing line. This means that every detail of the course is as close to real life as you will get.



MAERSK PEREGRINO

Janne Flensborg Otzen, Project Manager, and Christian Schack, Head of Department Hydro- & Aerodynamics

Maersk Peregrino is operating in the oil field Peregrino 85 km off the shore of Brazil. The vessel used to sail as a supertanker but has been re-built into one of the world's largest FPSOs with the capability of processing and storing approximately 1.6 million barrels equivalent to 255 million liters of oil.

Pumping oil from offshore wells requires a very safe operation as the costs of failure is immense - both economically and environmentally. The hook-up between the turret and the FPSO is a critical and costly operation, and it is therefore important for the owner and operator to get it right the first time.

In order to be certain that the hook up procedure of Maersk Peregrino could take place in a safe manner, Maersk FPSOs assigned FORCE Technology to evaluate and perform simulation studies of the hook up procedure. The simulations should form the basis for deciding the tug size needed during the hook-up between the FPSO and the STP buoy at the Peregrino oil field. The simulation studies were performed with the help of in-house developed mathematical and visual simulator models of the FPSO.

Technical assignments

Seen from FORCE Technology's point of view, the project was special, as all departments in the Division for Maritime Industry were involved in testing, simulating, training and evaluating different aspects of the complex operations connected with Maersk Peregrino.

Wind tunnel testing

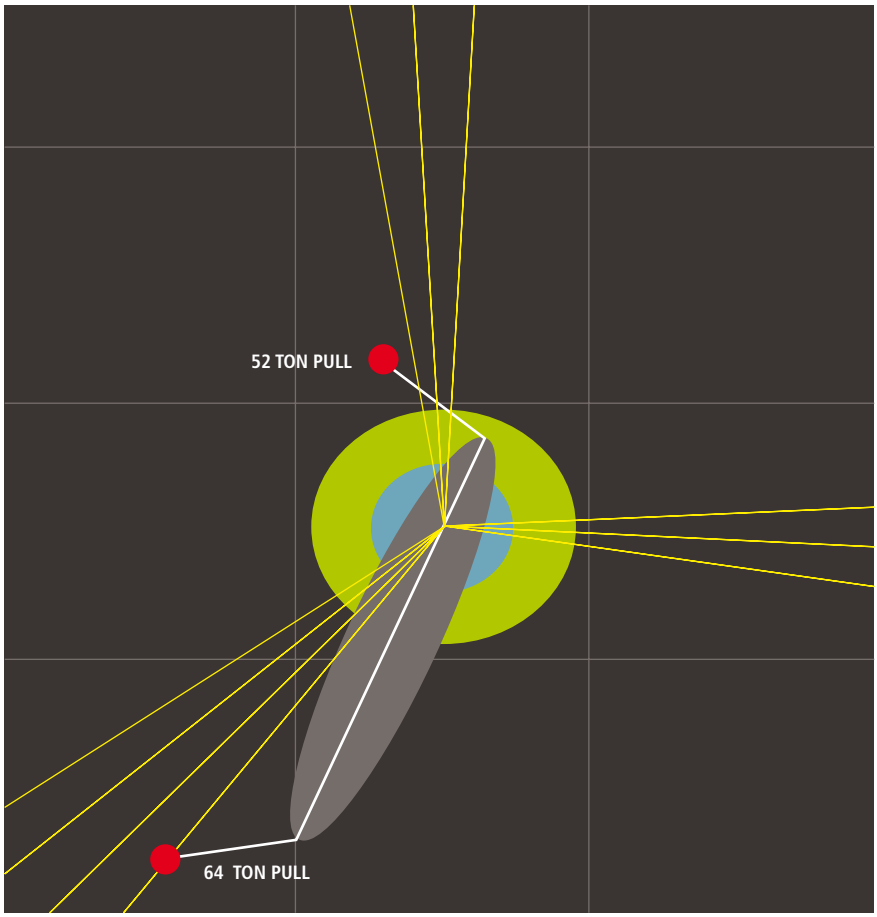
The tests started in one of FORCE Technology's five wind tunnels to determine the wind and current forces acting on the FPSO which is crucial in the structural design of turret and moorings. These tests were carried out for Advanced Production & Loading (today owned by National Oilwell Varco) who has supplied the STP buoy for the Peregrino project.

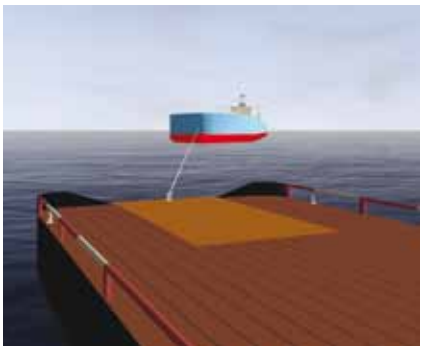
Establishing the mathematical model

By combining the aerodynamic data from the wind tunnel tests with the hydrodynamic forces acting on the ship, a simulator model of Maersk Peregrino was generated using our in-house developed manoeuvring prediction and ship generation tool ShipYard which is a part of SimFlex simulator setup.

Fast-time simulation

Once the mathematical model was developed, fast-time simulations of the hook-up between the turret and the FPSO were performed, and the size and number of the necessary tugs needed to bring the FPSO safely on top of the turret was evaluated.





View from tug to FPSO in the simulator.

Graphical view of the simulatoion where the FPSO is being positioned over the turret.

Bjarke N. Pedersen, towmaster in Maersk FPSOs during the hook-up, explains, 'The conditions under which we performed the work were almost an exact match of the simulations at FORCE Technology. The behavior of the tow spread was as simulated during the training session. On this part of the installation, our biggest surprise was that there was no surprise.'

The hook-up simulations focused on the ability to move the vessel to a fixed position and to keep the vessel in that position during the operation. To make the scenarios as realistic as possible, the simulations covered periods of three hours to confirm the ability of the tugs to bring the vessel in position over the turret and maintain its position for a long period of time. Tolerance-wise, the most critical part is just before the connection starts since the turret, after connection, will gradually help maintaining the position as it is being pulled in.

Subsequently, FORCE Technology evaluated the tug size needed in order to perform the riser pull-in procedure. This is the operation where the vessel is connected to the turret and is pulling in and connecting the risers. Maintaining heading during this operation is crucial.

During the simulation of the riser pull-in procedure, the FPSO was moored to the turret and its mooring system provided the right response in all degrees of freedom relevant for the assignment under the influences of wind, waves and current.Both the hook-up procedure and the evaluation of tug size were carried out based on detailed Metocean data from the Peregrino field for the time period of the installation.

Training of crew

Finally, the FPSO and Tug Captains assigned to perform the installation of the Maersk Peregrino were trained in the approach and riser pull-in manoeuvers. This training was carried out in the advanced full-mission simulators at FORCE Technology.

The simulations were performed at FORCE Technology's facilities with a mathematical model of the Maersk Peregrino FPSO and two mathematical tug models with similar dimensions and bollard pull as the tugs considered for the real hook-up operation. The wind forces applied for the FPSO were calculated using the wind coefficients from wind tunnel tests with the Maersk Peregrino FPSO.

By performing both testing, simulation and training at FORCE Technology, Maersk FPSOs was ensured that the data generated and used was an exact replicate of the way the actual installation would take place.

SMARTSHIP AUSTRALIA

Sverre Patursson Vange, Senior Project Manager, and Bugge T. Jensen, Senior Project Manager, Simulation, Training & Ports

In June 2010, Maritime Safety Queensland contracted FORCE Technology to deliver the most modern and professional simulator centre possible for training of pilots and tug masters.

The requested time frame from the contract was signed until the centre should be finalized and ready for use was set to 10 months.

In order to push the bar within simulation training and to fit Maritime Safety Queensland's requirements, FORCE Technology needed to develop and customize a number of features, including

- Stealth system that enables the instructor to 'fly' around in the exercise area and monitor the performance of the trainees
- Simulation of lee effects on tugs from large ships
- Support for wave fields combined of swell and wind waves
- Soft instruments for easy adaption of bridge instrumentation to different ship types

So, in this perspective, the short delivery time held an obvious challenge.

Fortunately, the department for Simulation and Information Technologies at FORCE Technology has decades of experience with design and building of simulator centres all over the world. So the centre was completed on time and the Site Acceptance Test successfully passed and approved by Director and Principal Instructor for Smartship Peter Listrup on April 14th, 2011.

Exceeding market standards

The simulator centre, Smartship Australia, is unique on the market due to the way design, equipment and mathematical models in the software work together to create a highly realistic atmosphere and thus increase the degree of training transfer possible from the exercises performed in the centre.

Project Manager Sverre Patursson Vange says, 'We are very pleased to have been able to fulfil all the requirements of Maritime Safety Queensland and at the same time meet the strict deadline. But the great satisfaction in this project lies in the delivered quality to which we can honestly say that both software and hardware are exceeding the market standards.

Further, we would like to thank Maritime Safety Queensland for a good and efficient cooperation, meaning that we are left with the impression that we have met their needs 100%.'

Amongst other things, the new centre consists of a 360° tug bridge and two 240° full-mission bridges.

Facts on Smartship Australia
Smartship Australia is going to facilitate training of approximately 200 pilots and tug masters in Queensland. Among the courses offered by the centre are Marine Pilot Training, Bridge Resource Management, Maritime Resource Management and Tug Handling. Also port and fairway design studies can be conducted in the centre.

The centre includes two full-mission bridges, both with a 240° field of view for traditional full-mission operations, and one full-mission tug bridge with 360° field of view. Furthermore, the centre also includes two part-task bridges for assisted vessel assignments and instrument training.

The primary full-mission bridge is equipped with two large bridge wings with 200° horizontal field of view and 100° vertical field of view. This unique feature is the first of its kind in the world and contributes to make the pilot training for berthing operations at Smartship Australia more realistic than ever seen before in a simulator.

Read more about Smartship Australia on www.smartshipaustralia.com.

GOING EAST

Lasse Bonde Christiansen, Project Manager, Simulation, Training & Ports

Sometimes references and proven ability to deliver above-standard solutions are all it takes to attract new customers

In the early spring of 2011, Gdynia Maritime University, contracted FORCE Technology to deliver a modern and professional simulator centre for training of crew with regard to ship-handling exercises, crew resource management training, stability training etc.

Gdynia Maritime University is the largest state school of higher maritime education in Poland and one of the largest in Europe. Since 1920, the university has been preparing graduates for positions as officers on board merchant marine vessels and for managerial positions at the land-based institutions and companies representing the maritime industry and seaside regions.

In the future, the simulators provided by FORCE Technology are going to enhance the practical training approach at the university's faculty of navigation. Since Gdynia Maritime University possesses great knowledge within hydrodynamics, one of the key reasons for Gdynia Maritime University's choice of FORCE Technology as supplier was the possibility to produce ship models in SimFlex Shipyard based on their own data.

Customer's experience wins contracts

The contact between Gdynia Maritime University and FORCE Technology did not follow the usual pattern where FORCE Technology hears about a tender or is invited to give tender. Instead, it all started when Mr. Lukaszewicz Arkadiusz from Gdynia Maritime University visited FORCE Technology as a regular participant on a Bridge Team Management course ordered by Princess Cruises.

Here he experienced the functionalities and visual effects of our SimFlex–based simulators. Later, when he had changed position and worked for Gdynia Maritime University who considered establishing their own simulator centre, Lukaszewicz Arkadiusz thought of FORCE Technology and contacted us in order for us to participate in the tender which we ultimately won.

Knowledgeable customer

Mechanical Designer Lasse Bonde Christiansen explains, 'We are, of course, honoured to be to be chosen to deliver simulators to an organisation that possesses so much experience and knowledge within hydrodynamics. This tells us that our mathematical model is still acknowledged as the best on the market, otherwise Gdynia Maritime University wouldn't have chosen us. But furthermore, we are very happy

that our simulators make a lasting impression on our course participants as this is one of the finest recommendations any company can get. This goes to show that the best publicity is the one gained through satisfied customers and quality products.'

NACOS Platinum included

The full-mission simulator and the two part-task bridges are equipped with the newest version of integrated bridge system from SAM Electronics, the NACOS Platinum Integrated Bridge System. These are the first simulators delivered by FORCE Technology to be equipped with the platinum edition.

The navigation systems for the bridge are based on the newly developed SAM common hardware/software platform. With this, the primary applications like RADAR, ECDIS, Trackpilot and Conning Displays will share hardware and data structures, providing an integrated environment in the true meaning of the concept.

The simulators in Gdynia are the first to be equipped with NACOS Platinum Integrated Bridge System platinum edition.

The benefits of real integration are complete data consistency, across-the-platform handling of alarms, truly multi-functional workstations and the greatest scalability and flexibility ever. Furthermore, the common platform gives access to secondary applications and the operation of blind sensors like AIS, VDR and other such devices.

Besides the full-mission bridge and the two part-task bridges, the simulators are equipped with all the standard functions, including FORCE Technology's market-leading fully modelled tug features.

Students from Gdynia Maritime University in Poland are going be trained on quality simulators.

THE ART OF LYING COMPLETELY STILL

Jacob Wiegand Clausen, Sales Manager, and Christian Schack, Head of department, Hydro- & Aerodynamics

For advanced offshore operations, position-keeping becomes more and more important. For example, placing a large wind turbine on a water depth of up to 30 metres puts heavy requirements on the hardware (rudders, propellers and thruster units) and Dynamic Positioning software onboard the vessel.

Similarly, Dynamic Positioning (DP) Drilling platforms are today used in harsher environments than previously, thereby putting heavier requirements on the DP capability of the platforms.

Since the early 1980's, FORCE Technology has performed R&D within DP. Our experience is rooted in DP of drilling platforms and other offshore structures and vessels. When the offshore wind turbine areas have been expanding, our knowhow has been used in a large number of projects with wind turbine installation vessels and service vessels.

Through our knowledge and experience, FORCE Technology has developed three different services within DP. These three services offer different knowledge of the operational constraints and can be used both individually and in connection with each other.

DPLab – Static Holding Capability

Embarking on a new project with a dynamically positioned ship or platform immediately poses the following three questions once the site has been determined:

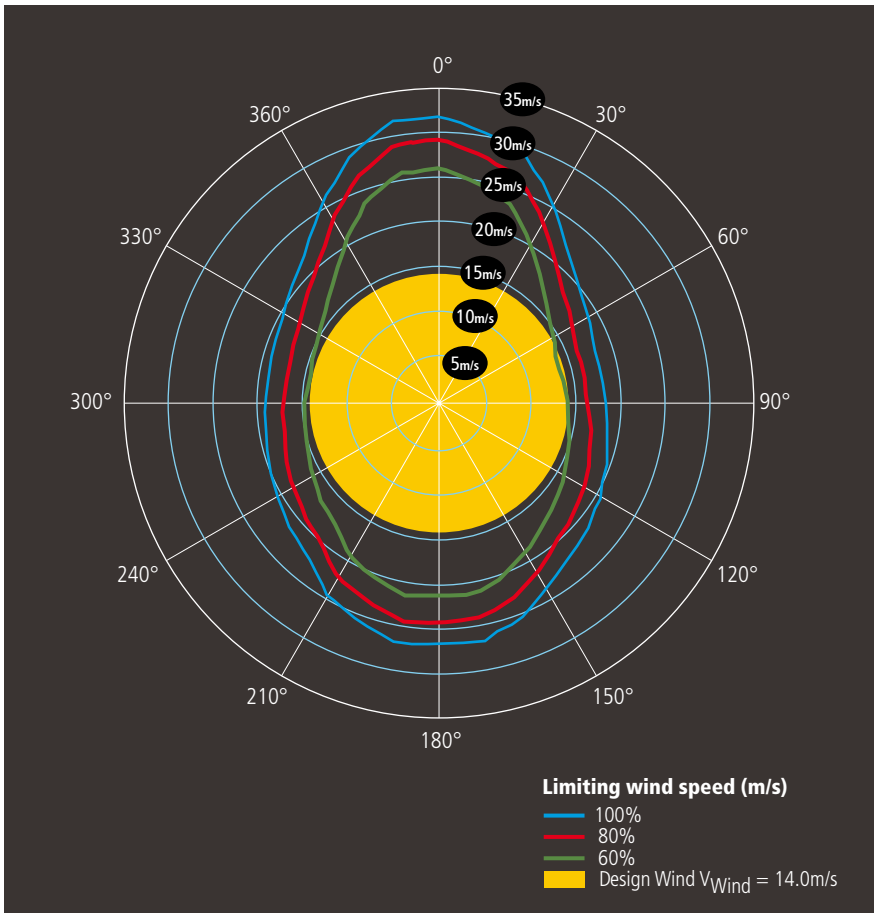
A) Is station-keeping possible under the anticipated conditions?

B) What sizes of thrusters are required, and where do we install them to maximize our station-keeping capability?

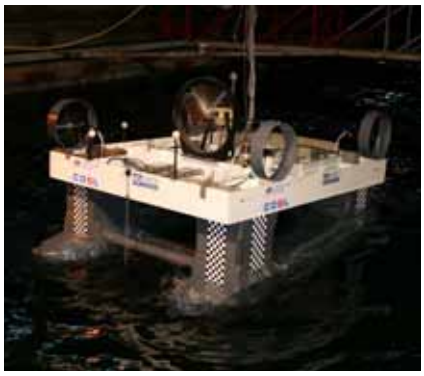
C) How are the thrusters best utilised?

These three problems do not, of course, have independent solutions, instead a common solution solving all three must be found. FORCE Technology has developed the Holding Capability Module for the DPLab software for in-house use or as software sold in a package with wind & current predictions or wind tunnel model tests. The program follows the recommendations of IMCA M 140.

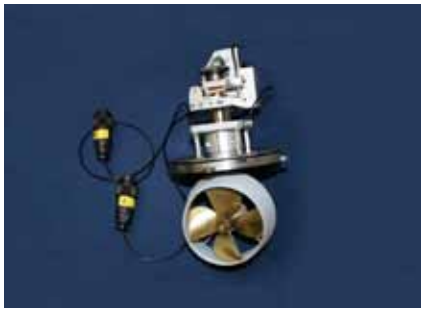
The tool performs static calculations, balancing the available thrust and the environmental forces. The holding capability is defined as the limiting environmental (arising from wind, current and waves) forces that can be balanced by the vessel using its propulsive systems in an optimal way.



Plot from DPLab showing a vessels holding capability depending on the available power.



DP model tests performed at FORCE Technology.



FORCE Technology Mk III offshore thruster model for installation in semi-submersible hulls.

DPLab has been sold to leading Asian shipyards and a number of consultants world-wide.

Time Domain Simulations
While DPLab provides only a static picture, FORCE Technology also offers dynamic possibilities in our simulators where it is possible to perform DP simulations with varying degrees of current, wind and waves. The core of the simulations is the in-house developed DEN-Mark1 model which is acknowledged to be the most accurate mathematical model with regard to maritime simulation.

With the time domain simulations you find out how precisely it is possible to keep the needed position under the influence of wind, current and waves. Furthermore, the time domain simulations in six degrees of freedom provide a strong indication of the motions of the ship during operation.

DP Model Tests
The final service FORCE Technology offers within DP is scaled model testing. During these tests, thrusters, propellers and rudder are tested together with the DP system. These tests give a very realistic representation of the precision you could expect during your actual DP operation.

Besides this important knowledge, the tests also include effects such as green water, slamming and advanced wave systems which are hard to copy in numerical simulations. The DP tests can be performed with our in-house DP system or with a vendor-provided DP system.

Through a model test you also get all the dynamic and non-linear effects. Thereby, model tests offer a more precise representation of the ship's ability to hold the position during operation. Model tests are usually preferred when the design is locked, and the DP capacity is to be documented.

To be able to perform DP model tests, FORCE Technology has prepared a series of advanced model thruster units. The units are controlled via advanced EPOS controls and are able to measure heading, RPM and the delivered thrust from each thruster unit. The development has taken place over the last 20 years, and our model thruster units are now in their 3rd generation and available for both integration into semisubmersible hulls and deck mounting on monohull vessels such as drilling vessels.

Rest rules violations statistics per crew-member

Crew-members' average number of rest rules violations

Legend: Rest rule 1 (1 x work<14h/24h) Rest rule 2A (1 x rest<6h/24h) Rest rule 2B (2 x rest<10h/24h) Rest rule 3 (work<77h/1wk)

NEW MANNING CONCEPT

Jens Bay, Project Manager, Simulation, Training & Ports

A new concept from FORCE Technology is set to change the way ships are manned. The concept is called Safe_manning and is a function-based approach to manning of ships.

In order for a ship to be profitable, every procedure and function on board must work as efficiently as possible. Today, manning procedures focus on ship size, type, engine etc rather than function, thereby failing to use the full extent of the on board working capacity. This approach is now being contested by the Danish Maritime Authorities, Technical University of Denmark and FORCE Technology.

Instead of the usual scale manning concept, the Safe_manning concept is based on defining the tasks for each member of the crew necessary to operate a ship in a safe and efficient way - and, of course, according to the STWC rules.

Many names, but only one concept

Even though Safe_manning is a relatively new concept, it has a lot of well-known synonyms such as safe crewing, ship crewing, crew simulation, crew estimation and safety crew, just to mention a few. Whatever you prefer to call the concept, the content is the same: Estimation of the necessary crew on board a commercial ship.

Safe_manning and good economy

Safe_manning is an online and world-wide accessible crew estimation tool to optimize the use of the crew's capabilities, thereby offering shipowners, operators, crewing companies, ship brokers and unions a clear picture of the work force needed on a given ship. By defining the tasks on board, the qualifications needed to solve the tasks and the period in which the tasks are due to be done, the software provides you with an overview of the workload of the different functions on board for the duration of the trip.

safe_manning

The result of using the Safe_manning concept is a more efficient use of the crew without violating the rest rules and providing the possibility of breaking the traditional (inefficient) patterns of who is doing what on board by letting the best qualified persons solve specific tasks.

The software tool developed in the project can also be used as a planning tool by estimating crew size through an optimized workload per crew member.

The concept operates with 6 elements

1. Ship schedule - which describes a cycle of port calls and open sea transits between ports
2. Task requirements - where the user defines a list of tasks that are needed to operate the ship
3. Rest rules - which is pre-defined and included in the simulation software
4. Resource (crew) competence - when defining each crew member, you define which tasks he/she is competent to solve
5. Resource state - the software keeps track of each crew member's ability to work in relation to the rest rules
6. Environment conditions - the user can define weather conditions that e.g. require a look out on the bridge

Main features

- Optimizing of necessary crew for a specific ship
- Planning of work on board

Your input defines

- Tasks on board (with several attributes)
- Phases: E.g. port, at sea, departure and arrival
- Ship schedule (made up by one or several phases)
- Crew
- Crew qualifications

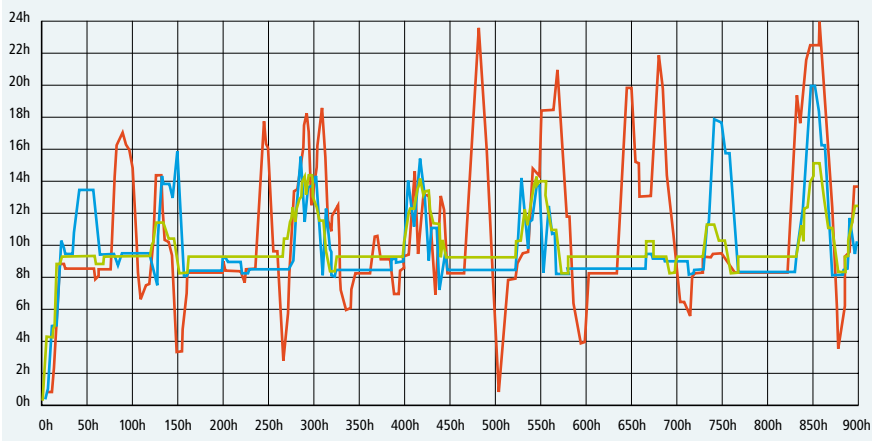
Safe_manning output

- Rest rule violation for each crew member
- Workload per crew member
- Detailed list of all tasks per crew member

PHOTOS: ITSFOTO

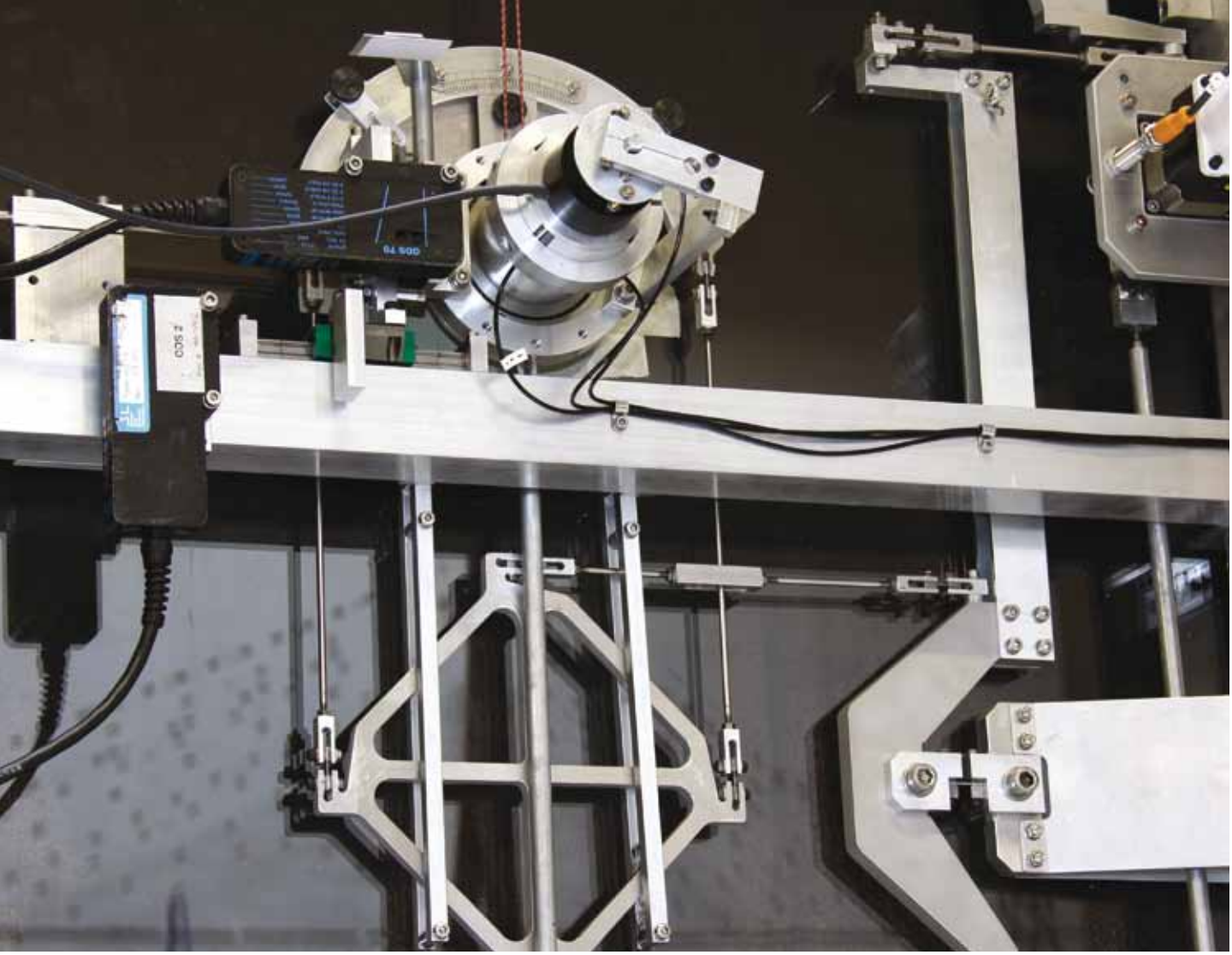
Safe_manning is developed to estimate the needed number of crew in order to run the ship efficiently and in accordance with STCW rules.

Detailed crew resource utilisation



Example of graphical view of the working load during a 900 hours operation.

- *Master*
- *Ch.Off*
- *1.Off*



EXPANDING THE POSSIBLE

Søren Vestergaard Larsen, Senior Project Manager, Hydro- & Aerodynamics.

Aerodynamic flutter derivatives are important parameters in connection with the design of flexible structures such as long-span bridges. FORCE Technology has developed a new test rig that can provide data for determination of the aerodynamic flutter derivatives in a fast and efficient manner.

With the method previously applied, FORCE Technology could provide a set of eight derivatives corresponding to a two degrees-of-freedom motion. With the new rig, we are able to provide the full set of eighteen derivatives that describe motion in three degrees-of-freedom. The aerodynamic flutter derivatives for a given bridge deck are the key parameters to the assessment of the bridge deck's buffeting response and stability limit by numerical methods. Buffeting response is a structure's response induced by the turbulence in the oncoming flow. The stability limit is the critical wind speed above which the structure is no longer aerodynamically stable.

The aerodynamic flutter derivatives can be used for calculation of the bridge deck's buffeting response and stability limit for varying dynamic characteristics of the same deck geometry, e.g., various steps of construction.

Free vibration technique

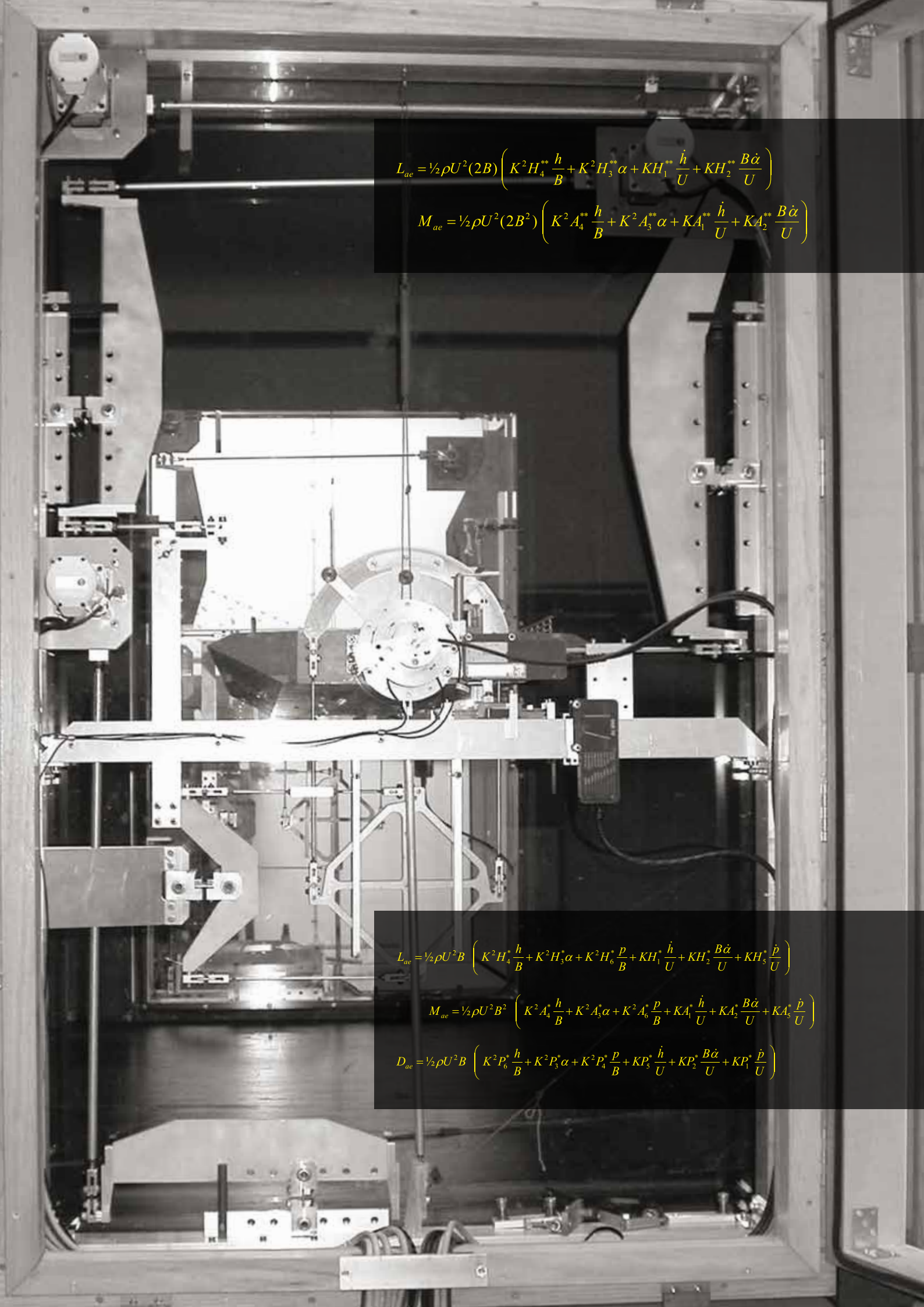
FORCE Technology used the so-called free vibration technique and system identification to obtain the flutter derivatives. However, the test method applied was limited to two degrees-of freedom corresponding to vertical motion and rotation (torsional motion). Further, the free vibration technique used was not suited for testing in turbulent flows.

Forced 3D vibration test rig

Due to the increasing demand for aerodynamic flutter derivatives for various bridge projects, a more effective test method was sought. Also, as the demand for flutter derivatives relating to three degrees-of-freedom was increasing, it was decided to establish a three degrees-of-freedom rig which can effectively provide data for the full set of eighteen derivatives - both in smooth and turbulent flows - by using the forced oscillations technique.

The new rig has already been used for a series of elaborate testing for a long-span suspension bridge.

FORCE Technology will continue to work on the development of the rig and its analysis methods in the coming years. Results obtained with the new rig were published in a paper presented during the summer of 2011 (please see the last page of this publication).



$$L_{ae} = \tfrac{1}{2}\rho U^2 (2B)\left(K^2 H_4^{**}\frac{h}{B} + K^2 H_3^{**}\alpha + K H_1^{**}\frac{\dot{h}}{U} + K H_2^{**}\frac{B\dot{\alpha}}{U} \right)$$

$$M_{ae} = \tfrac{1}{2}\rho U^2 (2B^2)\left(K^2 A_4^{**}\frac{h}{B} + K^2 A_3^{**}\alpha + K A_1^{**}\frac{\dot{h}}{U} + K A_2^{**}\frac{B\dot{\alpha}}{U} \right)$$

$$L_{ae} = \tfrac{1}{2}\rho U^2 B\left(K^2 H_4^{*}\frac{h}{B} + K^2 H_3^{*}\alpha + K^2 H_6^{*}\frac{p}{B} + K H_1^{*}\frac{\dot{h}}{U} + K H_2^{*}\frac{B\dot{\alpha}}{U} + K H_5^{*}\frac{\dot{p}}{U} \right)$$

$$M_{ae} = \tfrac{1}{2}\rho U^2 B^2\left(K^2 A_4^{*}\frac{h}{B} + K^2 A_3^{*}\alpha + K^2 A_6^{*}\frac{p}{B} + K A_1^{*}\frac{\dot{h}}{U} + K A_2^{*}\frac{B\dot{\alpha}}{U} + K A_5^{*}\frac{\dot{p}}{U} \right)$$

$$D_{ae} = \tfrac{1}{2}\rho U^2 B\left(K^2 P_6^{*}\frac{h}{B} + K^2 P_3^{*}\alpha + K^2 P_4^{*}\frac{p}{B} + K P_5^{*}\frac{\dot{h}}{U} + K P_2^{*}\frac{B\dot{\alpha}}{U} + K P_1^{*}\frac{\dot{p}}{U} \right)$$

MANAGEMENT TRAINING

Peter K. Sørensen, Vice President, Division for Maritime Industry, and Hans Schiønnemann, Owner, SLAMAT Development

Simulator Assisted Management Development - a different and more effective concept.
Can marine simulators be used for management development programs for non-mariners?
The answer is yes - indeed!

As an executive, your first responsibility is to set the direction of the company's development and communicate how to achieve these goals. Top management in a private company is responsible towards the three main stakeholders: Owners, customers and employees. And top management is responsible for ensuring that the company has a good reputation, both locally and in society in general.

Likewise, if you are a manager in a public or private organisation you are responsible towards specific stakeholders and have to follow a given strategy to reach certain goals and be able to provide certain services at a given level of quality.

Together with SLAMAT Development, FORCE Technology has launched a new management development programme based on the very effective learning transfer gained through simulator training.

The programme offers a unique way to work in a rational and targeted manner striving for individual and shared situational awareness among the managers in the organization. Jacob Sloth, Vice President Sales at Kvadrat A/S, says, 'The ship simulator brings management teams and colleagues together in a different and challenging way. Everybody in the team was without experience within sailing on commercial vessels, so the established hierarchy had to stand aside in order for us to navigate the vessel safely to port. Instead all our individual competences were brought into play in a new and mind-opening way.'

The SIMLE concept

Simulators are used for training of astronauts, mariners and pilots. Today, simulators are considered one of the most effective training tools for building competences. The value of simulator training is to be measured from the degree of training transfer that the participants experience.

At FORCE Technology, the degree of training transfer is boosted through a continuously refined approach based on pedagogical learning principles and self-recognition. This is done through debriefing sessions where each exercise is recorded on video and thoroughly evaluated with focus on increasing the participants' awareness of decision-making and communication.

SIMLE - management training using simulators.

This secures an objective and uncontested platform for evaluation and learning. In short, the learning outcome of SIMLE will be better management through:

- Establishment of shared situational awareness
- Clear goals
- Clear communication
- Less effect of human errors
- Doing the right thing first
- Better teamwork
- Disclosing and improving individual and group behaviour

The training and development themes addressed by SIMLE

- Shared situational awareness
- Effective decision-making processes
- Values in practice
- Teamwork and communication
- Minimising the effect of human error
- Constructive feedback
- Self-appraisal in the management group
- Optimising of strategy discussions and development of strategies
- Composition of new management groups

SAILING EFFICIENTLY

Christian Schack, Head of Department, Hydro- & Aerodynamics

With more than 50 years of experience with hydro- and aerodynamic testing, FORCE Technology has a unique knowledge regarding the forces and physics surrounding ships. Therefore, onboard systems are a natural product in FORCE Technology's portfolio.

Suppliers of onboard systems come and go, but what gives the onboard systems from FORCE Technology an edge is the mathematical ship models within the systems which are based on more than 50 years of practical experience within Hydro- & Aerodynamics.

A couple of years ago, FORCE Technology developed SeaSuite which is a range of products that use real-time data to monitor the ship's performance in order to maximize fuel efficiency and reduce CO2 emission. SeaSuite consists of the voyage planner SeaPlanner, the performance monitoring system SeaTrend and the trim optimisation system SeaTrim. FORCE technology has developed an advanced propulsion model which is used in our SeaPlanner and SeaTrend. The model is highly comprehensive and covers all major aspects of resistance and propulsion of a vessel in a seaway, allowing high-quality predictions of fuel consumption and emissions.

Today, more than 300 ships are sailing with or have ordered one or more of the ship performance systems.

SeaPlanner - weather forecasting and route planning

The Danish Meteorological Institute offers services within weather forecasting and route planning. The Danish Meteorological Institute is also our partner and provider of weather data for SeaPlanner. In the past, The Danish Meteorological Institute had their own system for forecasting and planning services, but in 2011, as a part of our partnership, they purchased SeaPlanner to be used as their internal system for their route planning services to seafarers.

SeaTrend - monitoring performance worldwide

The performance of a ship will deteriorate over time due to erosion and fouling of the hull and propeller. The Brazilian shipping company Rio Tinto Marine has invested in the performance monitoring system SeaTrend and installed it on 3 ships. The data from SeaTrend is accessed from a website and is used by their superintendents to plan the optimal dry docking and hull and propeller cleaning intervals.

Moreover, SeaTrend provides the land-based crew with information about voyage statistics such as fuel consumption, emissions and average speed for each voyage.

SeaLogger – a new product/service based on existing knowledge

The Danish passenger and freight line, DFDS, has over a period installed the newly developed SeaLogger on board DFDS Crown of Scandinavia and DFDS Pearl Seaways. SeaLogger has performed propulsive performance monitoring for sailing periods before and after installation of new propellers to document the performance of the new propellers.

This is done through logging the shaft torque, RPM, pitch and GPS (speed and course). The logged data and weather data for the two periods was later post-processed by means of our SeaTrend performance monitoring software to establish the propulsion analysis.

The propulsion analysis showed that the new propeller design, optimised for the operational profile of the vessels, produced significant fuel savings. As the DFDS fleet is using the FORCE Technology voyage planner SeaPlanner, the propulsion model has now been updated with the new propulsion data.

SeaTrim - selection of optimum trim

The SeaTrim decision support tool is designed to provide a quick and safe guidance in selection of the right trim in relation to the loading condition and planned speed.

SeaTrim offers large fuel savings and reduction of air emissions on all types of vessels. Especially vessels with large bulbous bows operating at light loading conditions can obtain large fuel savings.

The tool can be used both in the overall cargo planning and onboard the vessel during daily operation.

SeaTrim has just been launched in a version 2.0 with improved user interface and increased functionalities.

SeaSuite

New sales manager - onboard systems

The sale of onboard systems is going well, and the feedback from our clients is very positive.

At FORCE Technology, we have recognised the demand for reliable decision support software and have appointed a new sales manager to be responsible for our onboard systems.

Our new Sales Manager, Jacob Wiegand Clausen, is recruited from the Department for Hydro- and Aerodynamics where he has been working since 2007.

Jacob is 28 years old and was responsible for maritime aerodynamics before being appointed sales manager. Jacob is a highly dedicated person, and we are looking forward to introducing him to our customers.

Jacob can be contacted at jwc@force.dk or by phone: +45 72 15 78 89.

SeaSuite is a range of products that use real-time data to monitor the ship's performance in order to maximize fuel efficiency and reduce CO2 emission.

Fouling of the ship's hull leads to added ship resistance and thus increase fuel consumption. The performance monitoring application, SeaTrend, provides the shipowner, technical manager or the ship operator with a tool to monitor the performance of his ship.

SHIP-TO-SHIP INTERACTION

Captain Thue Rabjerg, Senior Specialist, Simulation, Training & Ports

The number of ship-to-ship operations has increased rapidly during the past years and with the increased requirement for STS operations the demand for officers trained in specific hands-on STS training has increased as well.

Side-by-side ship-to-ship (StS) transfer of crude oil, petroleum and gas cargoes has become common practice all over the world. The number of StS operations has increased rapidly and as such also the demand for senior officers trained in the manoeuvring aspects of the operation.

Going alongside a large tanker, anchored or making way, with another large tanker affected by wind, waves and current is not an easy task and even though an experienced Mooring Master or Marine Pilot might be available, the responsibility rests, as always, with the Shipmaster. Requests for StS simulator training have quite often been voiced by tanker officers participating in Bridge Team Management or Ship Handling courses at FORCE Technology. Consequently we have developed a two-day StS course targeted towards these captains and chief officers.

The aims and objectives of the course are to improve safety and efficiency of StS operations by:

- Enhancing the captains' knowledge of and skills in shiphandling in connection with StS operations
- Knowledge of correct communication and procedures
- Knowledge and understanding of the hydrodynamic forces involved in StS operations

Besides the need for knowledge and experience from the captains, the demand from major oil companies and vetting companies with regards to the captain's StS qualifications and abilities is increasing - and in this context the two-day course in StS operations at FORCE Technology will ensure the needed qualifications.

Captain at DS Norden, Harald Dam, says, 'The simulator training provided an excellent possibility to train in different StS-strategies without the financial and environmenta risks involved in real life. This gives me certainty regarding what is possible when performing StS operations.'

Simulator realism increases training transfer

StS training using FORCE Technology ship simulators is a key element in the course. The simulators give the participants the opportunity to train in a highly realistic manner.

Accuracy: Due to the mathematical framework DEN-Mark1, the interaction between the two approaching vessels in a simulated StS operation is very accurate, thus enhancing the realism experienced.

FORCE Technology has developed a 2-day course in STS operations targeted at Captains and senior officers who are involved in STS operations. The objectives of STS specific training is to bring the participants up to a high skill level in terms of close quarter ship-to-ship operations.

A successful StS transfer operation depends on proper planning, use of bridge procedure and checklists, good communication and skilled shiphandling. And all these elements can be trained and evaluated in the simulator.

The simulator calculates very precisely all factors affecting the vessels' movements. Particularly the interaction between the two approaching vessels in a simulated StS operation must be very accurate to enable a realistic simulation. Skilled captains with a wide experience in StS operations have confirmed that this is the case.

The course of events in the simulation is logged automatically. All events can be replayed in detail, either as video showing the communication and behavior of the navigators or electronic replay showing the ships' movements and manoeuvres. This enables the instructor together with the participants to make qualified analyses of the operation and pinpoint the elements which need further training.

Content of the course

Through the two-day course, the participants will gain knowledge and experience in StS-related ship handling including:

- General principles in StS operations as described in StS transfer guide (ICS & OCIMF)
- STS preplanning including contingency planning
- Performing StS operations using two simulators operating in parallel
- Communication during approach, mooring and unmooring
- Emergency aborting of StS operation
- Safe watch-keeping during StS operations
- Ship handling and manoeuvring during StS operations
- Use of operational and safety checklists
- Weather conditions, waves, wind and electrical storms
- Shiphandling theory, ship-ship interaction

Besides the 2-day course, FORCE Technology offers a 4-day course. Besides training the crew in handling of emergency situations, the 4-day course covers planning and execution of a full StS operation at speed or at anchor.

'Using CFD for Simulation of Ships with Different Fuel Saving Rudder-Propeller Devices'

Numerical Towing Tank Symposium, Duisburg, Germany, 10-12 October 2010

Claus D. Simonsen, Senior Specialist, Christian Klimt Nielsen, Project Manager, Zdravko Kishev, Project Manager, all FORCE Technology

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'The impact of Human Factors on Bridge Team performance while operating in open-confined waters'

Sub-study of the 'Study on Nautical Procedures for COGNAC2', presented to the Cooperative Research Search Group in Trieste, Italy, March 2009

Guillermo G. Garay, Senior Instructor, FORCE Technology

'Potentials for using a Vibrotactical Belt on board tug boats'

Cooperation project between DELTA/ SenseLAB and FORCE Technology, Copenhagen, December 2009

Guillermo G. Garay, Senior Instructor, FORCE Technology and Birger Bech Jessen, DELTA

'Human Factors - Safety and Performance'

Megatrade Magazine – shipping, ports and freight for the Mercosur region, November 2009

Guillermo G. Garay, Senior Instructor, FORCE Technology

'Enhancing Efficiency and Safety of Pilotage by using state of the art Full-Mission Simulators'

Latin-American Pilotage Forum – Cartagena, Colombia, September 2009

Guillermo G. Garay, Senior Instructor, FORCE Technology

'CFD simulations of KCS sailing in regular head waves'

The 2010 Gothenburg CFD Workshop, December 8-10, 2010, Gothenburg, Sweden.

Claus D. Simonsen, Senior Specialist, FORCE Technology and F. Stern

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'Extraction of aerodynamic flutter derivatives in newly developed forced motion rig with 3 degrees-of-freedom'

13th International Conference on Wind Engineering, Amsterdam, The Netherlands, July 10-15, 2011

Søren V. Larsen, Senior Project Manager
Peter Sinding, R&D Manager
Leif Wagner Smitt, Senior Specialist
all FORCE Technology

'Bridge Cables – and Wind, Rain, Ice and Snow'

Wind Tunnel International 2010, Global Wind Tunnel Symposium 2010, Pasadena, California, USA, 2010.

Holger K. Koss, Senior Specialist, FORCE Technology, Christos T. Geogarkis, DTU, Søren V. Larsen, Senior Project Manager, FORCE Technology

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'An experimental study of the water depth effects on the KVLCC2 tanker'

NATO AVT-189 Specialists' Meeting, Portsdown West, UK, 12-14 October, 2011.

L. Fabbri, E. Campana, Claus D. Simonsen, Senior Specialist, FORCE Technology

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'Viscous-flow calculations for KVLCC2 in manoeuvring motion in deep and shallow water'

NATO AVT-189 Specialists' Meeting, Portsdown West, UK, 12-14 October, 2011.

Toxopeus, S., Claus D. Simonsen, Senior Specialist, FORCE Technology, E. Guilmineau, M. Visonneau, F. Stern

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Experimental and Computational Studies of Low-Speed Tanker Calm Water Maneuvering'

NATO AVT-161 Chapter 24 in Final Report

Claus D. Simonsen, Senior Specialist, FORCE Technology, E.F. Campana

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'CFD based prediction of ship-ship interaction forces on a tug beside a tanker'

Proceedings of the 2nd International Conference on Ship Manoeuvring in Shallow and Confined Water (2011)

Claus D. Simonsen, Senior Specialist, Christian Klimt Nielsen, Project Manager, Janne F. Otzen, Project Manager, Kristian Agdrup, Project Manager, All FORCE Technology

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'Improving Safety Through the Design of a New Function: Design Process Findings and Post-release Analyses'

Designing beyond the Product – Understanding Activity and User Experience in Ubiquitous Environments. Proceedings of the European Conference on Cognitive Ergonomics 2009, Helsinki, pp. 267-274.

Thomas Koester, Psychologist, Nicholai Hyll, Psychologist, both FORCE Technology and Jan Stage, Aalborg University

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'Distributed Cognition in Ship Navigation and Prevention of Collision'

Designing beyond the Product – Understanding Activity and User Experience in Ubiquitous Environments. Proceedings of the European Conference on Cognitive Ergonomics 2009, Helsinki, pp. 202-209.

Thomas Koester, Psychologist, Nicholai Hyll, Psychologist, both FORCE Technology and Jan Stage, Aalborg University

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'Double Ended Ferries – Propulsive Performance Challenges and Model Testing Verification',

Proceedings of The Second International Symposium on Marine Propulsors, SMP'11, Hamburg, Germany, 15-17 June 2011

Anton Minchev, Chief Naval Architect, Claus Simonsen, Senior Specialist, Rune Zilcken, Project Manager, all FORCE Technology

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