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WHAT WE CAN DO FOR YOU

A port contains all components of a city. The planning and design of port complexes therefore requires a vast number of interrelated services. Ramboll provides all necessary services and will assist clients through all phases of a project.

Ramboll can provide you with professional and independent consultancy services in all areas of port, coastal and marine engineering. Our competent and dedicated staff has comprehensive experience from national as well as international projects.

We undertake both major and minor projects and assist clients throughout all phases of a project from the earliest planning and pre-feasibility studies to master plan studies, design, and tendering. Further, our services include assistance during construction, operation and maintenance.

It is our policy to work with local companies and hire local manpower. We benefit greatly from their in-depth local knowledge and are hereby able to adapt projects to local conditions and economies. Through such joint ventures, important know-how and technology are also transferred to our local partners.

ABOUT RAMBOLL

Ramboll is a leading engineering, design and consultancy company founded in Denmark in 1945. We employ 13,000 experts in the Nordics, North America, the UK, Continental Europe, Middle East and India, supplemented by a significant representation in Asia, Australia, South America and Sub-Saharan Africa.

With more than 300 offices in 35 countries, Ramboll combines local experience with a global knowledge base, constantly striving to achieve inspiring and exacting solutions that make a genuine difference to our customers, end-users, and society as a whole. Ramboll works across the markets: Buildings, Transport, Environment & Health, Water, Energy, Oil & Gas and Management Consulting.

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FEASIBILITY STUDIES - A BASIS FOR DECISION-MAKING

Based on consistent development scenarios, we prepare feasibility studies and provide expert consultancy in port master planning.

The feasibility study typically includes technical investigations, traffic analyses, financial analyses and environmental impact analyses. Further, Ramboll will also assist with conceptual and preliminary designs, authority management and development policy.

Financial and economic evaluations are typically based on the set up of traffic forecasts. Ramboll is uniquely qualified to identify and analyse port cargo-potentials and to subsequently prepare a reliable viability analysis.

In-depth technical, environmental and economic issues must be evaluated when greenfield seaport projects are considered. Ramboll can assist port authorities, municipalities, and other decision-makers with preparing a basis for decision-making. We have vast experience within project management of large projects through all phases from pre-investigations and planning to design and project implementation in the field.

Feasibility studies typically form the basis for investor decision-making. Ramboll is well qualified to prepare feasibility studies that fulfil the specific requirements of development banks. Based on our feasibility studies, we have helped clients get financing for their projects, notably from the World Bank (WB) and Asian Development Bank (ADB).

Feasibility studies often comprise traffic forecasts, technical investigations, port planning activities, environmental and socio-economic impact assessments – and viability assessments.

**SELECTED SERVICES**

- Traffic forecasts
- Technical pre-investigations
- Site surveys
- Evaluations of coastal processes and impacts
- Environmental impact assessments (EIA)
- Socio-economic impact assessments (SIA)
- Port planning
- Master planning
- Infrastructure planning
- Conceptual design
- Financial and economic viability assessments
- Project structuring
- Tender documents for EPC/Turnkey tender

**FEASIBILITY STUDY**

- Traffic forecasts
- Technical investigations
- Port planning
- Environmental impact assessments
- Socio-economic impact assessments
- Feasibility assessments
- Basis for: Decision on project implementation
Ramboll assisted Sri Lanka Ports Authorities (SLPA) with planning the development of a new major greenfield seaport at Hambantota, situated on the south coast of Sri Lanka. Hambantota Port is expected to relieve Colombo Port and is intended to support the growing demand for servicing large vessels.

The new seaport will eventually have a water depth of 23 metres, and the complete reserved port area is 15 square kilometres. The seaport will contain a wide variety of terminals, including a dry bulk terminal, liquid bulk terminal, break bulk terminal, Ro-Ro terminal for vehicles and a container transshipment terminal. The harbour basins are located inside an existing natural lagoon and the entrance channel will be protected by the construction of two breakwaters that will be 500-1500 metres long.

Ramboll has carried out detailed feasibility studies including: Site identification, analysis of land use pattern and constraints, coastal surveys, geotechnical and geophysical field investigations, mathematical modeling and evaluation of coastal processes, traffic forecasts, environmental assessments (IEE and EIA), socio-economic assessments, port planning, conceptual design and costing of primary port and marine structures, economic and financial viability assessments, commercial and financial project structuring, master planning and phasing of the project. Ramboll worked with local Sri Lankan firms, including Lanka Hydraulic Institute.

Following the finalisation of the detailed feasibility study and port master planning, the first phase of the port development was initiated, comprising a service, liquid bulk and multipurpose terminal. Construction works corresponding to costs of approximately 450 million USD, were financed by the Chinese government and carried out by Chinese contractors.

Ramboll prepared a detailed port feasibility study for the Kvanefjeld mining project. The mine is planned for producing rare earth minerals and uranium. Ramboll compared different options for locating the port in the area. A master plan layout was prepared for the chosen location. The project included capacity calculations, conceptual design for all storage and other operational facilities as well as equipment (e.g. conveyors, loaders and unloaders as well as stackers and reclaimers) for handling bulk cargo.
**FEATURE PROJECT**

**PHILIPPINES GLOBAL GATEWAY PROJECT**

Ramboll has performed a feasibility study for a combined new Sangley Airport and Seaport Project in Manila, Philippines, envisaged as the new gateway to Manila and the Philippines.

**Ports make the world go around**

Ports meet a demand for efficient and environmentally sound cargo and goods transport.

The size of vessels is increasing dramatically. This necessitates more efficient and environmentally sound transport, but port facilities must also be consolidated and expanded, water depths increased and local infrastructure like roads and railways improved. This is all part of the equation when we look at globalisation, technological innovation and the increasing concern about the environmental footprint.

A new gateway to Asia

With a GDP growth of 7% per year, the Philippines is among the most rapidly expanding economies in Southeast Asia. The Philippine government’s vision is clear: In the coming decades, the Philippines should become an economic epicenter of Southeast Asia. Yet much of the Philippines’ economic and social potential remains untapped, and the country could play a much stronger role in the global village. Experts and politicians agree that a clogged infrastructure is at the heart of the problem.

A multidisciplinary team of experts from Ramboll’s Aviation team, the Global Port Sector and the Transportation Planning and Urban Development Department has already conducted the feasibility studies for the combined Sangley Airport and Seaport Project in Manila.

**Securing a sustainable port development**

The All-Asia Resources and Reclamation Corporation (ARRC) in the Philippines – the private developer on the project - commissioned a study that includes a new international airport and seaport with supporting traffic infrastructure comprising roads, bridges, an immersed tunnel and a light rail connection. The new international airport will be state-of-the-art, with an ultimate capacity of 90 million passengers per year. The new seaport will be configured as a modern terminal with the latest logistics and equipment technology, initially handling two million containers (TEU) annually, but with the capacity to expand to as many as ten million containers (TEU) in stages. The expansion element ensures that the seaport can respond to changing needs, potential downsizing or even the relocation of the existing terminals in the city centre, thus securing the sustainable development of the port in future.

Establishing the new airport and seaport on reclaimed land in the outskirts of Metro Manila offers some
unique possibilities and advantages. The seaport will be located close to important existing and planned special economic industrial zones in the vicinity. Reducing the overall transport of containers on the Manila road network and enabling short-distance container transport between the seaport and the industrial zones will relieve some of the serious congestion problems in Metro Manila.

Positive interaction with stakeholders
A large number of stakeholders, including the Ministry of Transport, airport and port authorities, urban development authorities, economic zone authorities and the national development board have all been consulted in the process. This extremely positive interaction has shown how dialogue can turn a set of common goals into results, in this case a multidisciplinary gateway project that will help unlock Manila’s and the Philippines’ strong economic potential while also contributing to new, sustainable developments in the city centre.

Services provided
The feasibility study consisted of stakeholder analyses, market forecasts, geotechnical assessments, coastal hydraulic assessments, Initial Environmental Evaluation (IEE), port planning, airport planning, infrastructure planning, urban planning, financial assessments and draft business plans.

COASTAL HYDRAULIC ANALYSIS
Impact on current and wave patterns was studied using MIKE 21 HD and SW models which are state-of-the-art numerical tools for studies and analysis of currents and waves in ports and near-shore areas. Furthermore, the modelling resulted in prediction of maximum wave heights during a typhoon scenario. Finally, the modelling resulted in assessments of the impact on the sediment transport in Manila Bay.

MASTER PLANNING AND CONCEPTUAL LAYOUT
Forecasts of cargo/vessel traffic and design vessels during the next 25 years were used as basis for master planning and conceptual layout of the seaport and planning of required equipment, facilities and structures. The master plan and conceptual layout was coordinated with the obstacle zones (flight zones) in the adjacent airport layout.

Highly complex projects
Port projects are generally becoming increasingly complex and challenging. They tend to be high profile and often entail integrated transport systems involving rail, road, seaports and airports. They are projects we want to work on in Ramboll.
When port authorities consider expanding and upgrading port facilities to accommodate new or larger vessels, a number of facilities may need to be reconfigured such as, for example, berths, land storage areas, mooring systems, and scour protection.

The first step, however, is evaluating and analysing the facilities. Ramboll will assist port authorities with all necessary evaluations and analyses. The need to keep up operations during expansion and upgrades is duly considered in all our studies.

In our evaluation of the manoeuvring conditions at project sites, we include real-time ship simulations—preferably carried out by local captains. In the design of mooring arrangements and quays, the dynamics of moored ships, which are influenced by wind, waves, currents and passing ships, are analysed using numerical mooring models.

The crucial analysis of wave climate in coastal regions, wave agitation and sediment processes in ports, coastal development and particle dispersion in oceans, rivers and estuaries, are carried out using the internationally recognised MIKE 21/3 and LITPACK models, developed by DHI. The models are used by our highly qualified staff, who are experts in ports, hydrodynamics and coastal morphology.

**SELECTED SERVICES**

- Determination of design vessels
- Assessment of coastal hydraulic conditions
- Assessment of manoeuvring conditions
- Assessment of geotechnical conditions
- Port logistics
- Terminal planning
- Assessment of infrastructure conditions
- Assessment of constraints
- Assessment of Environmental conditions
- Preparation of port layouts
- Preparation of layout of breakwaters, harbour basins and entrance channels
- Infrastructure planning
- Port master planning

**01 Gdansk, Container Terminal Expansion, Poland**

The Container Port in Gdansk is in a very positive development which requires an expansion of the existing terminal. DCT Gdansk employed Ramboll to carry out a conceptual design, including a new approx. 650 m long deepwater quay and approx. 32 hectares of storage area in the hinterland. The new deepwater berth has been designed to meet the requirements set by Maersk Line vessels in a size of 18,000 TEU.

**02 Søby Harbour, Port Expansion, Denmark**

Port of Søby comprises several port activities, including a ferry harbour, a pleasure boat harbour and a shipyard with 3 dry docks. The shipyard plans to expand with a new larger dry dock, and also 2 more berths are planned. Due to the compact layout, a port expansion is required. Ramboll has prepared expansion layouts, and modelling and assessments of wave tranquillity and sediment transport along the coast and port entrance. Further, Ramboll has prepared EIA Scoping, and the following EIA.
03 Port of Copenhagen, Denmark
The Port of Copenhagen wanted to develop a new cruise terminal in order to accommodate the increasing number of large Voyager Class cruise vessels that call every year. It has been built in the North Harbour along the existing approach channel, Kronløbet. The project comprises the development of a 900 metre new quay and quay area, connection roads, terminal buildings and adjustments to the existing approach channel.

04-05 Port of Copenhagen, Denmark
The planned position of the new terminal, close to the existing approach channel to the port, implied need for an evaluation of wave interaction between cruise vessels moored at the new cruise terminal and passing ships. Apart from traditional preliminary investigations such as modelling and assessment of wind and wave conditions, geotechnical investigations and assessment of erosion conditions, Ramboll has been responsible for special analyses of manoeuvring conditions and simulations and evaluations of ship movements and mooring conditions. Ship simulations and mooring studies were carried out at Force Technology, utilising state-of-the-art simulation facilities and specialist know-how.

06 Runavik, Port Development Plan, Faroe Islands
The Skalafjordur inlet in the Municipality of Runavik offers protected waters and suitable conditions for establishment of new port activities and terminals which can relieve Port of Thorshavn. The Municipality envisages establishment of a container terminal, ferry and cruise terminal, and port facilities for offshore activities. Ramboll prepared a port development plan for the Municipality of Runavik, which holds the second largest port in the Faroe Islands.
PORT DESIGN - PREPARING TECHNICAL SPECIFICATIONS

Ports are continually being developed in response to changing cargo traffic patterns and climate. Ramboll has been involved in many new port projects around the world and can assist port authorities and municipalities with all design aspects of such projects from planning and conceptual design through detailed design and supervision.

Ramboll has experience within all types of marine works from small marinas to large ports. Ramboll’s expertise includes the following:

- Large cargo ports, such as general cargo ports, container ports, dry bulk ports, liquid bulk ports, oil terminals and LNG terminals
- Fishing ports
- Small harbours, such as marinas
- Ferry ports
- Dry docks and floating docks
- Fairways, dredging, land reclamation, stabilisation of sediments
- Breakwaters
- Coastal protection, such as groins, revetments, beach nourishment, etc.

Port structures are optimised based on evaluations of local conditions, including soil and hydraulics. Ramboll is able to assist with optimisations of all port structures from breakwaters, pavements, moorings, scour protection, ramps, and installations. In most cases we carry out port rebuilds, while the existing port is running. In fact, we have assisted a large number of ports around the world with solutions that facilitated rebuilds with minimal interruption of port operations.
01 Hirtshals, Denmark
During the last 15 years, Ramboll has been consultant for a large number of port projects in Hirtshals, a port in the northern part of Denmark. Our projects included new breakwaters, a new container quay, and an expansion of the existing Color Line ferry terminal including new quay structures, ramps and a complete rebuilding of the approach area.

02 Port of Helsinki, Finland
Port of Helsinki in Finland opened a new cargo port at Vuosaari 2008. As Finland’s new main port, it offers efficient transport with frequent shipping services to Central European ports as well as direct connections to the entire Finnish main road and railway network. The new location of the main port eases the traffic of downtown Helsinki significantly, as heavy traffic is transferred to Vuosaari.

The huge six-year project with a total cost of 682 million euros employed about 100 engineers from Ramboll. Our experts were involved in a large number of planning tasks for traffic and land structure engineering as well as environmental impact assessments and ground surveys. Ramboll carried out the design of the new Ro-Ro / Ro-Pax ferry terminal in Vuosaari harbour for Finlines’ German traffic ferries.

03 Beirut Quay 12-14, New Container Terminal, Lebanon
Port of Beirut has been rebuilt a number of times to accommodate the growing sizes of modern container vessels, and is now expanded again. Ramboll has been responsible for detailed design related to the expansion of the new Quay 12-14 – including the construction of a new 500 m deep water block quay wall, planning and specifications of dredging works in front of the new quay wall to ensure a water depth of 15.5 m, reclamation works in the old harbour basin to make space for an additional 20 hectares container terminal, as well as new fenders, bollards, crane rails, pavements.

04 Liverpool cruise liner facility, UK
Liverpool’s new cruise liner facility is located on the historic Liverpool quayside — part of a UNESCO World Heritage Site — and immediately adjacent to the famous Liver Building. The 250 m long × 25 m wide floating facility has reception and pilot boat buildings, a covered walkway and a marshalling area for the large number of coaches which serve cruise liners as big as the Queen Mary II. The facility includes a 90 m double lane floating linkspan and a floating platform constructed of four reinforced concrete pontoons each 60 m long × 5 m deep with a freeboard of just over 2 m.
The industrial port of Jorf Lasfar in Morocco is undergoing major rehabilitation and extension works, facilitated by Ramboll’s detailed engineering design. The 190-hectare site opened in 1982 with berths for exporting phosphates, fertilisers, coal, chemicals and bulk products.

To keep pace with the anticipated rise in demand, the current project is working on seven quays. It consists of upgrading existing quays and constructing new ones, made more interesting by the construction and logistical challenges of keeping the port fully operational.

Ramboll is working with the engineering, procurement and construction contractor Archirodon, and providing complete detailed design for all the remedial, rebuilding and new works at Jorf Lasfar. Our services here encompass geotechnical, civil, infrastructure, marine, mechanical and electrical engineering.

Geotechnical investigation enabled us to develop a ground model of the layered geology of marls, sandstone and limestone before commencing the detailed design. The client originally envisaged precast concrete caissons throughout the scheme. However, the contractor’s tender proposal of diaphragm walls in combination with caissons was accepted as a time-efficient solution.

Ramboll’s detailed design for a major upgrade of Morocco’s Jorf Lasfar facilities is being implemented while the port remains operational.

Three quays are being constructed using diaphragm walls and tie-back piles and two quays are being extended with caissons. Upgrade work to two more quays is limited to rehabilitating existing structures and deepening their berths by dredging. Some quay extension work on the landward side of existing quays replaces earth embankment access roads, and is being constructed in areas of fill and pre-existing material, further complicating the engineering design details.

Cost-effective circular precast concrete caissons with cast in-situ fairing panels were selected to produce the required flat faced quays, and a floating dry dock was brought to site specifically for casting. The caissons, 15 m in diameter and 20-22 m high, are floated and sunk into position to form a gravity wall. Ramboll used Plaxis 2D and 3D digital modelling to analyse the caisson design. Concerns about possible caisson overturning in soft marl were overcome by dig and replace ground improvement.

Concrete diaphragm walls up to 400 m long and 34 m deep are toed into resistant marl or limestone bedrock. Changing geology along the walls is accommodated in the design by changing the reinforcement rather than wall depth.

The walls are formed using a hydrofraise, making panels 1.2 m thick and 2.4-2.6 m wide. The centre of each panel is anchored by an inclined steel tee rod to a 1.2 m diameter 25 m long bored cast in-situ pile behind the wall. Connections with the piles are below sea level (4 m below ground) to limit pile bending moments. Diaphragm wall configuration and pile positions are dictated by the rails being installed to support the dock cranes running along the quays.

Rehabilitation of existing concrete structures required careful inspection and concrete testing to chart the necessary repair work. The original concrete caissons had deteriorated and reinforcement had corroded owing to relatively high ambient temperatures, exposure to the marine environment and chemical attack. We assessed their durability meticulously and specified efficient remedial action, the implementation of which ensures the repaired structures meet their required design life. Phased construction work is allowing ongoing port operations.

FEATURE PROJECT
PORT OF JORF LASFAR

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ABOUT
Project data
Client: Société D’Exploitation des Ports (Archirodon)
Completion: 2015
Value: 180 million Euro

Services we provided
• Ground engineering
• Infrastructure Asset Management
• Management & efficiency
• Ports & marine engineering
• Project management
UPGRADING PORT FACILITIES - MEETING NEW DEMANDS

Ports are important links in the transportation chain, and efforts to upgrade facilities and increase cargo capacity are continuously being made in response to increasing demands. The new generation of ships are larger and carry more cargo, thus calling for a vast number of rebuilds.

Receiving new vessels requires re-evaluation of water depths, berth lengths, land storage areas, mooring conditions and facilities, ship manoeuvring conditions and existing operations. Deepening of berths for larger vessels typically requires rebuilding and reinforcement of existing quay structures. In this context, it is often necessary to carry out environmental assessments of the procedures for handling contaminated soil or sediment.

Landside operations are also continuously changing and may call for port upgrades. The introduction of larger and heavier truck loads or cranes will require investigations and most often need reinforcements of the existing pavements and foundations.

Within the ferry terminal segment, ramp systems with higher capacity are continuously being developed, and automatic mooring and bunkering systems implemented. Furthermore, new regulations such as the ISPS and environmental stipulations influence operations and infrastructure.

Rebuilding and upgrading of port facilities are typically carried out in stages to allow ongoing operations and execution of port activities.

SELECTED SERVICES
• Technical pre-investigations
• Condition assessments
• Environmental assessments
• Determination of new design basis
• Terminal planning
• Design of rehabilitation works
• Design of quay deepening
• Design of dredging works
• Design of upgraded quay structures
• Design of upgraded pavements and storage areas
• Tender documents
• Contract and construction management
**01 CMP Crane Rails, Denmark**

In connection with the increase of the crane capacity on Levantkaj in Port of Copenhagen (Denmark), crane rails were extended and reinforced. The total length of crane rails on pile foundation was approximately 450 metres.

Ramboll carried out geotechnical field investigations, assessment of load carrying capacity, preparation of detailed design for extension and reinforcement of crane rails and contract management and supervision during construction works.

**02 Port of Göteborg, Sweden**

The port is a major hub for overseas container traffic. The port has invested in new Super-Post Panamax cranes for the ship-to-shore handling, and a new terminal master plan with new handling equipment has been prepared to meet the demands up to year 2012.

The study covered the entire Skandia Harbour, including a rail terminal, truck traffic areas, empty storage, reefer blocks, storage blocks with beams and/or rails for gantries, geotechnical stability analysis, paving and drainage, power system and lighting. The services also included calculation of investment costs and elaboration of an environmental impact assessment for the various alternatives – diesel powered RTG cranes or electrical powered RMG cranes.

At an early stage, 600 m berths were deepened from 12.0 to 14.2 m depth to be able to serve Post-Panamax container vessels. The project was carried out in stages to allow full operation of the terminal. Ramboll provided the planning and design of dredging, fairways, new berths, port areas, logistic studies, repairs and maintenance, utility systems including electrical power, drainage, water/sewage, etc.

**03 Malindi Port, Zanzibar (Tanzania)**

The existing wharves in Malindi Port were reconstructed and upgraded to facilitate container handling and storage in the port. The following elements/areas are reconstructed: North Wharf, length 114 m, design depth 8.3 m – and West Wharf, length 276 m, design depth 11.8 m.

In response to the late and surprisingly unfavourable results from the supplementary geotechnical investigations, we carried out complete detailed designs for two different solutions. Each detailed design comprised elaboration of design basis, structural calculations and drawings.
BULK TERMINALS - PROVIDING FACILITIES FOR MINERAL IMPORT/EXPORT

Maximising bulk terminal performance by perfect planning, design and handling technology.

Ramboll has a wide array of expertise within planning and design of bulk terminals, including coal terminals, iron ore terminals, aggregates terminals, biomass terminals, wheat terminals or other terminals for import or export of minerals.

Projects are often initiated with the preparation of operational and strategic studies, as well as financial and feasibility analyses. A typical planning study often includes comparison of different berth structures and land reclamation versus alternative structures such as jetties and trestles. Several cargo handling options can be considered and should be compared. We have strong experience with dimensioning conveyors or other means of transport for different cargoes.

Different technologies should be considered for ship loaders and unloaders as well as stackers and reclaimers in the storage area. Storage facilities could be warehouses built with different materials, silos or open storage. Rail handling and respective unloaders and loaders are also often needed as part of terminal operations.

Bulk cargoes can cause dust and noise problems which can be minimised by good planning and design in order to protect the products and the environment.

SELECTED SERVICES

- Feasibility studies
- Strategic studies
- Logistics studies
- Operational planning
- Terminal planning
- Terminal design
- Planning and design of bulk handling equipment
- Specifications for bulk handling equipment
- Tender documents for EPC/Turnkey tender
- Contract and Construction Management
01 Kemi, Iron Ore Terminal, Finland
Port of Kemi is preparing itself for the mining boom in Finland. There are several mining projects in the pipeline. Hannukainen iron ore mine may produce volumes up to 8 million tons per annum. Ramboll prepared a master plan for the port with storage facilities and alignment of conveyors and cargo handling equipment as well as reclaiming for new yards and berths. Ramboll also conducted the environmental impact assessment (EIA) procedure together with local environmental authorities.

02 Port of Fos sur Mer, Marseille, France
Ramboll undertook a full engineering, operational and management efficiency review of the port to identify where loss of down-time could be significantly reduced. Logistics analyses were undertaken as well as a thorough on-site audit of the processes and equipment condition and type.

03 Immingham Renewables Biomass Fuel, Terminal, Associated British Ports, UK
Ramboll delivered design specialist services, including design risk reviews, biomass expert assessments, assessment of dust extraction systems, fire risk assessments and other specialist services. The facility will include 10 conveyors, 4 storage silos and 10 transfer towers.

04 Port of Fujairah, Expansion of Bulk Terminal, Fujairah, UAE
Ramboll prepared port expansion plans for Port of Fujairah, as part of overall master planning for the Emirate of Fujairah up to 2040. An important component in the port is the Bulk Terminal, from which large amounts of aggregates and stones from the entire Emirate are exported. Yearly exports are in the order of 20 million MT.

05 Kvanefjeld Rare Earth and Uranium Mine, Port Facilities, Narsaq, Greenland
Ramboll prepared a detailed port feasibility study for the Kvanefjeld mining project. The mine is planned for producing rare earth minerals and uranium. Ramboll compared different options for locating the port in the area. Master plan layout was prepared for the chosen location. The project included capacity calculations, conceptual design for all storage and other operational facilities as well as equipment (e.g. conveyors, loaders and unloaders and stackers and reclaimers) for handling bulk cargo.
LIQUID BULK TERMINALS – PROVIDING FACILITIES FOR OIL & GAS IMPORT/EXPORT

Ramboll has extensive experience working within Energy markets, ranging from renewables through to oil and gas, and nuclear. In each case we have provided expert services to the advantage of our clients.

With a client list including the World Bank, governments, development agencies and regulators, generators and developers, consumers and energy retailers, metering data companies, network operators and market administrators, Ramboll has established a global reputation as a knowledgeable and innovative consultant in managing energy value.

Ramboll advises clients related to Energy projects under the following headings: Fuel Storage, Fuel Distribution and Control, Marine Terminal Facilities, Consents, Regulations Compliance and Local Interfaces, Authority Approval and Consultation Management.

The delivery of successful projects revolves around achieving the following key components, each of which relates to certainty and timeliness of project delivery – something which is especially critical to the oil and gas industry:

- Robust feasibility studies
- Robust environmental assessment and innovative mitigation measures
- Carefully managed stakeholder engagement and consultation
- Industry standard detailed designs
- Programme, budget and risk management and review
- Health and safety
- Environment and quality systems.

Our capable and adaptable teams provide a high level of service in relation to the above challenges whilst maintaining focus on project delivery. Highly experienced in the marine and Oil & Gas environments, we adopt a partnering approach with our clients.

In recent years, Ramboll has been advisor to a number of clients for developments of LNG terminals from early phase feasibility studies through conceptual and FEED studies.

Safety First: Safety of both cargo and vessels is a primary requirement which is heavily dependent on vessel conditions at the berth and in the channels. Accurate data and studies, either using mathematical models and/or physical models, are therefore required to accurately replicate conditions. With innovative, robust and meticulously planned designs, our specialists endeavour to deliver projects within highly exacting timeframes whilst maintaining the superior safety and quality standards required in the oil and gas sector. In offering designs to the gas industry safety standards, we take the ‘safety first’ message very seriously.

SELECTED SERVICES

- Feasibility studies
- Strategic studies
- Logistics studies
- Operational planning
- Terminal planning
- Terminal design
- Planning and design of liquid bulk handling equipment
- FEED studies
- Environmental studies
- Mooring studies
- Specifications for liquid bulk handling equipment
- Planning and design of hydrocarbon storage facilities, including tank farms
- Risk & safety assessments
- Risk management
- Tender documents for EPC/Turnkey tender
- Contract and Construction Management
- Project Management Consultancy (PMC)
01 Stigsnaes Gulf Harbour Oil Terminal, Oil Pier, Denmark

The Oil Pier at the Stigsnaes Gulf Harbour Oil Terminal is operated by Inter Terminals. The Oil Pier was originally built in 1964 and consists of a 220 m access pier and 500 m berthing pier with 2 pier heads and dolphins. Water depth at the pier head is 12-16 m.

Ramboll carried out investigations and analyses of the deepwater pier, in order to determine the optimum maintenance strategy.

02 Ras Laffan, Port Expansion, Qatar

Ramboll carried out extensive FEED-design and prepared tender documents for an EPIC-tender, as part of the development of Ras Laffan Port Expansion Project (RLPEP).

New facilities comprised Container Yard Facilities, Small Tanker Berths LPB28 and LPB29, Common Facilities for Liquid Product Berths LPB30 and LPB31, Port Operation Building, Leading Light Towers, and a canopy for parking bays at the Port Administration Building (PAB).

03 Finnngulf LNG, Finland

Ramboll was awarded a contract by Gasum Oy, Finland, for provision of project management services in connection with their plans for construction of a terminal for import of liquid natural gas (LNG) to Finland. The work concentrated on developing concepts for LNG receiving terminals at two distinct locations on the south coast of Finland. Ramboll’s services were directed towards drafting a strategy and road map for the development of the Finnish LNG import terminal. As a result, critical tasks were identified and initiated.

04 Fawley Oil Terminal, Southampton, UK

The Esso refinery at Fawley is the largest in the UK and one of the most complex in Europe. Situated on Southampton Water, it has a mile-long marine terminal that handles around 2,000 ship movements and 22 million tonnes of crude oil and other products every year. The refinery processes around 270,000 barrels of crude oil a day and provides 20 per cent of UK refinery capacity.

Ramboll was appointed by Exxon Mobile to carry out a series of structural inspections and assessments of the jetties and fender systems on the marine terminal. Ramboll also completed design for supplementary structures to facilitate dredge deepening at the berths to enable deeper draught oil tankers to berth.
RO-RO TERMINALS - NEWEST TECHNOLOGY KEEPS THE WHEELS ROLLING

Continuously increasing Ro-Ro traffic and larger Ro-Ro vessels require efficient operations and structures in Ro-Ro terminals.

Landside operational development includes parking, waiting areas and traffic lanes alignment. Ramboll has long experience in design of Ro-Ro ramps, passenger gangways, special Ro-Ro technology and multilevel ramps. Efficient and well planned ship-to-shore solutions ensure fast port turnaround times.

Ramboll has extensive experience in adapting different automated/semi-automated mooring systems to keep vessels safely moored even in difficult weather and tidal conditions.

Frequent manoeuvring in a single location is typical for Ro-Ro shipping. It is important to ensure robust and safe erosion protection.

Special mooring systems are sometimes required for safe and fast mooring procedures.

SELECTED SERVICES
• Feasibility studies
• Strategic studies
• Logistics studies
• Operational planning
• Terminal planning
• Terminal design
• Planning and design of Ro-Ro ramps and mooring equipment
• Specifications for Ro-Ro ramps and mooring equipment
• Tender documents for EPC/Turnkey tender
• Contract and Construction Management
01 Norra Hamnen, Malmo, Sweden
Design of the new Ro-Ro / Ro-Pax Ferry and Container Terminal in Norra Hamnen, Malmö. Ro-Ro traffic in Malmö has been relocated to the new terminal area in Norra Hamnen. The new terminal provides better loading and parking facilities, as well as quick access to the highway network. The new terminal area also includes a combi-terminal for train traffic. The terminal comprises four Ro-Ro/Ro-Pax ferry berths, designated cargo areas, berth for container handling and cargo areas, port gate area and traffic waiting areas.

Ramboll prepared preliminary design and layout design of the new terminal area. Ramboll also conducted design for turnkey tendering including: Berths, mooring facilities, bunkering facilities etc., two-tier ramps for Ro-Pax vessels, semi-automated mooring systems, cargo areas, turning areas for vessels and dredging works.

02 Helsinki, Port of Vuosaari, Finland
Port of Helsinki in Finland opened a new cargo port at Vuosaari 2008. As Finland’s new main port, Ramboll carried out the design of the new Ro-Ro / Ro-Pax ferry terminal in Vuosaari harbour for Finnlines’ German traffic ferries, comprising three ferry berths, two designated tier ramps and cargo areas. Ramboll conducted preliminary and detailed design for the following structures: Berths, mooring systems, bunkering systems, adjustable lower ramp, adjustable multipurpose upper ramp, concrete bridge to the upper ramp, steel structures incl. Fem modelling and semi-automated mooring systems.

03 Oban Ro Ro Ferry Terminal, Scotland, UK
Ramboll were appointed for the design, specification and construction supervision of various terminal upgrades arising from our expert review of best practice at the port. Our audit and compliance expertise linked with engineering implementation helped Oban Port maintain their high standards. The work ranged from fuel storage/bunkering equipment and processes through to cost effective infrastructure maintenance and upgrades (paving, drainage, quayside works etc.)

04 Wightlink Portsmouth and Fishbourne Ferry Terminals, UK
Ramboll was appointed to provide port master planning, concept design, traffic modelling and a port energy strategy review for Wightlink’s Portsmouth and Fishbourne ferry terminals. The projects are in response to a major service upgrade with an increase in vessels size, which has required a solution to dual-height stacking and loading at both terminals.
Coastal protection and shoreline management has received increasing attention during recent years. New developments of coastal zones and more extreme variability in the oceanographic and meteorological conditions impact existing assets and set new demands. Ramboll carries out planning and design of coastal protection solutions, provides expert consultancy for shoreline management, and prepares coastal protection strategies.

Design criteria are evaluated based on statistical analyses of extreme weather events (wind, water level, currents and waves). Complex problems are evaluated based on in-situ investigations and numerical modelling, using state-of-the-art models.

All marine works must be tailored to local conditions. To ensure that each project is optimised accordingly Ramboll undertakes site investigations, prepares analyses of data and collects samples, including hydrographic, meteorological, oceanographic, geotechnical surveys and hydraulic model studies.

The internationally recognised MIKE 21/3 and LITPACK models developed by DHI are utilised to analyse the hydrodynamic climate of coastal regions, wave agitation in ports as well as sediment processes, coastal development and particle dispersion in oceans, rivers and estuaries. The models are used by an experienced staff with expertise within ports, hydrodynamics and coastal morphology.

**SELECTED SERVICES**

- Hydraulic modelling
- Wave modelling
- Modelling of currents and sediment transport
- Assessment of coastal impact
- Assessment of environmental impact (EIA)
- Metocean studies
- Determination of design waves and design loads
- Design of breakwaters and other coastal protective structures
01 Hallig 2050, Germany

Holms are a characteristic part of the landscape of the North Frisian Islands along the west coast of Schleswig-Holstein, Germany. Holms are small islands with a ground level a few decimeters above mean tidal high water. Single dwelling mounds protect people, animals and their houses against storm floods. With respect to climate change and the rise in sea levels, continual adaptations are necessary. Ramboll developed a sustainable strategy for flood protection for the dwelling mounds and the adaptations of new and existing houses with regard to anticipated rising sea levels in the future.

02 Port of Hirtshals, Extension of breakwater, Denmark

Manoeuvring problems for the ferries in Port of Hirtshals in Denmark have suggested that a new breakwater was required. Ramboll carried out wave analyses, preinvestigations and the design of the new breakwater.

03 Salvage of wreck “Murmansk”, Sørvær, Norway

The sunken Russian battleship “Murmansk” in Sørvær in northern Norway has been attempted salvaged. A contractor was given the contract to dismantle and remove the 211 m long warship with a dead weight of around 17,000 tons. Breakwaters and retaining walls were constructed around the battleship, but damaged during a storm. The contractor claimed compensation of derived costs from the insurance company. Ramboll has been responsible for technical review of the design assumptions and design of breakwaters and retaining walls for the insurance company. Further, Ramboll carried out analysis of design waves using MIKE 21 SW and BW modules, to assess the contractor’s design assumptions.

04 Sangley Seaport and Airport, Manila, Philippines

During the feasibility study for a combined Airport and Seaport Project in Manila, Philippines, Ramboll performed a Coastal hydraulic analysis. Impacts on the currents and wave patterns were studied using MIKE 21 HD and SW models which is a state-of-the-art numerical tool for studies and analysis of currents and waves in ports and near-shore areas. Further, the modelling resulted in prediction of maximum wave heights during a typhoon scenario. Finally, the modelling resulted in assessments of the impact on the sediment transport pattern in Manila Bay.
DREDGING AND LAND RECLAMATION
-CREATING ASSETS AND VALUES

In large infrastructure projects like harbours or industrial areas with quay facilities, dredging works and the use of dredged material for land reclamation are often interrelated. On the seaward side, a certain water depth has to be guaranteed for transshipment with larger vessels. On the landward side, the dredging material is used to fill the existing topography up to a safe level.

Large infrastructure projects like the JadeWeserPort in Wilhelmshaven and the Airbus extension in Hamburg became economically feasible because dredging techniques developed and the dredged material could be transported over short distances. At the site, the land reclamation works have to be planned according to the geotechnical and hydraulic boundary conditions. Especially in case of soft soils, a careful planning of the reclamation works must consider all relevant boundary conditions. Depending on the project location, various materials can be used for reclamation works, which means that intensive geotechnical planning is essential to fulfil the client’s requirements.

The dredging of fairways is a standard procedure in regions with morphodynamic activity whenever hydraulic conditions initiate sediment transport processes and water depths are limited. The layout of the fairway as well as the dredging measures have to be planned well. Moreover, when fairways are narrow, their navigational purposes have to be taken into account. Dredging can be minimised by the use of a smart alignment or the installation of waterfront structures.

SELECTED SERVICES

• Feasibility studies
• Consultancy within the approval process
• Analysis and assessment of hydraulic and morphodynamic processes
• Environmental Impact Assessments (EIA)
• Design of dredging works
• Design of reclamation works
• Geotechnical engineering of reclamation works
• Design of revetments and scour protection
• Expert Reports
01 Port of Uusikaupunki, New Fairway, Finland
Fairway of Uusikaupunki is approximately 45 km long and runs through the archipelago to port of Yara Suomi Oy and via Hepokari fairway to Port of Uusikaupunki. Ramboll provided owner’s supervision for the project including preparation of tender documents, on-site supervision, health and safety coordination, coordination between involved parties and stabilisation design and supervision.

02 Jade Weser Port, Greenfield land reclamation, Germany
JadeWeserPort is the only deep water harbour in Germany. Ramboll was involved in the initial planning phases and conducted detailed design during the construction phase. More than 40 million m³ of sand were used for land reclamation.

03 Airbus Plant, Expansion of landing strip, Germany
Ramboll was commissioned as a general planner for the Airbus extension in Hamburg from the beginning until the delivery to Airbus. More than 10 million m³ of sand were used for land reclamation founded on very soft soils.

04 Beirut Quay 12-14, Dredging and Land reclamation for new Container Terminal, Lebanon
Ramboll has been responsible for all design works related to the expansion of the new Quay 12-14 – including planning and specifications of dredging works in front of the new quay wall to ensure a water depth of 15.5 m, reclamation works in the old harbour basin to make space for an additional 20 hectare container terminal. Ramboll prepared detailed design for the Contractor and participated in the Approval process with Port of Beirut.
Rivers and channels are one of the oldest transport routes. Until now transport by ship has been the most economical and ecological means of transport. Considering the lack of resources, waterways have to be developed and become more and more competitive compared to other kinds of transport.

Inland waterways are of major importance for transportation of goods in Europe and worldwide. The inland waterways connect economic centres where transshipment takes place. Inland waterways in Germany uniquely run 6,350 km; in all of Europe there are more than 44,000 km of inland waterways. The largest inland waterway network is in China with 110,000 km. All developing countries are actually expanding their inland waterway network.

Along the inland waterways many different facilities are necessary to regulate or hold the water (weirs and sluices), protect the banks, coasts and shorelines (revetments), to cross the inland waterways (bridges), protect against flood water (dikes or barriers) or for transshipment (quay walls). All these structures became necessary because of trading along the inland waterways and they have to be maintained or partially rebuilt to guarantee sufficient water depth for vessels and allow convenient vessel traffic.

Besides technical aspects, more and more ecological aspects have to be considered and integrated into the planning works. As an example, the European Water Framework Directive mentions which certain water quality standards have to be reached. With regard to structures along inland waterways, the installation of fish ladders becomes more important.
01 Hamburg, Harburg Port Lock, Germany

Within the municipal programme “Modification of the Hanseatic City of Hamburg’s public flood protection”, the Harburg port lock (125 m × 17.4 m) was adjusted to meet the new criteria for storm surge water levels. The structure and technical equipment were strengthened for the next 70 years. Ramboll was commissioned to do the preliminary design, basic design, approval design, final design, and preparation of tender documents as well as assistance with the contract award process, technical equipment and on-site construction supervision.

02 Kiel, Kiel Canal, Germany

The Kiel Canal is the most heavily sailed waterway in the world. Approximately 40,000 vessels p.a. make use of this shorter route between the North Sea and the Baltic Sea. To maintain the canal’s expanded dimensions and to enable a further expansion, both routine dredging as well as a one-off dredging campaign are necessary. The dredging practice previously relied upon was dredging material disposal sites along the Kiel Canal. Due to changes in environmental and waste legislation the last 30 years, Ramboll developed an alternative concept for the disposal of dredged material.

03 Kiel, Kiel-Holtenau
Group of Locks, Germany

The large Kiel Canal locks in Brunsbüttel and Kiel-Holtenau are the key areas of traffic flow. After an increasing number of ship collisions and sliding gate malfunctions, a new sliding gate with a width/height/depth = 46 m / 18 m / 8 m and weight of approx. 2,000 MT was designed by Ramboll. Incorporated in the structure are fenders which can absorb the impact energy of a 13,000 DWT ship with a velocity of 1 m/s without any damage.

04 Ems Barrier, Storm surge barrier, Germany

The Ems barrier is designed for two types of functions, which are flood protection and retain barrage in order to enable transfer of cruise vessels with higher draughts. Ramboll was commissioned to conduct feasibility and plan statement documents with conceptual and detailed design for the project and its structure including hydraulic calculations, extensive plans for technical equipment such as mechanical, electrical and control technology, as well as preparation of tender documents and cost calculations.

Ramboll performed engineering services in all planning and construction phases up to the check of shop drawings and consultancy.
ENVIRONMENT AND HEALTH SERVICES – MINIMISING ENVIRONMENTAL IMPACT

Ramboll provides support to ports and maritime operations through every stage of their lives: from before they are built, throughout operation, during expansion and as they are wound down.

Through the acquisition of ENVIROn in 2014, Ramboll’s Environment and Health practice grew by 1,500 dedicated environment, health and sustainability specialists based in 21 countries, with a reputation for providing assistance to port clients.

Our combined environmental and health services assist clients to manage the potential for harm to the environment (water, air, soils, and sediment), to people (working there, using the port and in the vicinity) and to the businesses themselves. Projects requiring consideration for environmental and social issues include:

- Establishment of a new port and terminals
- Extension of an existing port and terminals
- Recovery of building materials (i.e. sand) from the maritime environment
- Disposal or treatment of contaminated sediments and wastewaters

Typical related environmental and social issues and impacts include:

- Impacts on nearby protected natural resources and animal habitat areas
- Impacts from dispersion of sediments during construction
- Changes of existing hydraulic flow and possible sedimentation/erosion
- Noise, vibrations, emissions and odours
- Increases in traffic
- Visual effects from the construction
- Displacement and resettlement
- Waste generation

SELECTED SERVICES

- Environmental and social impact assessment
- Noise impact and mitigation assessment
- Environmental management systems
- Air quality management
- Dredged materials and sediment management
- Contaminated land management and remediation
- Water and wastewater management
- Ecosystem services
- Resource management and habitat restoration
- Climate change and adaptation services
- Hazard and enterprise-wide risk assessment and management
- M&A due diligence
- International finance
01 Port of Poti, Georgia
Ramboll was appointed to conduct the environmental and social impact assessments (ESIA) for the Port of Poti development on Georgia’s Black Sea coast. We were responsible for the overall delivery of an ESIA package in dual languages and led on the more detailed assessment studies including climate change predictions, hydrological modelling, air quality and socio-economic impacts. The ESIA was prepared to meet both Georgian and international environmental standards including those of the EBRD.

02 London Gateway, UK
Ramboll provides environmental consultancy to DP World in relation to its development at London Gateway, the UK’s largest port and infrastructure development project. Initially appointed to provide environmental due diligence, we work closely with the client on environmental monitoring of surface and groundwater, contaminated land remediation, environmental permitting, sustainable management practices and implementation of an EMS consistent with Equator Principles metrics and regulator communications.

03 Port of Seattle, USA
Ramboll evaluated the air quality and environmental noise implications of the modernisation of an existing container handling facility at Terminal 5 at the Port of Seattle. The air quality analyses considered emissions from trains, on-site operations and vessels and included AERMOD dispersion modelling to assess compliance with ambient air quality standards. The air quality review also considered the general conformity of pollutant emissions associated with construction activities subject to federal approvals due to the project areas being in an air quality maintenance area for fine particulate matter. The noise analyses included extensive noise modelling to simulate operations of the expanded facility to assess both compliance with applicable city noise limits and to consider the potential for noise impacts in off-site communities. Ramboll personnel used the CadnaA noise model to evaluate the noise reduction benefits of possible noise control measures. Results were incorporated into the environmental review documentation for the facility.
URBAN WATERFRONTS AND MARINAS – MAXIMISING LEISURE VALUE

Ramboll plans and designs urban waterfront developments and marinas in an integrated process, according to our Liveable Cities Concept and well-developed holistic Master Planning Approach.

Creating liveable cities
Effective transportation systems are a prerequisite for a city's social and economic progress. For several decades, Ramboll has developed solutions that increase mobility and reduce traffic, without compromising efficiency. Vibrant public and recreational spaces also make an important contribution to increasing urban liveability and serve to attract residents, businesses and tourists. Ramboll has world class expertise and an enviable track record in creating the 'blue/green' physical elements that breathe life into both new and existing urban spaces.

Ramboll has among others exercised such developments in our Head Office town, Copenhagen. Copenhagen is the first three-time winner of the “Quality of Life Survey 2014” carried out by the international magazine Monocle. Waterfront promenades, grassy pedestrian zones and green parks are just a few of the many reasons why Copenhagen reclaims the title as the world’s most liveable city.

The eighth annual Quality of Life results see the Danish capital defend its top rank thanks to an unbeatable combination of culture, tolerance, effective public transport, sun appreciation, green space, global connectivity and clever architecture making the city the first three-time winner.

Realising complex urban waterfront developments and marinas
Coordination and understanding of a wide range of disciplines is critical to successful master planning, which is why our ability to integrate our areas of expertise is crucial to our success.

We help customers realise their development potential, particularly when it comes to complex urban concepts. We identify key risks and suggest solutions. We provide the spectrum of knowledge required for the development of all kinds of urban, suburban, former industrial and greenfield areas. The realities of commercial feasibility remain central to our consultancy.

We have the ability to carry out any combination of master planning services from our multidisciplinary profile. In keeping with our philosophy, our master planning teams encourage the exchange of ideas between all disciplines involved to reach the most streamlined, cost-effective result, enabling us to meet the social, technical, environmental, and financial requirements of any project.

The objectives when planning and designing urban waterfront developments and marinas include, to:

- Maximise the interface and synergy between marine and urban facilities and opportunity
- Advise regarding the opportunity and scale of marine leisure and commercial activity (water taxis, buses, etc) and inter-modal connectivity
- Support wider regeneration of the surrounding area
- Produce robust studies to assess the commercial, environmental and engineering feasibility of waterfront infrastructure and marinas including navigation risk and sustainable dredging strategies
- Conduct environmental consenting, audit and compliance to achieve and maintain best practice.

SELECTED SERVICES

- Market Analysis and Analysis of target markets
- Business Plans and Financial Analyses
- Port and Urban Master Planning
- Transportation and Infrastructure Planning
- Planning of optimized use of water assets
- Development of sustainability, low carbon and waste management strategies
- Analysis of coastal hydraulic conditions and flooding risks and management
- Environmental and Social Impact Assessments
- Identifying and handling of possible contaminated soils in former industrial areas
- Design of waterfront structures and marina facilities
- Condition Assessments and rehabilitation of existing structures
- Specifications and Tender Documents
- Tendering and Construction Management
01 Porto Montenegro, New Mega-yacht marina, Montenegro
This exclusive marina development is part of a larger regeneration project which also comprises high-end residential, commercial and leisure facilities, including a Four Seasons hotel. Constructed on a former Yugoslavian naval base, the new marina currently incorporates over 50 superyacht berths (30-100 m LOA) with an additional 200 berths for smaller vessels (10-30 m).

02 Royal Pier Waterfront development, Southampton, UK
Royal Pier Waterfront is a £450m world-class development which will incorporate restaurants, leisure attractions, apartments, office space and hotels, all linked by pedestrian promenades and piers. The project includes 5.5 ha of reclamation and relocation of an entire Ro-Ro terminal to make way for this significant development. Ramboll is responsible for all ports and marine engineering and the environmental studies and consenting.

03-04 Copenhagen North Harbour, Development of new sustainable township, Denmark
Nordhavnen is probably the most extensive and most ambitious metropolitan development project in Scandinavia in recent years. Nordhavnen is a 200-hectare area currently used for a number of harbour-related activities. When fully developed, the site will feature buildings with a total floor area of up to four million square metres, providing living space for 40,000 inhabitants and workspace for another 40,000 inhabitants.

Ramboll was appointed, together with architects Cobe, Sleth and Polyform, to develop the Master Plan & Urban Development Plan for the new township. Further Ramboll was responsible for traffic engineering, transport planning & safety, all environmental services & EIA. In later stages Ramboll has been responsible for planning and design of a number of canal and bridge projects, being part of the overall development plan.

05 HafenCity Hamburg, Germany
HafenCity Hamburg is the largest project for urban development in Europe. Upon completion, the city area will have been enlarged by 40%. Although the HafenCity borders the river Elbe outside the official flood protection line, flood protection plays a central role in the urban development and the design of its urban waterfronts and houses. Ramboll was commissioned to define and assess various flood protection measures.
MAINTENANCE MANAGEMENT - IMPROVING OPERABILITY

Maintenance management of ports is highly complex, requiring the integration of many disciplines and services. In fact, maintaining a port is comparable to maintaining an entire city. Ports have a similar multitude of different structures and facilities, notably quay structures, piers, breakwaters, paved areas, buildings, loading and unloading facilities, and movable equipment.

It is, however, possible to simplify, optimise and keep maintenance procedures within budget by systematising the procedures and introducing known and tested methods from other fields such as maintenance of bridges and roads. This approach will also allow forecasting of future costs, increase safety and minimise the risk of unexpected break-downs. The result is a vastly improved port operation.

By prioritising activities, appropriate actions may be taken in time. In other words, rehabilitation efforts will not be taken too early or too late. So, while expenses may initially increase slightly for the planned maintenance services, ports will in the long run save money by avoiding potentially costly mistakes such as heavy repair on structures overdue for rehabilitation.

To support the growing demand for efficient maintenance management of ports and similar infrastructure facilities, Ramboll developed a program called SMART Ports – a web-based IT-system featuring systematic and well-documented maintenance management procedures, long-term budgeting and easy access to large and complex amounts of data. SMART Ports is based on state-of-the-art principles within operation and maintenance. It provides a user-friendly interface supporting all levels of maintenance management.

SELECTED SERVICES

• Systematic registration methods
• NDT (non-destructive tests) and Destructive test methods
• Determining conditions and damage reasons
• Estimating life span and deterioration rate of materials and structures
• Evaluating environmental influence
• Setting up optimal repair strategies and solutions
• Financial evaluations
• Working out projects and supervising rehabilitation works
• SMART Maintenance Management system
01 Port of Aarhus,
Maintenance Management, Denmark
Port of Aarhus, Denmark’s largest port, is using Ramboll’s SMART Ports system for maintaining port infrastructure (quays, pavements, buildings).

02 Port of Portland, UK
To assist the Port of Portland with their asset and risk management, Ramboll has undertaken a comprehensive laser scan above and below water of the whole port estate. The value created in the scan has helped clearly assess any movement in the breakwaters which could lead to a failure as well as mapping obstructions or erosion which could cause risk to the quay walls or vessel movements.

03 APMT, Pavement Maintenance Management
Once infrastructure facilities such as roads, bridges, railways, ports and airports are in operation, they have to be constantly supervised and maintained. But keeping track of the state of facilities may be an enormous task when you are supposed to maintain thousands of square meters.

Over the years, Ramboll has developed several systems to help ease maintenance processes. Most recently, we developed a new Pavement Management System (PMS) to help keep track of pavement conditions. The system has been delivered to APM Terminals, a leading global container terminal operator.

04 Port of Naantali,
Maintenance Management, Finland
The Port of Naantali is the third largest port in Finland, with an overall traffic of 8.5 million tonnes of cargo annually (2007) and more than 2,000 vessels/year, covering liquid bulk, dry bulk, containers and trailer cargo. The port has focused heavily on rehabilitation of quay structures and maintenance during the past years, and now with the SMART system, it will be systematised even further. The Port of Hamina is the fifth largest port in Finland, with an overall traffic of 5.4 million tonnes of cargo annually (2007) and more than 1,450 vessels/year, covering liquid bulk, dry bulk, general cargo and containers.

Ramboll assisted the ports during SMART implementation and training of the staff in the ports.

05 PTP Tanjung Pelepas,
Maintenance Management, Malaysia
The Container Terminal in Tanjung Pelepas, operated by PTP, is one of world’s largest, with a total quay length of approximately 5,200 m. Ramboll carried out Principal Inspections of selected berth structures as trial testing for implementation of a systematic maintenance program.
SELECTED REFERENCES

• International recognised, world-leading consultancy

• 100 specialists working with port and marine projects

• 50 ongoing and more than 500 completed port and marine projects in more than 50 countries around the world

KEY PROJECTS

01 DENMARK
Copenhagen
Aarhus
Aalborg
Esbjerg
Vejle
Hirtshals
Skagen
Thyborøn
Køge
Rønne

02 SWEDEN
Göteborg
Malmö
Stockholm
Helsingborg
Luleå
Gävle
Norrköping
Karlskrona
Trelleborg
Varberg

03 NORWAY
Bergen
Fredrikstad
Sandefjord
Trondheim
Hammerfest
Oslo
Drammen
Hellesylt
Bodø
Tromsø

04 FINLAND
Helsinki
Naantali / Turku
Kemi
Kokkola
Pietersaari
Rauma
Hanko
Kotka
Hamina

05 GREENLAND
Nuuk
Sisimiut
Narsaq

06 FAROE ISLANDS
Thorshavn
Runavik

07 UNITED KINGDOM
London
Southampton
Dover
Portsmouth
Bristol
Liverpool
Immingham/Grimsby
Edinburgh

08 IRELAND
Rossiare
Baltimore

09 GERMANY
Hamburg
Stade
Brunsbüttel
Wilhelmshaven
JadeWeserPort
Kiel Canal
Canal Salzgitter
Gandersum

10 POLAND
Gdansk

11 ESTONIA
Tallin

12 LATVIA
Riga

13 LITHUANIA
Klaipeda

14 RUSSIA
St. Petersburg
Murmansk
Arkhangelsk
Novorossiysk
Temryuk

15 ITALY
Venice Lagoon
Port of Brindisi

16 MONTENEGRO
Porto Montenegro in Tivat