STATEMENT OF CAPABILITIES

Background

OMC International Pty Ltd (OMC) is a specialist company providing consulting services and operational systems to the international maritime industry. OMC is the world's only provider of independently validated and widely operational real-time under keel clearance technology, the proprietary Dynamic Under-keel Clearance System (DUKC®).

DUKC® has safely facilitated **165,000+ transits** for 120 ports, terminals and waterways, and is the most comprehensively validated UKC management system. On average, a vessel sails under DUKC® advice somewhere in the world every hour.

DUKC® is the standard underkeel clearance management tool adopted by more than twenty ports within Australia, and internationally, including the world's largest bulk export ports, container ports, and tanker facilities. DUKC® is recognised as the leading UKC management system in the world. The terms "Dynamic UKC®" and DUKC® are both registered trademarks of OMC.

In addition to DUKC®, the services and systems provided by OMC to our clients include:

- Mooring analysis – deep sea, CBM, conventional and suction pad mooring systems
- Moored vessel motion and mooring line warning systems (Berth Warning System, BerthAlert)
- Optimised channel dredging design and planning
- Under-keel clearance studies
- Horizontal navigation and vessel manoeuvrability studies
- Fast time simulations using SimFlex4 from Force Technology
- Full scale vessel motion measurement and analysis
- Probabilistic analysis and risk assessments
- Operational static UKC management (KeelCheck)
- Measured & forecast environmental data displays (PortWeather)
- Optimisation of Port throughput using our Dynamic Port Capacity Model
- Hydro/meteo analysis, modelling and forecasting
- Hydro/meteo data processing and quality assurance

Dynamic Moored Vessel Analysis

OMC has extensive experience in modelling the motions of moored ships exposed to various environmental conditions, resulting in unparalleled expertise in mooring design and ship motion modelling. OMC developed the numerical model, **SPMS** (**S**imulation **P**ackage for the **M**otions of **S**hips), for the analysis of various problems associated with the motions of vessels, either moored, towed or free moving along channels or in deep water. Since development commenced in 1962, it has been extended to solve a wide variety of maritime projects in Australia and overseas. This includes analysis of motions, line tensions and fender forces of bulk carriers, oil tankers, container vessels, frigates, submarines, Ro-Ro vessels, general cargo ships and tugs at a wide variety of berths, including spread moorings, swamp moorings, fendered jetties and single point moorings. The model has also been used for the analysis of the relative motions of a transhipment.

The SPMS numerical model includes the capability to model the slow drift oscillations of moored vessels due to long waves (periods greater than 30 seconds), as well as the wave frequency oscillations caused by sea and swell waves. Long period waves can be the most important driving force on moored vessels exposed to ocean swell because they can excite large amplitude, low frequency oscillations of the moored vessel in the horizontal modes of surge, sway and yaw.

These oscillations occur at frequencies similar to the corresponding natural frequencies of the ship/line/fender system, leading to possible resonance amplification of the moored vessel motions, breakage of mooring lines and damage to berth and fenders - unlike wave frequency motions which are relatively highly damped, low frequency motions are only lightly damped, hence the great danger of resonance amplification arising from any significant long wave excitation.

Major calibration and validation exercises for the SPMS moored ship model have been completed during 1998/99 for two vessels at Port Taranaki on the west coast of New Zealand, during 2005 for two vessels at Geraldton and in 2006 for three vessels at Port Hedland, Western Australia.

These exercises involved DGPS measurement of moored ship motions, direct measurement of line tensions by strain gauges and collection of short and long wave data at the berth. An important outcome of these studies was the full-scale calibration and validation of the low frequency damping forces generated by the SPMS model.

The SPMS model is the **only comprehensive ship-modelling package developed in the Southern Hemisphere**, and is one of only a handful in use in the world. It has being extensively used in the Australasia region for moored ship problems where long waves/seiching are prevalent.

Full Scale Validation

The DUKC® and its associated models have undergone more validation that any other UKC management system.

OMC has carried out close to 100 full scale measurement validation campaigns, comprising more than 600 vessels at 40 different locations globally. This includes all major vessel types with varying depth/draft ratios, stability characteristics and transit speeds, channel configurations, tidal patterns and wave climates.

This data is analysed to validate the numerical model predictions utilising the measured wave, current and tide data against the ship particulars, thereby verifying the vessel motions.

Validation campaigns have been performed for both underway vessels and moored vessel applications.

Vessel Interaction Expertise

OMC has extensive experience with passing vessel interactions, and was an Industry partner in the Marin Research Institute Research on Passing Effects on Ships (ROPES) research project.

ROPES was a joint industry project and included development and validation of a computer tool to predict the effect of passing vessels for existing and new port and terminal developments. The project included extensive scale model testing and full scale monitoring campaigns in the Port of Rotterdam. Participants in the project included Ports of Rotterdam, Antwerp and Amsterdam, ExxonMobil, Cavotec, KRVE, and Deltares. As a partner OMC holds and has full rights to the developed IP which has used to both validate the OMC passing vessel model and to complement it for ongoing projects.

OMC has undertaken passing vessel mooring studies at Fremantle (2017), Gladstone (2017, 2016), Port Hedland (2014, 2012, 2011, 2010, 2009, 2008, 2006) Newcastle (2011, 20106), Brisbane (2012), and Cape Lambert (2010). For these studies, OMC has used modelling to determine optimum vessel passing speeds and distances given the prevailing environmental conditions, tidal levels and characteristics of both the moored and passing vessels. The Port Hedland study also involved validation of the model against full scale measurements, with excellent correlation between measured data and model outputs.

Berth Warning System

In addition to mooring studies, OMC has also developed the Dynamic Berth Warning System (BWS) to improve port operating safety.

The BWS is a real-time berth warning system designed to provide assistance to terminal operators in making decisions as to the operating safety of berthed vessels. BWS assesses both the vessel motions and the loads placed on moorings, lines and fenders by ocean swells, currents, and wind to provide produce a rating of port operating safety.

The BWS can incorporate wind, wave, and current forecasts from the National Weather Service, or private forecast providers, giving the potential to provide dynamic berth operability forecasts up to a week in advance, improving berth safety and performance.

Previous Experience: Dynamic Moored Vessel Analysis

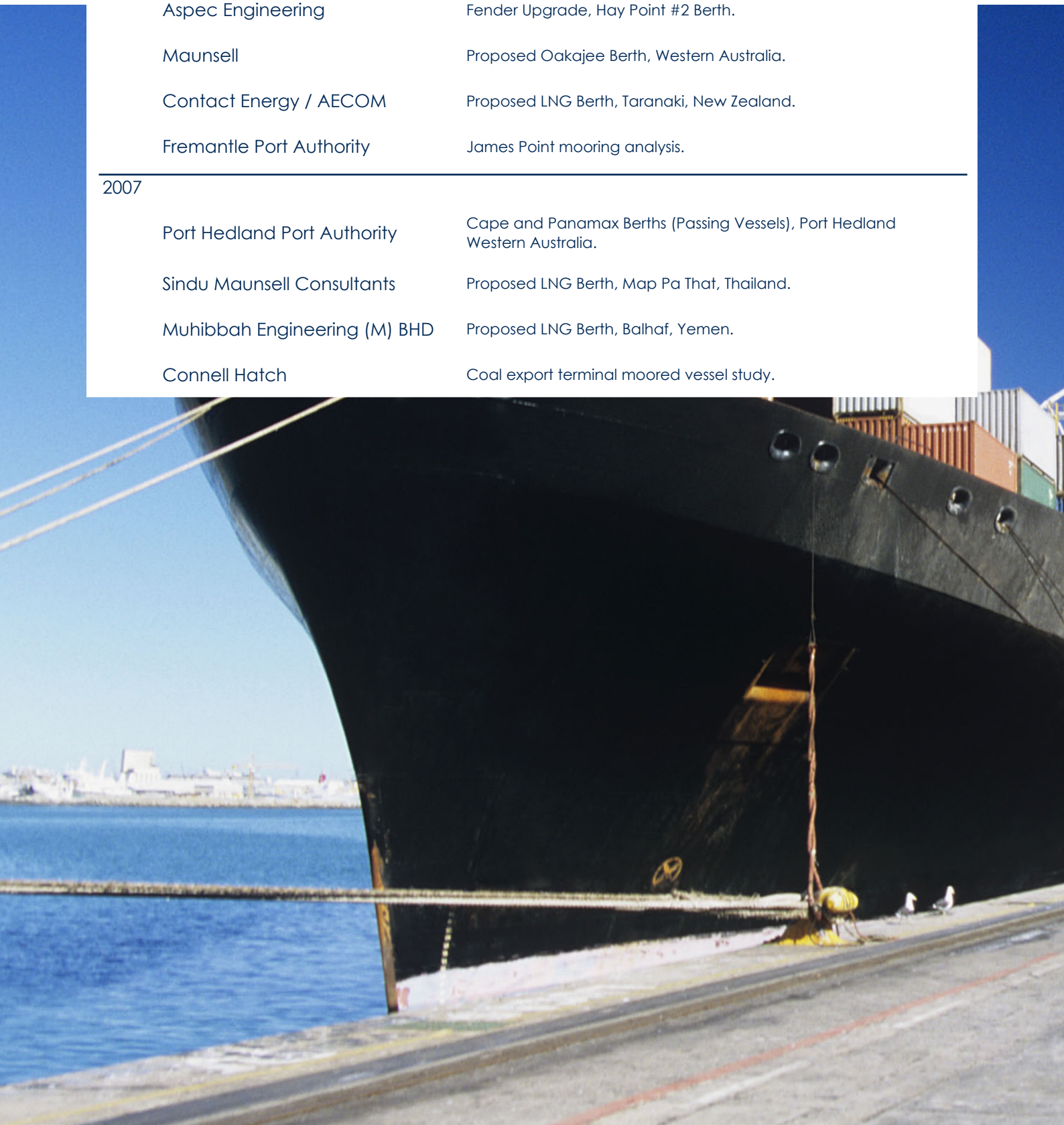
2019		
	Port of Napier	Dynamic moored vessel analysis for Cavotec MoorMaster system.
2018		
	Caltex	Passing vessel interaction study at the Port of Brisbane.
	Caltex	Dynamic moored vessel response analysis for MR and LR1 tankers at the Port of Mackay.
2017		
	AECOM / BP	Tangguh LNG project.
	Caltex Australia	Barney Point moored vessel response analysis for passing vessel interactions, Gladstone.
	Fremantle Ports	Moored vessel response analysis for passing vessel interactions.
	Rio Tinto	VLOC mooring analysis for Cape Lambert.
2016		
	Viva Energy	Mooring analysis for LR1 tankers at Dampier.
	Wallbridge Gilbert Aztec	Kangaroo Island floating wharf mooring analysis.
	Gladstone Ports Corporation	Clinton vessel interaction study assuming Cavotec MoorMaster.
	Jacobs	Moored vessel analysis for Amrun project.
	Pilbara Ports Authority	Passing vessel interaction study for MoorMaster moorings at Utah Point, Port Hedland.
2015		
	Rio Tinto	Assessment of alternative mooring configurations for iron ore berths at Dampier.
2014		
	Rio Tinto	Numerical modelling study of vessel motions, mooring line tensions and fender deflections for Eloha berth, Africa.
	Rio Tinto	Moored vessel analysis for Cape Lambert operational Berth Warning System.
	AECOM	Moored vessel analysis for Geraldton Berth 7.
2013		
	Jacobs	Moored vessel analysis for Amrun project.
2012		
	GHB / Arrow Head	Dynamic vessel mooring study for Gladstone LNG jetty.
	AECOM	Numerical modelling study of vessel motions, mooring line tensions and fender deflections for proposed Port Kembla Outer Harbour development.
	FASTJV / BHP	Quantum Project, Port Hedland Western Australia.

Previous Experience: Dynamic Moored Vessel Analysis

2011		
	SKM	Passing vessel interaction study for Port of Newcastle.
	KLH / James Price Port	Dynamic vessel mooring study for proposed LNG Berth at James Price Point.
	AECOM	Numerical modelling study of vessel motions, mooring line tensions and fender deflections for proposed Port Kembla Outer Harbour development.
	AECOM	Dynamic vessel mooring study for Port Hedland's FMG3 berth.
	SKM / BHP	Dynamic vessel mooring study for Port Hedland's AP4 and AP5 berths including MoorMaster units.
	Aztec Analysis	Numerical moored vessel study for a Land Helicopter Dock (LHD) vessel at BAE site.
	Beca	Mooring study for Cliffored Bay including MoorMaster units.
2010		
	AECOM	Dynamic vessel mooring study for Geraldton #7 Berth including MoorMaster units.
	SKM / Rio Tinto	Mooring analysis for proposed Cape Lambert Port B berths.
	Aspec Engineering	Mooring analysis for Hay Point upgrade.
	Cavotec	MoorMaster mooring analyses for Hay Point.
	Geraldton Port Authority	Dynamic vessel mooring study for Geraldton #3, 4 & 5 Berths.
	PHPA	Utah Point Port Moorings Analysis including MoorMaster units, Port Hedland.
2009		
	SKM / Damper Port Authority	Dampier Fuel Wharf Moorings Analysis including MoorMaster units, Dampier.
	AECOM / Port Kembla Port Authority	Proposed Port Kembla Outer Harbour Development, Port Kembla.
	JFA Consultants / Chevron	Proposed Ro Ro and Module Carrier Berth for the LNG Gorgon Project, Barrow Island.
	Rio Tinto Alcan	South of Embley dynamic mooring analysis.

Previous Experience: Dynamic Moored Vessel Analysis

2008		
	SKM / BHP	Proposed Berths at Harriet Point and Nelson Point South, Port Hedland.
	FASTJV / BHP	Quantum Project, Port Hedland Western Australia, 180 and 250k Cape Vessels, Option B (Moored and Passing).
	Port Hedland Port Authority	Cape and Panamax Berths (Moored and Passing Vessels), Inner Harbour Port Hedland Western Australia.
	Aspec Engineering	Fender Upgrade, Hay Point #2 Berth.
	Maunsell	Proposed Oakajee Berth, Western Australia.
	Contact Energy / AECOM	Proposed LNG Berth, Taranaki, New Zealand.
	Fremantle Port Authority	James Point mooring analysis.
2007		
	Port Hedland Port Authority	Cape and Panamax Berths (Passing Vessels), Port Hedland Western Australia.
	Sindu Maunsell Consultants	Proposed LNG Berth, Map Pa That, Thailand.
	Muhibbah Engineering (M) BHD	Proposed LNG Berth, Balhaf, Yemen.
	Connell Hatch	Coal export terminal moored vessel study.



Previous Experience: Full Scale Vessel Motion Analysis

2019	
	Belfast
2018	
	Melbourne
	Gisborne
	Lyttelton
	Melbourne
	Geelong
	Torres Strait
2017	
	Gladstone
	Dampier
	Cape Lambert
	San Fransisco
	Melbourne
	Mundra
	Torres Strait
	Weipa
	Whyalla
2016	
	Brisbane
	Geelong
	Gladstone
	Halifax
	Hobart
	Melbourne
	San Fransisco
	Torres Strait
	Weipa
2015	
	Brisbane
	Melbourne
	Napier
	San Fransisco
	Spencer Gulf

2014	
	Melbourne
	Napier
	Port Hedland
2013	
	Brisbane
	Cape Cuvier
	Columbia River Bar
	Fraser River
	Fremantle
	Ocean
	Port Hedland
2012	
	Bass Strait
	Columbia River Bar
	Melbourne
	Newcastle
	Ocean
	Singapore
2011	
	Bass Strait
	Columbia River Bar
	Geelong
	Melbourne
	Port Phillip Bay
	Vancouver
2010	
	Cape Lambert
	Torres Strait
	Newcastle
2009	
	Townsville
	Weser River
	Port Kembla

2008	
	Torres Strait
	Weipa
	Weser River
	Brisbane
2007	
	Hay Point
	Marsden Point
	Melbourne
	Weser River
	Dampier
2006	
	Geraldton
	Gisborne
	Gladstone
	Lisbon
	Marsden Point
	Newcastle
	Singapore
2005	
	Brisbane
	Fremantle
	Geraldton
	Mackay
	Marsden Point
	Weser River
2001	
	Geelong
	Melbourne
2000	
	Geelong
	New York
	Weser River
1999	
	Geelong
	Karumba
	Weipa
	Weser River
1998	
	Geelong
	Melbourne
	Townsville
	Weser River
1997	
	Fremantle
	Dampier
	Port Hedland

DELIVERING TOTAL PORT SOLUTIONS

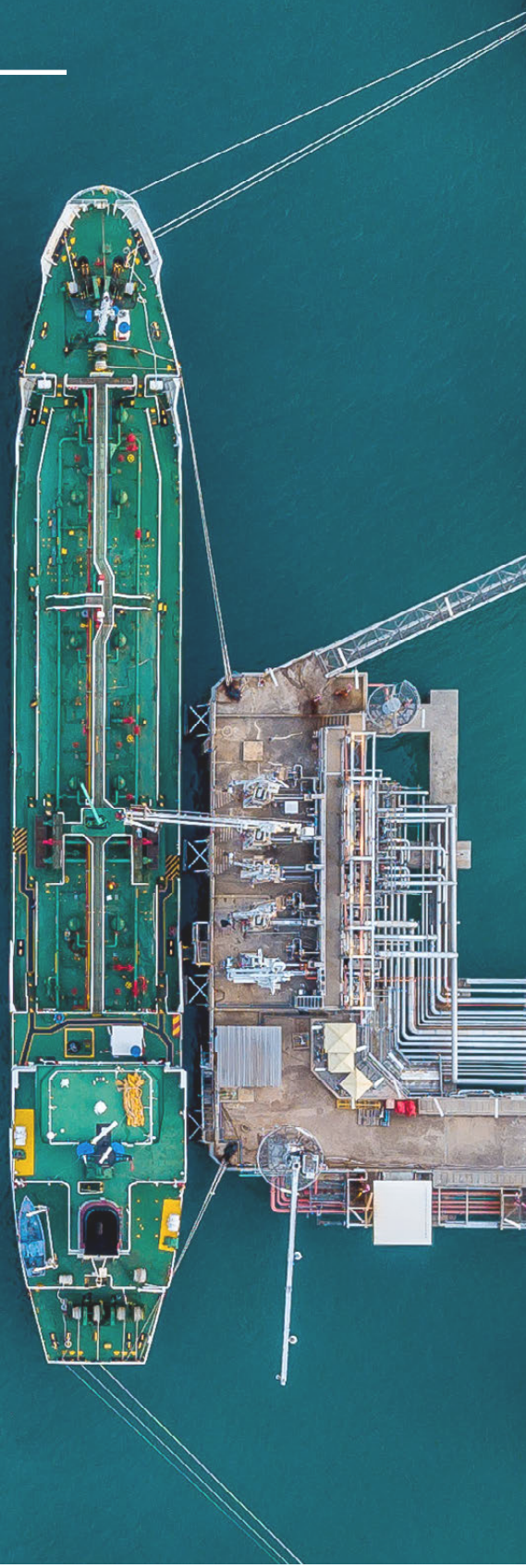
DUKC®

DUKC® has assisted more than **120 port facilities, terminals,and waterways to safely and efficiently conduct 165,000+ deep draft transits**. Utilising state-of-the-art modelling techniques, DUKC® is the world's most comprehensive, and extensively validated, operational UKC management system.

Drawing on a team of engineers, environmental scientists, naval architects, and master mariners, OMC's waterways design expertise is built on a 25 year history of leading the development and implementation of operational UKC technology (Vertical Dimension).

Our unique technology has been extended to include the Horizontal Dimension, port operations and statistical modelling techniques. This enables us to provide an even more precise cost benefit analysis for our clients.

Our optimisation methods enable dredging to be targeted, ensuring maximum return on investment and minimum environmental impact.



OMC's additional capabilities:

- Horizontal and Vertical Channel Design
- MetOcean Data Measurement and Forecasting
- Capital and Maintenance Dredging Optimisation
- Channel Siltation and Maintenance
- Dynamic Port Capacity Modelling
- Ship Motion Analysis
- Mooring Design and Berth Warning Systems
- Ship Simulation

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