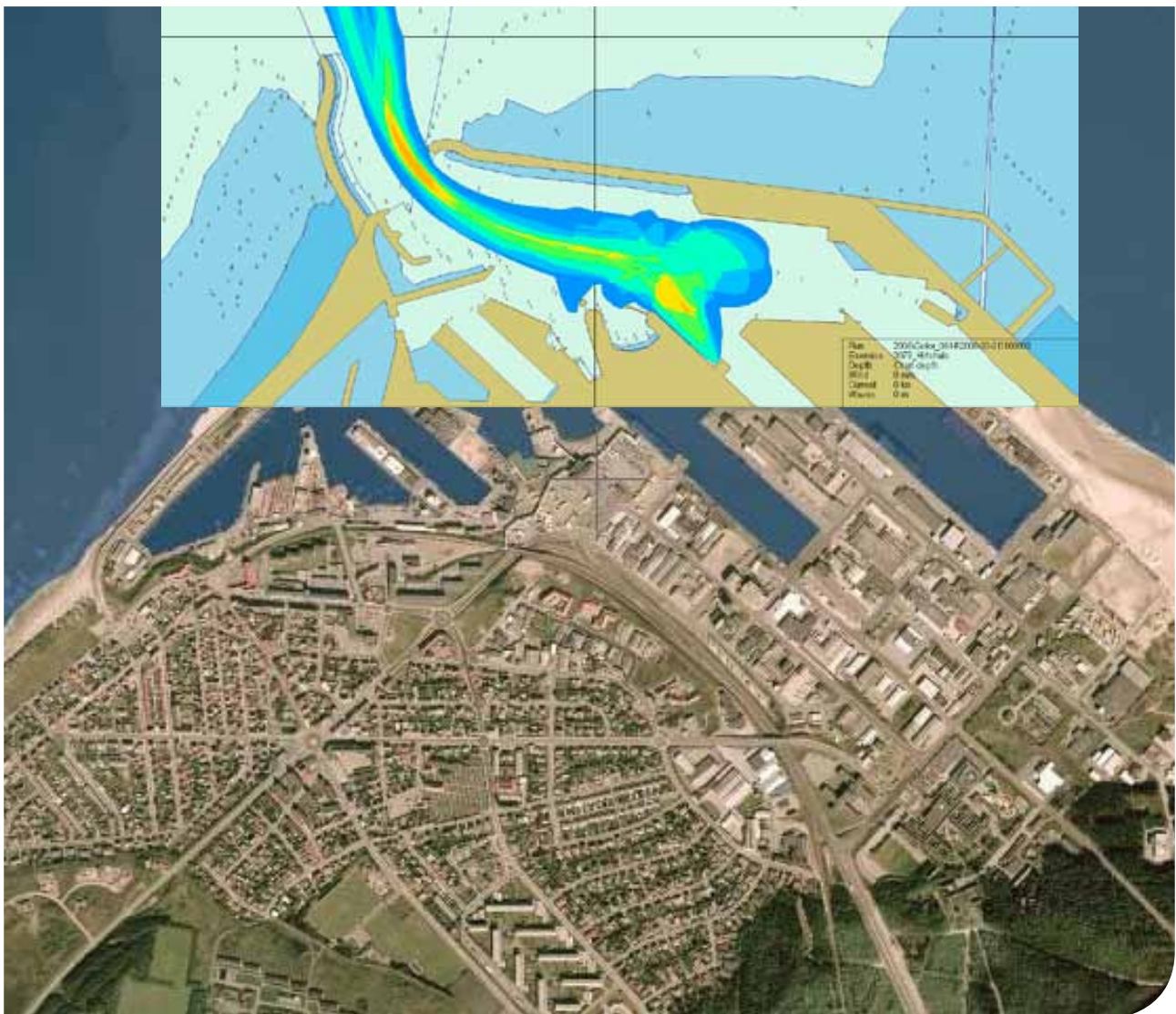


Maritime Engineering

– Accuracy, efficiency, flexibility and realism



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FORCE Technology offers knowledge that supports you in the engineering phase

- Placement of navigational aids
- Evaluation of breakwater layout and alignment, including width and alignment of approach channels
- Evaluation of arrival/departure conditions for existing or new port facilities
- Ship motions in both frequency and time domains giving accurate assessments of e.g. risk of grounding
- Ship motions of moored vessels along an open or a closed structure
- Controllability of vessels at limited water depth
- Operational guidelines including determination of tug assistance
- Risk analysis

Securing and supporting sustainable decisions

As ship sizes increase, ports all over the world face new challenges. The new and larger ships require larger berthing facilities as well as improved training of Pilots, Captains and Navigators in different and adverse weather conditions.

Changing a berthing facility or constructing a port is a decision with a wide-ranging impact on economy as well as on the surrounding environment. With today's technology and our competencies within mathematical modelling, we are able to make very precise and realistic simulations of how a given change will affect vessels and facilities in practice. By using simulation you get certainty concerning the sustainability of your decisions. At the same time you save resources by gaining knowledge on how to do the port modelling right the first time.

50 years of experience - 30 port studies a year

With close to 50 years of experience in comprehensive manoeuvring and simulation studies, FORCE Technology conducts around 30 port studies in our simulation facilities every year. The studies are conducted in order to ensure safe and efficient navigation of different types of vessels in existing or planned port facilities.

FORCE Technology's Division for Maritime Industry (DMI) has a very long record of engineering studies and optimization of port designs carried out for clients worldwide. Our mathematical ship and port models are recognized as being extremely realistic which is a prerequisite for accurate simulation.

For further information, please contact:

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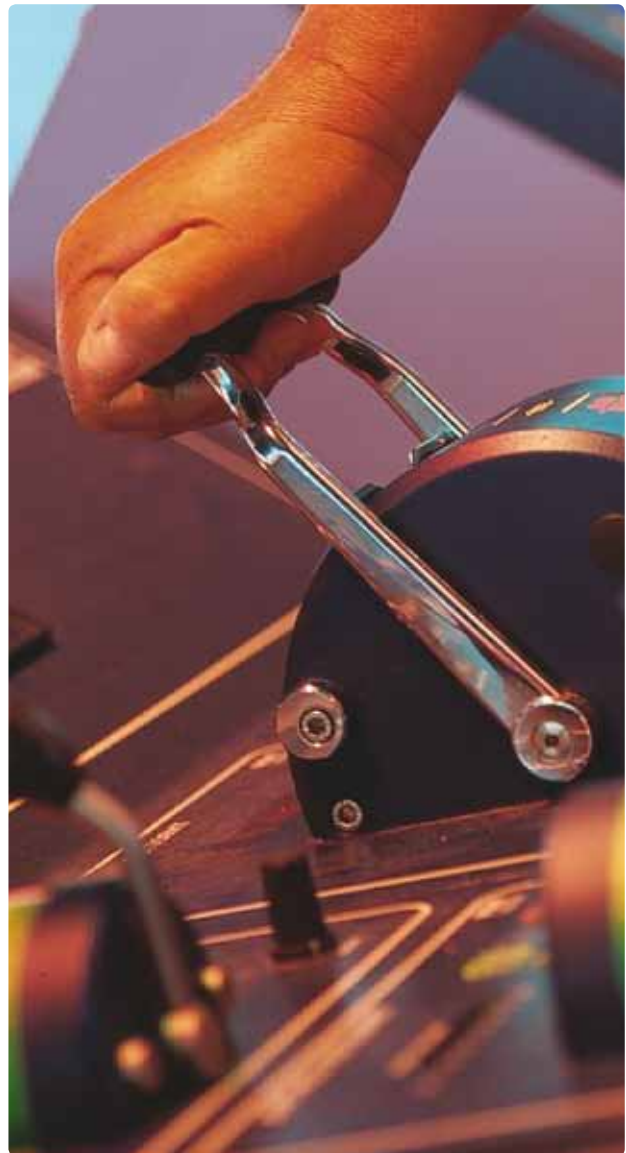
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About FORCE Techology

Division for Maritime Industry

At our Division for Maritime Industry we offer our customers extensive services and expertise within aerodynamic and hydrodynamic model testing, numerical fluid mechanics and computer-based simulations.

Our competencies within simulations are based on combining our hydrodynamic and aerodynamic facilities and know-how with state-of-the-art graphical simulation in our four full-mission simulators and three part-task training simulators, all with real bridge equipment.



FORCE Technology in brief

FORCE Technology is a leading technology, consulting and service company on the international market. We offer our expertise to a broad range of industries, such as the building and construction industry, offshore and maritime industry, pharmaceutical and food manufacturers and to the public sector.

We offer unique competitive advantages through the development of flexible, innovative and value-creating solutions that build on trust and close collaboration with our customers.

FORCE Technology's headquarters are located near Copenhagen and we also operate subsidiaries in Sweden, Norway, Russia and U.S.A. The group employs approximately 1,200 people.

Services and products

Simulation - efficient, flexible and cost saving

Simulation offers a very cost effective approach during the evaluation of the port layout as well as when placing navigational aids.

FORCE Technology has developed a wide range of simulators ranging from desktop versions to full-mission 360° field of view bridges – from initial investigations to extensive training programmes.

The core, the SimFlex Navigator simulation software, of the simulators is however the same. The simulators are based on the same mathematical model, making it possible to go from one platform to another without major changes. In short, FORCE Technology offers realistic training and knowledge about your port facility or terminal before it is built. This provides assurance and certainty about all implications of your project in advance.

Fast-time Simulation

Fast-time simulation is used to evaluate a wide range of scenarios covering changes in water level, current, wind, draught etc., and it is therefore a highly efficient tool.

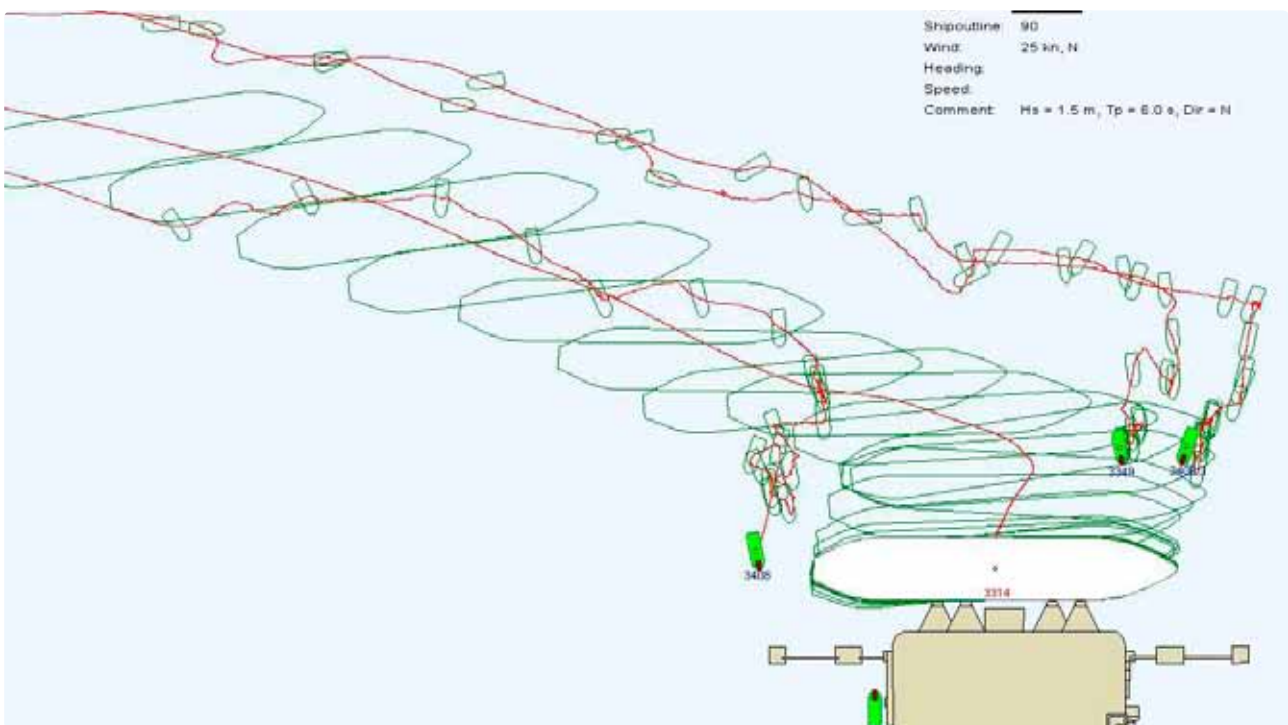
Fast-time simulations can reduce the cost of carrying out full-mission bridge simulations as problematic areas and conditions are identified at an early stage, enabling a more targeted full-mission bridge simulation scenario to be planned and executed.

Fast-time simulations are carried out in order to focus on alternative channel layouts. The simulations provide an objective quantification of the conditions and are therefore ideal for comparing different layouts.

In the fast-time simulation, a numerical navigator is used. The navigator is designed to behave as human-like as possible. It follows a pre-defined track plan, and human error or misjudgements are included as a random function with a given standard deviation to obtain a number of different tracks as well as a track envelope.

The actual sailing plan is devised in close collaboration with the Pilots navigating the channel in order to ensure that the various scenarios reflect reality. By utilizing fast-time simulations, a significant number of runs are provided, thus quantifying the findings.

The controllability of the vessel is also investigated by use of fast-time simulations to determine whether the ship is able to pass a channel under various environmental conditions. As an example, the ship may be forced to limit its speed due to squat. This might cause problems with keeping the ship in the channel because the reduced propeller thrust may not provide power to maintain steering even with full rudder. If that is the case, fast-time simulations will reveal this and the proper precautions can be taken.





Desktop study

The fast-time simulations might be followed by a short desktop study; QuickSim, carried out either at FORCE Technology or at the client's premises, using portable equipment. The simulations are real-time simulations with a human navigator to manoeuvre the ship, e.g. with the assistance of tugs to the berth.

These low-cost real-time simulations are validated through full-mission simulations with participation of representatives from local pilots, port authorities and operators.

Accuracy – a key to perfection

FORCE Technology's Den-Mark1 model is among the most accurate mathematical ship models on the market, and the backbone of FORCE Technology's services within maritime engineering.

The Den-Mark1 was developed in the period 1991 to 1993, and represents the 5th generation of hydrodynamic models developed by our institute. The model has been validated in numerous cases against model tests and full-scale measurements. With access to extensive experimental facilities, including towing tanks, wind tunnels and professional mariners, the hydrodynamic models are continuously updated and refined.

DEN-Mark1 models are used in more than 50 simulator centres around the world.

Know the consequences

Constructing or changing a port facility has a great impact on the surrounding environment. Through simulation it is possible to show the consequences of a given change, and the thus acquired knowledge makes it possible to make sustainable decisions.

In order to evaluate and verify a port layout, the selected area is modelled in the simulator with a visual model of the area.

To obtain a detailed understanding of the area and the local restrictions a meeting at the site with all involved parties is proposed. The site inspection will also be used to take photographs of buildings and other landmarks, enabling a highly realistic visual model of the area to be generated.

Based on charts and harbour drawings provided by the client, FORCE Technology is able to establish the numerical models of the bathymetry and topography. It is possible to implement wave and current fields calculated by numerical models such as the hydrodynamic model MIKE21 developed by DHI – Water & Environment directly.

The visual model is based on texture techniques. Photo textures can be applied to all fixed or moving objects thus creating a highly realistic environment. The system can provide night, dusk, and daylight scenes and reduced visibility due to fog, snow or rain.

Own Ships and traffic ships are shown in the visual scene together with buoys and navigational lights with appropriate colours, sectors and flashing characteristics. Wave action is shown in the scene according to the sea state and direction specified, and the horizon moves according to the motions of the Own Ship. Sound signals (Own Ship – traffic ships) as well as engine noise, thruster noise, wind noise and sea noise is heard on FORCE Technology's full-mission simulators.

Coupling of simulators

For engineering studies and simulations involving tug boats we have the possibility of coupling up to 4 simulators, e.g. Own Ship and 3 tug boats manned by Tug Masters. This advanced simulation tool and the involvement of Tug Masters in a realistic environment has assured valuable input on the manoeuvring strategies for new ports or terminals.





Tug simulators

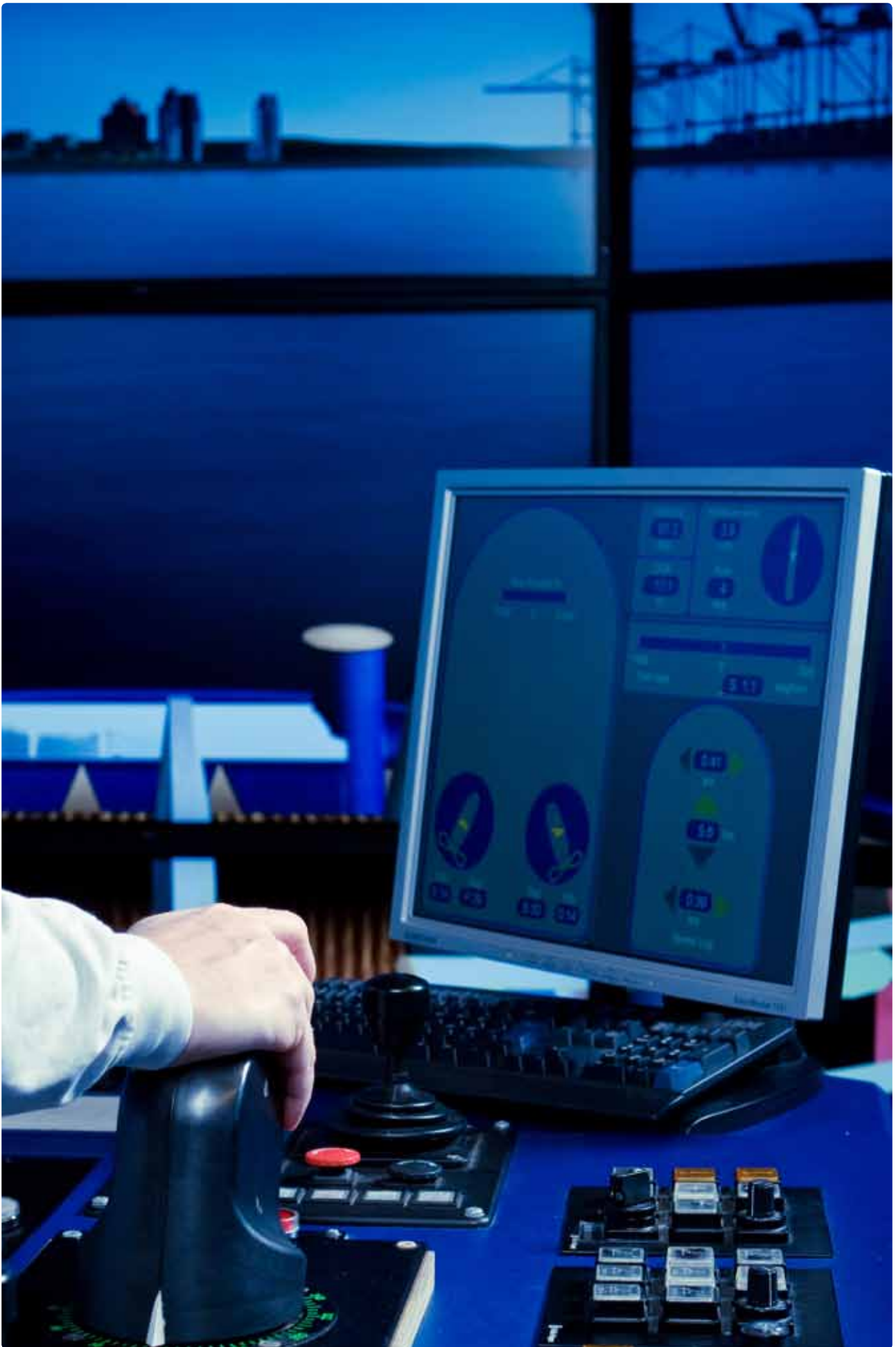
FORCE Technology's 4-coupled interactive simulators can interact with one fully modelled Own Ship and 3 fully modelled 6 degrees of freedom tugs. The tugs can be controlled by FORCE Technology's staff or by tug Masters from the local facility.

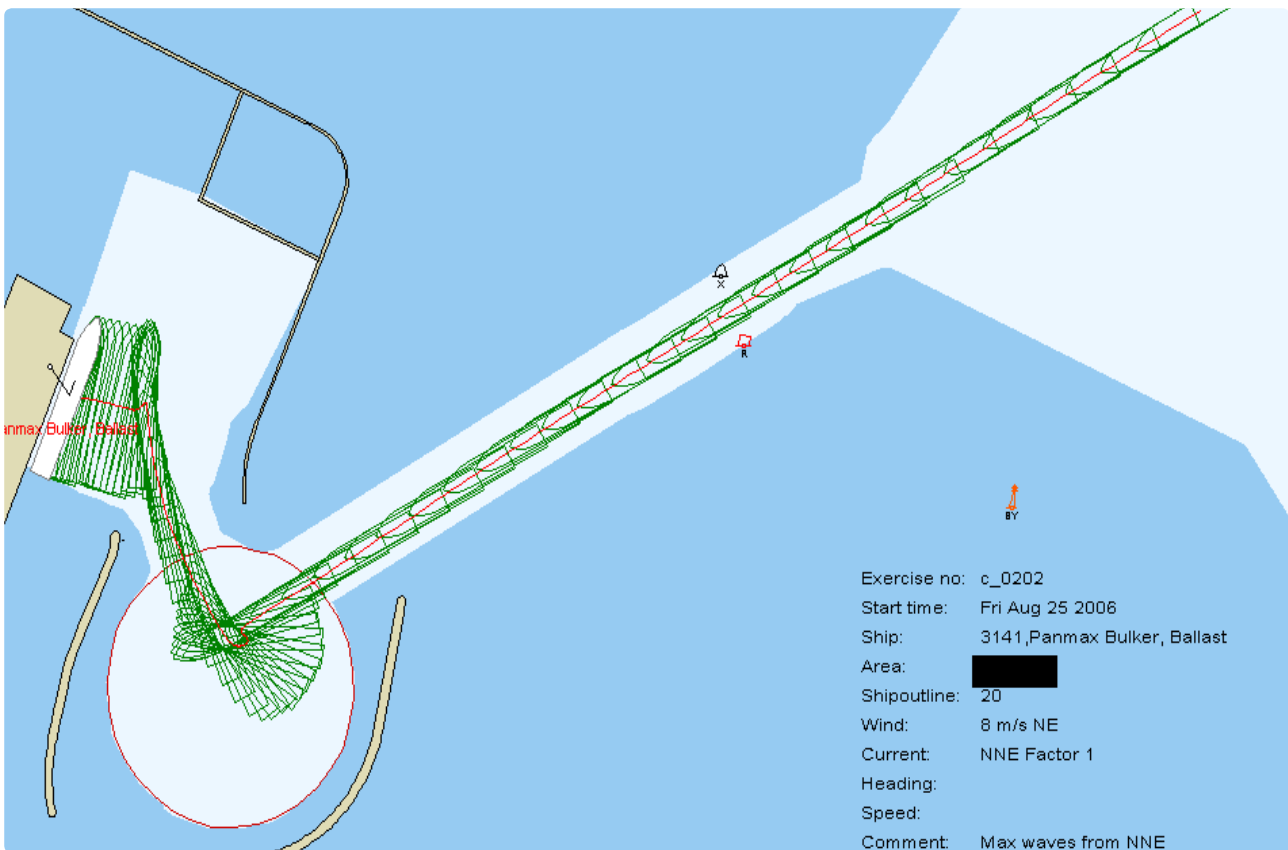
Tug size, -number, -type and -strategies can be investigated using our full-mission tug simulation system.

Improved flexibility and integration of real equipment

A realistic training environment is very important when learning to handle a ship. Realism ensures efficient and correct work routines thus minimizing the risk of accidents. Consequently, FORCE Technology strives to offer training facilities that are as realistic as possible. This has led to the integration of real handles, joysticks, instruments, back-up systems etc. in the simulators, creating a true replica of the bridge equipment onboard the simulated ships.

At FORCE Technology we specialize in providing training for crews operating special ship types fitted with special propulsion such as joystick- operated high-speed catamarans, POD-driven ferries and cruise ships, supply ships, cable layers and tugs, to name but a few.





Visual scene realism – 3D perception projectors

The SimFlex Navigator ship bridge and port simulator solutions are offered with state-of-the-art 3D perception projectors which contribute to achieving a high level of realism.

Together with FORCE Technology the client can decide on the level of detail needed for the ship model and the port database.

FORCE Technology has more than 20 years of experience in producing port models. Close cooperation between engineers and instructors ensures the optimum solution, while still maintaining a superior level of accuracy in the presentation of water depths, current, wave patterns, navigational marks, hydro- and aerodynamic effects and port layout.

Training of Pilots

One of the objectives of Pilot training is usually to familiarize them with a new port layout and the associated restrictive conditions. On one of FORCE Technology's part-task or full-mission simulators, the Pilots can train arrivals and departures under a wide range of environmental conditions.

Debriefing is a crucial element in training. After each session the Pilots and FORCE Technology's Instructors evaluate the performance using FORCE Technology's in-house developed debriefing tool MsReplay in order to propose amendments to procedures or establish the operational envelope.

As a part of the study or Pilot training, FORCE Technology can provide an operations manual addressing the manoeuvring strategies for various ship types under different loading and weather conditions. This is a great benefit to the port and Pilots as it provides valuable information to plan and execute approaches, docking and departures in a safe manner.

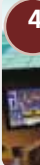
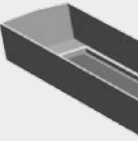
These guidelines will define the limiting conditions according to the most critical situations as well as the requirements for tug assistance. These will impact positively on both safety and efficiency.

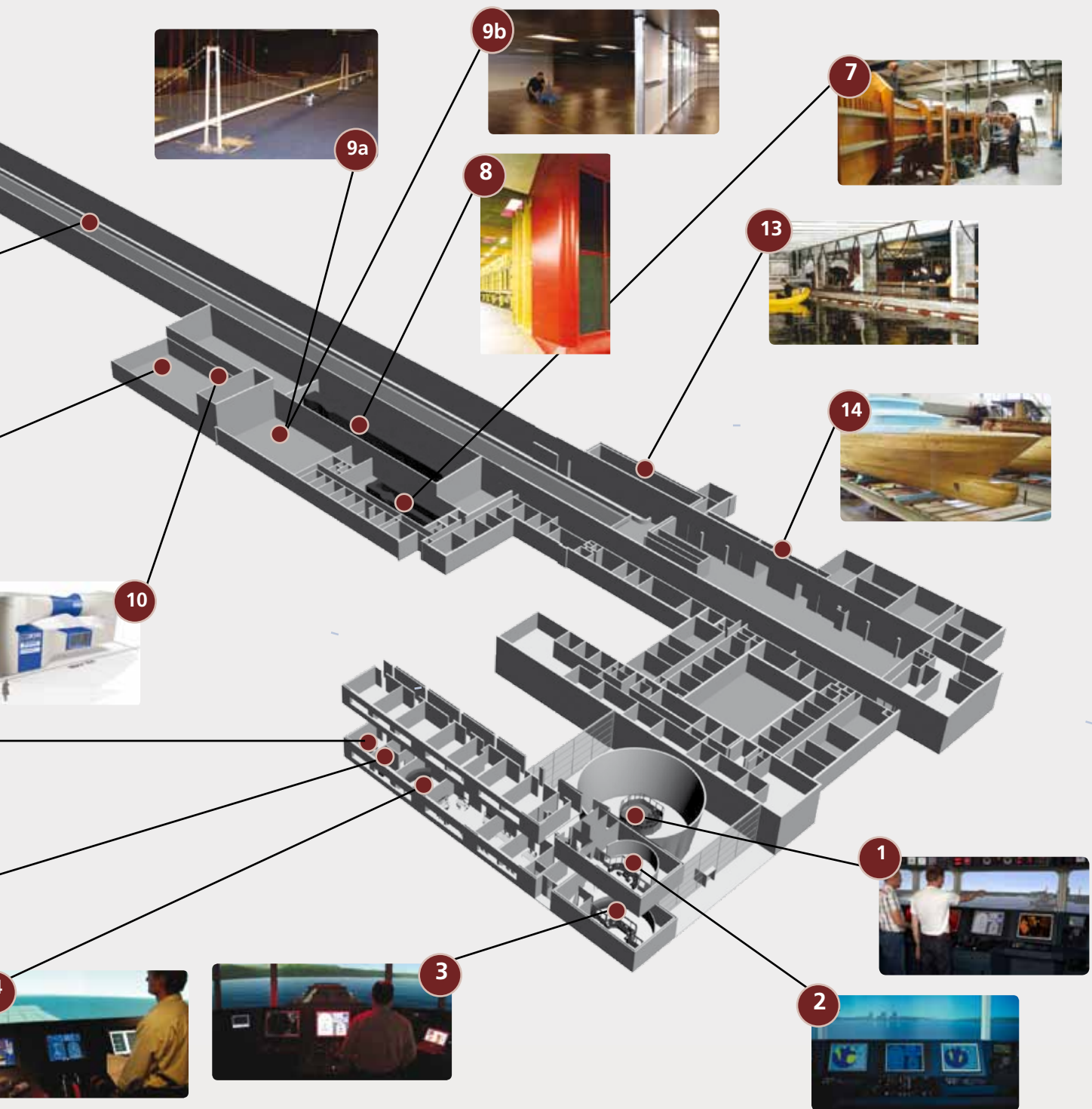
FORCE Technology has together with the Swedish Marine Authorities been instrumental in the development of IALA's guidelines No 1058 for use of simulators for design of waterways and placement of aids to navigation.

Engineering studies are planned, executed, analysed and documented according to the guideline.

Facilities

- 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 (WT1)**
Dimensions: Test section length x width x height: 2.60 x 1.00 x 0.70m
Max Flow Velocity: 80m/s.
- 8 **Boundary-layer wind tunnel (WT2)**
Dimensions: Test section length x width x height: 21.00 x 2.60 x 1.80 - 2.30m
Max Flow Velocity: 24m/s
- 9a **Wide boundary-layer wind tunnel (WT3)**
Dimensions: Test section length x width x height: 15.50 x 13.60 x 1.70m
Max Flow Velocity: 7.3 m/s
- 9b **Wide boundary-layer wind tunnel (WT4)**
Dimensions: Test section length x width x height: 15.50 x 7.50 x 1.70m
Max Flow Velocity: 12.0 m/s
- 10 **Climatic wind tunnel (WT5)**
Dimensions: Test section length x width x height: 15.50 x 7.50 x 1.70m
Max Flow Velocity: 25.0 m/s. Temperature down to -5 degrees Celsius at maximum 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: $\pm 0.2\%$ of actual value
Maximum wave height: 0.9 m
- 13 **Shallow water towing tank**
Length x breadth x water depth: 25 x 8 x 0 to 0.8m.
Speed: From 0 to 2 m/s, Accuracy: $\pm 0.2\%$ of actual value
- 14 **Workshop**
Workshop for construction of all types of models for towing tank and wind tunnel tests





Combining knowledge with technical supremacy

The strength of FORCE Technology is the unique combination of top-class know-how and facilities within hydro- and aerodynamics testing and state-of-the-art simulator and training facilities.

In our two towing tanks and five wind tunnels, we are testing and measuring everything related to ships and ports. The knowledge we gain from these facilities are used in our seven full-mission and part-mission training simulators, where we simulate conditions and train Captains, Masters, Navigators and Pilots.

By choosing FORCE Technology you get market-leading knowledge from three different but equally important areas.

Customer cases

At FORCE Technology our goal is to deliver the best possible combination of state-of-the-art simulator systems and experienced staff. Thereby we aim at ensuring a quality platform for decision makers when they design ships, waterways and ports.

Accurate ship and port models are a prerequisite when trying to match the requirements for justifiable safety levels. The width and depth of fairways, the required space for manoeuvring inside ports, the size, type and configuration of tugs are all very important aspects that call for precise validated models.

The visual systems in the simulators must be able to reflect the level of realism that Pilots and Navigators experience in real life. It has always been problematic to recognise objects visually in a simulator at the same distance as in real life. By using the latest 3-chip DLP projectors FORCE Technology ensures a high level of realism in this respect.

Simulation is indeed not all about technology. The people that operate the simulators and act as Instructors and marine advisors are the key to successful studies. All our mariners have an extensive operational background as Captains or Pilots. With their operational experience as well as experience from previous simulator studies they are able to match the maritime professionals participating in simulation studies. This is an important issue in IALA's Guideline 1058 on the use of simulators for design of waterways and planning of aids to navigation - we take this very seriously!

Emphasis is on high fidelity, realism and qualified advice through an experienced, skilled and passionate staff. This ensures that technical as well as human interaction issues can be tested during simulator-based engineering studies. The fidelity of the advanced full-mission tug simulation system ensures that both technical aspects as well as human interaction can be evaluated at a high level. This includes not only establishing a realistic simulation environment, but it also ensures that the human interaction between systems, tug and assisted vessel, response times and communication reflects reality – thereby ensuring a more realistic basis for decision-making.

Peter Krogsgaard Sørensen
Head of Department
Training, Ports & Human Factors



Peter Krogsgaard Sørensen, Head of Department, Training, Ports & Human Factors

Qatargas Guangdong

FORCE Technology won the contract for performing a qualitative engineering study and the training of local Pilots for Qflex LNG carriers at Qatargas Shipping's new LNG terminal in Guangdong.

The objective of the qualitative study was to draw clear conclusions about tug utilization for escort towing, towing configuration, transit in the channel and weather operating limits, to evaluate the possible need for upgrade of aids to navigation, and to familiarise local Pilots and Tug Masters with the new port.

The engineering study was performed in order to define operational limits. The operational limits are defined as the physical environmental limits under which a ship, without assistance, can be manoeuvred in such a way that, at no stage, all available controls are required to their full extent during an extended period of time. In other words, there should be sufficient controlling options left to manage unexpected situations or to correct error of judgement. When defining the operational limits, emergency situations should be taken into account.

Cultural difference adds flavour

Niels Arndal has been with FORCE Technology for more than 18 years. He works as a Project Manager primarily on port development and engineering projects as well as being responsible for the departments' production of port models. Niels holds an MSc in Maritime Engineering.

"We have worked together with Qatargas before on the building of Port of Ras Laffan, Qatar. Regarding the LNG Terminal in Guangdong, Qatargas hired us to determine the terminal's Standard Operation Procedures (SOP) together with the Port Authorities of Guangdong and the Chinese Pilots and tug Masters," Niels Arndal explains.

To Niels Arndal, the main objective as a project manager is getting people to reach a common understanding of the conclusions in the project. "When building or extending a port or terminal you have to be open to other people's input and contribute with your own knowledge. In the Guangdong project, our customer was from Qatar and the Pilots and Tug Masters were from China, and there are some differences in how Arabs, Chinese and Scandinavians interact socially and organizationally." The cultural differences in this particular project only made the assignment more interesting, as Niels could draw on his knowledge about different cultures, "It is exciting to see, how people with almost the same technical background but different cultural background interact. You can have all the required technical experience to do an assignment but you also have to understand how to get the message across and how to reach a common understanding; and for me that is where the good project manager excels."



Niels Arndal (to the left), Project Manager on the project.

Adriatic LNG terminal

The Adriatic LNG terminal is the first offshore Gravity Based Structure (GBS) in the world for unloading, storage and regasification of liquefied natural gas (LNG).

Terminale GNL Adriatico Srl is the company that has designed, built and will operate this first of its kind facility located offshore of Porto Levant in the northern Adriatic Sea. Today, the terminal receives an LNG carrier approximately every four days.

FORCE Technology won the contract for simulating the approach to and the departure from the terminal. There were three main objectives in the project:

1. Assessment of tug performance for the Adriatic LNG terminal by use of a ship manoeuvring simulator.
2. Testing and analysing tug configurations, combinations and capabilities in order to determine if the selected number of tugs and bollard pull was suitable to berth and un-berth a wider range of LNG carriers during an array of terminal environmental operating limits.
3. Training of local Italian pilots and tug masters. The pilots and tug masters used the same Full mission simulator and tug simulator setup with 4 on line simulators that were used for the Engineering simulation study.

Offshore experience

Robert Smyth has been with FORCE Technology for almost 10 years as instructor and project manager. Robert has sailed as Captain for more than 20 years. At FORCE Technology he has participated in numerous port studies and training sessions.

At the project concerning the Adriatic LNG Terminal, Robert was participating as an Instructor and navigational advisor and contributed with his immense experience.

Especially, working with a terminal positioned offshore was an interesting challenge. 'The LNG market has increased rapidly the last couple of years requiring a number of new LNG terminals around the world. I am proud of having had the possibility to be a part of many of these projects, mainly in the Far East, Middle East, South America and Europe. The difference between berthing and unberthing in a normal terminal compared to a GBS terminal primarily is found in the variation of wave size and length and thereby the requirements for tug assistance. The Adriatic LNG Terminal was very interesting, as the project was the first with an offshore GBS that FORCE Technology participated in.'



Simulation studies at Port Salalah, Oman

Port of Salalah is a transshipment hub in the West Central Asian Region. Therefore, the port continuously evaluates their expansion capabilities in order to attract increasingly larger tonnage.

The Dutch consultancy, Royal Haskoning, was commissioned by Port of Salalah to conduct a feasibility study on a new container terminal. FORCE Technology won the contract to review the navigational aspects of the new terminal by simulating arrival and departure to and from the new berths under different environmental conditions, e.g. monsoon wind, waves and current, and with assistance provided from the local tug boats.

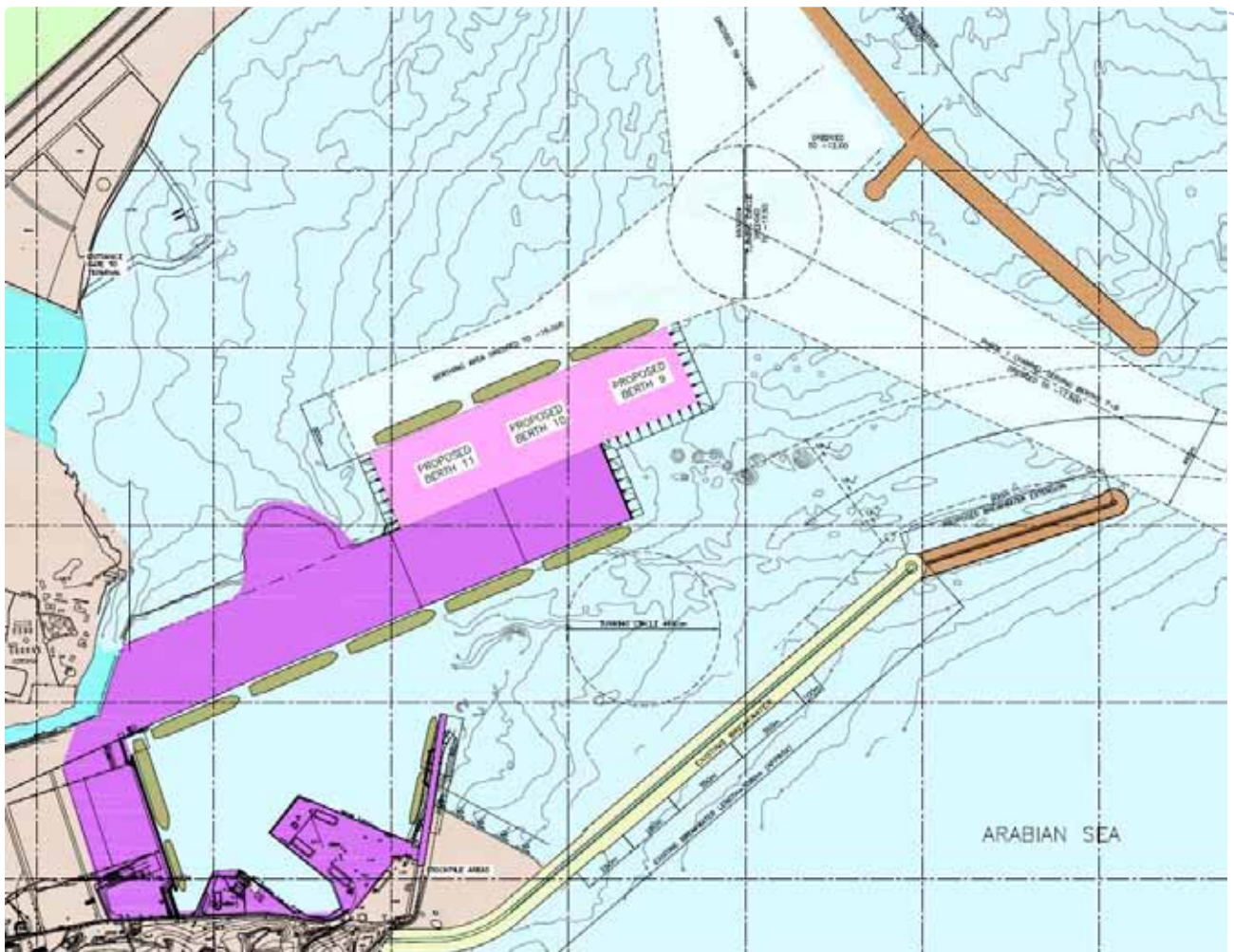
A key reason for performing simulation the studies is that Port of Salalah to some extent is affected by the influence of the long crested waves (swell) due to the position in the heart of the Indian Ocean.

In the study, ship models expected to call the proposed new terminal were selected, i.e. a 11.000 TEU container vessel, a 9.100 TEU container vessel and a 2.500 TEU container vessel.

Environmental data was provided by Port of Salalah and Danish Hydraulic Institute (DHI) in the form of wind tables, wave tables and current data tables, and the prevailing directions and speeds were used for the simulations.

Findings

Project manager, Arne Funch Mejer, explains, 'In the proposed layout, the entrance channel and the distance between the breakwaters was sufficiently wide, so the engineering study was straight forward from a theoretical point of view. But even though the overall conditions for receiving calls from container ships of up to 11.000 TEU were fine, the simulation study provided recommendations on modifications of the layout that would make the port more efficient in its daily operation.'



Ship manoeuvring study with 11 different cruise ships

Determination of operational limits for cruise ships arriving at and departing from the Port of Stockholm.

The Port of Stockholm can accommodate up to 10 cruise vessels at a time at its nine berths and at a mooring buoy. In order to evaluate the risk associated with the operation of different sizes and types of cruise ships arriving at and departing from the Port of Stockholm, the Swedish Maritime Administration assigned FORCE Technology to do a qualitative simulator study.

The purpose of the study was to evaluate the safety level and operational limits for 11 different cruise ships and their passage of nine narrow areas of navigational interest during the voyage to and from the Port of Stockholm. Furthermore, an important objective was to determine the influence of human factors on the safety level.

During the 14 days of training a total of 342 simulations were completed by 7 pilots from the Port of Stockholm. The simulations were carried out at the simulator centre of FORCE Technology, Division for Maritime Industry.

Risk assessment the important factor

Captain Magnus Anderson was one of the navigational advisors on the project. Magnus Anderson has experience both as a pilot in The Port of Malmö and as a Navigator and Staff Captain on large cruise vessels. One of the major advantages of having Magnus Anderson onboard the project is his recent operational experience from large cruise ships where he has been responsible for navigation and manoeuvring. "Sailing a large cruise ship through the archipelago is a safety critical task. With small margins, the consequences of error, technical or human, are likely to be severe."

Magnus Anderson emphasizes the importance of considering all factors when performing risk assessment. "When assessing the risks involved with this kind of operation it is important that as many hazards as possible are identified. And the hazards are many and the interface between sophisticated technical equipment, forces of nature and human operators add to the complexity."

Therefore, it is important that procedures and practices are set by taking not only the physical limitations into account but also the human limitations and shortcomings. Magnus Anderson elaborates, "Essentially, the whole idea is to ensure that the operation continues with the risks involved reduced to As Low As Reasonably Practical (ALARP). In relation to this project, our risk assessment resulted in a number of recommended control measures to mitigate the risks of the identified hazards."



Captain Magnus Anderson (to the right) was one of the navigational advisors on the project

Marine Safety simulation study in Canada

Recently, FORCE Technology completed a comprehensive full-mission bridge simulation for the Northern Gateway Pipelines project ordered by Enbridge Inc.

The objective was to confirm that VLCC's (Very Large Crude Carriers) could safely and efficiently navigate from open sea at the North West coast of the Canadian British Columbia and through the Douglas passage all the way to the proposed location of the Kitimat Oil Terminal.

In order to identify all safety sensitive areas, fast-time simulations were conducted and then further studied through real-time full-mission simulations. For the latter, the advanced tug simulator system was used to provide accurate input to manoeuvring strategies. Furthermore, using the tug simulator system confirmed the best navigation option and contingencies along the proposed routes. The tug simulation system was composed of four interactive simulators where tug masters operated advanced fully modelled tugs, while coastal pilots operated the tankers.

The results of the study are being used to establish operational procedures and determine the guidelines for safe operation in relation to the local weather conditions. These findings will be used as input to an extensive training program for pilots and tug Masters who will be involved in the operations in the future. The project is currently scheduled for completion in 2014, subject to the completion of satisfactory shipping agreements and subsequent regulatory approval.

Jens Bay was the project manager of the conducted simulation study. Jens has been with FORCE Technology for more than 10 years. Jens holds an MSc in Maritime Engineering and has been project manager for a very large number of similar studies over the years.

"The Enbridge project is economically important to the Canadian society as the oil from Alberta contributes vastly to the Canadian economy. At the same time the transportation of oil requires extensive safety and environmental considerations.

Therefore, it was crucial to determine if it was possible for the large VCCL's to operate from open sea and through the archipelago on the west coast of British Columbia and under which conditions it would be safe," Jens explains.

As the consequences of an accident are enormous, it is crucial that the engineering studies performed are precise and uncovers all possible risks. In order to perform the studies satisfactory, it is necessary to customise the analysis for the specific assignment. Jens elaborates, "At FORCE Technology we have the technology, the methods and the experience to solve these kinds of studies. One of our key competencies is the ability to tailor-make the methods and analysis to the assignment, thereby providing the customer with the answers they need in order to make the right decisions."

"Enbridge takes marine safety very seriously and we chose FORCE Technology for this important work due to their experience and advanced technological expertise in marine simulations,"

Cynthia Hansen, Director, Operations Services with Enbridge.



Jens Bay (to the right) was the Project Manager on the project

FORCE Technology's collaboration to the Peruvian port development

Melchorita LNG Terminal

The Peru LNG project developed at Melchorita, is one of the most important resources of the Peruvian Government's future energy strategy and is considered one of the largest industrial projects ever to be undertaken in the country. The total investment for the project was of US 3,8 bn. The LNG terminal built at Pampa Melchorita in the town of Cañete, was officially inaugurated in June 2010 and it is the first liquefaction plant in South America.

The selection of Pampa Melchorita was based on its oceanic conditions suitable for reliable tanker and berthing operations and confirmed by offshore engineering studies, including the assessment of maximum operating metocean limits for the permanent berth facilities assisted by four full-time tugs on location conducted at FORCE Technology facilities.

The engineering studies conducted at FORCE premises also included a dedicated training with the aim of familiarizing Pilots and Tug Masters with the particulars of large LNG tankers (90,00 – 173,400 m³) and ASD tug handling (80 tn bollard-pull) in that particular environment. The training included emergency procedures as well as various strategies to be implemented under critical or demanding situations.

Standard Procedures require a minimum of two pilots on board LNG tankers docking and undocking at the terminal and these pilots have all undertaken the particular training developed at FORCE Technology.

Captain Guillermo Garay exchanged opinions with many of the harbor Pilots and tug Masters during and after the training had been completed and all of them were of the opinion that "they have not only made a significant progress in handling these ships but also gained a solid confidence when Pilots and Tug Masters started team-working in the simulators".

Later on, one of the instructors Robert Smyth, learnt from Port authorities at Matarani about the outstanding performance of Pilots and tug Masters when operating for the very first time these ships. Captain Guillermo Garay also highlighted the issue that many of the navigators attending this dedicated training, never had been on board these types of vessels so they started their training with a limited knowledge and no skills.

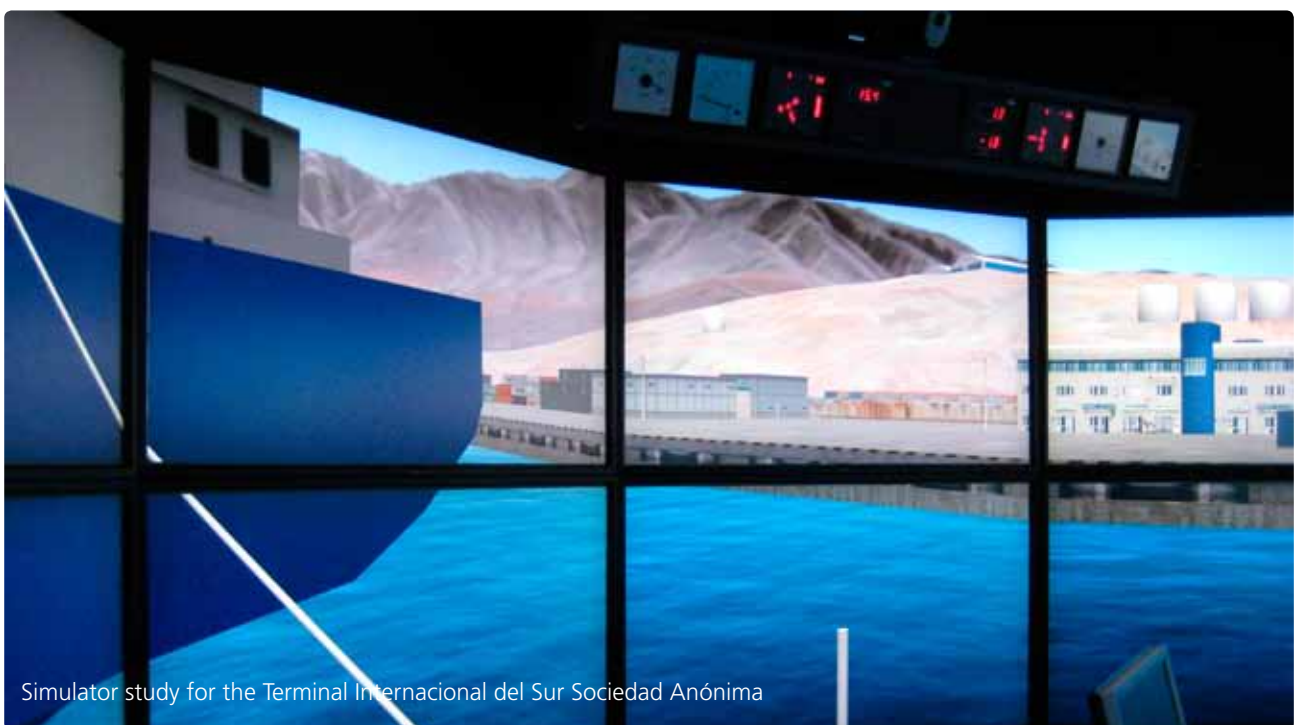
Matarani Engineering study

Terminal Internacional del Sur Sociedad Anónima (TISUR), contracted FORCE Technology in order to evaluate the safety and efficiency of the terminal of Matarani in Arequipa.

This strategic port in the southern part of Peru constitutes the Bio-Oceanic corridor between the principal cities of Bolivia, Paraguay and lately integrating important regions of the southern part of Brazil. The study not only evaluated the current terminals at Matarani but also the planned mooring sites both at Caleta Islay and inside the port. The study also determined the minimum tug requirements for the safe operation of each terminal.

Local Pilots and harbor Masters took part in the study in order to provide their expertise as well as to bring about solutions to their concern and needs. The study identified core aspects within the operational environment that will enhance Matarani's top performance and safety in its daily operations and included a risk assessment chapter where potential hazards were analyzed and recommendations were made in order to reduce or eliminate potential risks.

The recommendations included the minimum tug requirements for the different operations both at Matarani and at Caleta Islay, using ships up to 245 m in length under rigorous weather conditions. "The representatives of Matarani, both the Harbor master and the Tug master, were pleasantly surprised with the knowledge they also acquired during the study in terms of new strategies in the use of ASD tugs for docking and undocking operations" commented Captain Guillermo Garay.



Simulator study for the Terminal Internacional del Sur Sociedad Anónima

Reference to National and International Standards

In December 2007, IALA issued a new guideline (IALA Guideline 1058), Use of Simulation as a Tool for Waterway Design and Aids to Navigation Planning.

In general, the new guideline provides input to which simulation tools that are available (fast time, desktop, part task, full mission and traffic flow), how to select a specific simulation tool for a given task and how to plan, analyse and report a simulation study. The guideline also suggests important issues to consider regarding the capability of the simulation software and the advantages and limitations of each type of simulation tool. Finally, the importance of accuracy and realism should be carefully considered. In this connection, it is important to understand that such studies require very accurate mathematical models for the vessels and accurate input data (bathymetry, current, waves etc.) for the areas to be studied in order to be able to provide a sufficient basis for decision making.

In addition studies should be carried out by experienced engineers and mariners, including tug masters, with recent operational and simulator experience, that focus shall be on the technical aspects when determining the operational limits, but also on the Human Factors aspects, and that the facilities used shall have a certain quality and standard. FORCE Technology has fully implemented the IALA guideline and lives up to the best standards within the industry.

The simulator centre is recognized by the Danish Maritime Academy (DMA) as a maritime training institution, and the development and implementation of training courses is conducted in full compliance with the Danish Maritime Authority's guidelines for Quality Management of Maritime Training and Education and STCW 95.

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Further information

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