THE AUSTRALIAN NAVAL ARCHITECT

Volume 24 Number 1
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The start of the Rolex Sydney to Hobart Yacht Race provided a splash of colour and excitement during a tragic summer of fires.
Here the maxi *Black Jack* shows off her massive rig during pre-start manoeuvres
(Photo John Jeremy)

THE AUSTRALIAN NAVAL ARCHITECT

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Cover Photo:

Bajamar Express, built by Austal in Western Australia for Fred. Olsen Express of Canary Islands, was launched on 4 February 2020 (Photo courtesy Austal).

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on the
World Wide Web
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From the Division President

Welcome to another great edition of *The Australian Naval Architect*. I hope that you managed to get a good break over the Christmas and New Year period, and that the bush fires have not caused you too much in the way of problems.

The annual SMIX bash in Sydney proved to be as good as ever. I was able to present the inaugural Bob Campbell Award to Michelle Grech for her paper *Assessing the Determinants of Safety Culture in the Maritime Industry* at the event. It's great to see that many other sections are organising similar Christmas networking events, and I'm sorry that I missed them this year.

You may recall that I mentioned in my last column that, at Pacific 2019, I had had an initial discussion with Ian Irving, the new CEO of the Naval Shipbuilding College (NSC). I am very pleased to say that we followed up this contact with an extensive telephone conversation in the New Year. Ian wants the NSC to include interaction with professional bodies. He recognises the importance of naval architects in the shipbuilding enterprise and is very keen to set up an agreement with RINA at as early a stage as possible. Ian also offered to make a presentation to one or more of our Sections and I know that this is being followed up by the SA-NT Section. Hopefully that presentation will be recorded so that members who are not able to attend can view it at their leisure. However, I know that Ian is also happy to make a similar presentation to other Sections, if that can be arranged.

The Blue Economy Cooperative Research Centre (BE CRC) was formally opened in Launceston on 28 January. This is the largest ever CRC, with over 40 participating organisations, and Federal Government funding for an initial period of ten years. As I mentioned in my previous column, this includes a wide range of maritime activities, focussed mainly on the challenges of marine renewable energy and moving aquaculture farms further offshore. There is a great need for innovative maritime engineering associated with these activities, and there will be plenty of opportunities for all sorts of maritime engineers. The Centre will fund at least 50 PhDs over its ten-year life. You can find more information on its website at https://blueeconomycrc.com.au/.

I am a member of the Scientific Advisory Committee for the BE CRC and so attended the Participants' workshop in Hobart. This was a two-day event which was a great opportunity to meet with a wide range of people who are going to be involved in this initiative. Although most were from Australia, there were quite a few from overseas, including New Zealand.

I was disappointed to see that many people at the workshop, who are active in maritime engineering, are not members of our Institution, as they had not realised the breadth of our scope. Some thought that we only covered naval architects, and that other maritime engineers are not allowed to join. This is a message that I hear time and time again, despite the best endeavours of the Institution to promote the fact that we are of relevance to all those engineers working in the maritime field.

At the end of December we lodged the Institution's submission to the Senate Inquiry into Developing and Delivering Australia's Sovereign Naval Shipbuilding Capability. Information about this inquiry, and those submissions received already, can be obtained at https://www.aph.gov.au/Parliamentary_Business/Committees/Senate/Economics/Navalshipbuilding. A number of Council members contributed to our submission, but I would particularly like to thank Gordon MacDonald for leading this task, and Rob Gehling for pulling it all together into a comprehensive document. Contributing to such inquiries is one of the important activities that the Division undertakes, and I think that this role is appreciated by those receiving our advice in the form of these submissions.

Martin Renilson

One of the important points which we made in our submission is that it is naval architects and maritime engineers which have the training and experience to plan for, and understand the engineering, production, and sustainment of ships. We noted that, as the demand for maritime engineers is only just being met by current supply levels, the increase in naval ship production, operation and sustainment will be well beyond current supply levels of graduates. The increased demand for naval architects and maritime engineers from initiatives such as the Blue Economy CRC and associated activities, will also make it difficult for Defence to attract sufficient naval architects and maritime engineers into the naval shipbuilding enterprise.

Therefore we emphasised that increasing the number of maritime engineers in Australia should be one of the highest focuses for the Naval Shipbuilding College. Of course, the demise of the Naval Architecture course at UNSW is certainly not going to help this situation.

We also drew attention to the need for para-professionals in maritime engineering, who are fully familiar with the preparation and interpretation of shipbuilding drawings. As a consequence, the industry has to make-do with personnel from other areas. We noted that this should be rectified by the prompt establishment of appropriate training courses to meet the industry's needs.

On another subject, the Minderoo Foundation has a $US300 million commitment to a new initiative to end worldwide plastic waste. This includes an effort to drive ocean clean-up operations and develop comprehensive data by engaging experts from around the world. I have been providing assistance to Minderoo on behalf of the Institution in the initial phases of this initiative. Further information about Minderoo's 'no plastic waste' initiative can be obtained at https://www.minderoo.com.au/no-plastic-waste/.

As I mentioned in my last column, one of the tasks which the Council undertook was to revise the list of relevant programs on our website. This has now been uploaded onto the website, and is a useful summary of the Australian programs in Naval Architecture, Maritime Engineering and related subjects. This work was led by Jason Steward and I would like to thank him for all the work that he has put into this. The information can be accessed at https://www.rina.org.uk/res/Naval architecture and maritime engineering related courses.pdf.

The working group advising AMSA on Domestic Commercial Vessel (DCV) issues continues to remain active under the leadership of our Secretary, Rob Gehling, and member Violeta Gabrovska. AMSA has indicated that it really appreciates our feedback as a representative body compared with input from individuals. If you have any input for this working group on DCV issues, positive or negative, or are interested in joining it, please get in touch with Rob Gehling.

Preparations are continuing for RINA's participation in the Australian Oil and Gas Exhibition and Conference (AOG 2020) this year, which will take place in Perth from 11–13 March. The Institution will be hosting the Offshore Marine Technology stream, which forms a part of the AOG Knowledge Forum. The link to AOG knowledge forum is https://aogexpo.com.au/conference/knowledge-forum/. Eight technical presentations will be made across the four topic sessions: Floating Solutions, Offshore Operations, Marine Renewable Energy and Offshore Marine Digitalisation, reflecting the changing trends and technical developments in the industry. The Institution will also have a stand in the Exhibition hall to promote the Institution. A dedicated sub-committee of the WA Section is busy with organising the event. For more information, Division members may contact Yuriy Drobyshevski (yuriy@bigpond.com), Tim Gourlay (tim@perthhydro.com) or send their requests to the WA Section Secretary (wa@rina.org.uk).

Whilst on the subject of activities in Western Australia, I was pleased to be able to meet with some of the members of the WA Section Committee in Perth in January. This was a particularly momentous occasion as both Tony Armstrong (Immediate Past President) and Jim Black (the President immediately prior to Tony) were able to attend. As Jim followed me after my first stint as President, I sort of "bookended" the set! It was great, as always, to meet with members of the Section Committees, something I have been very pleased to have done at all the Sections during my Presidency.

As you will be aware, we hold our Annual General Meetings at different locations each year. I am pleased to say that the

(L to R) Standing: Sammar Abbas, Kalevi Savalainen, Yury Drobyshevski
Seated: Tony Armstrong, Martin Renilson, Jim Black
(Photo courtesy Tony Armstrong)

Queensland Section will be hosting our AGM this year, which is scheduled for 31 March 2020. As usual, this will be in conjunction with a technical meeting, which is also being arranged by the Queensland Section. Full details are given elsewhere in this edition.

I will be standing down as President at the AGM, having completed two two-year terms, which is the maximum permitted under our rules. I was very honoured to serve as your President during this time, and enjoyed doing so very much. It was great to travel around Australia and to meet with many members, often at active Section Technical Meetings. I appreciate the effort that many other Council members have put in over these four years to support me — I have been very lucky indeed to work with such a dedicated group of people.

I particularly want to thank our Secretary, Rob Gehling, for all the work which he has done to support me and to ensure that everything has gone so well. I don't think that many members realise quite how much work he puts in to ensure the success of the operation of the Institution in Australia and that our links with the HQ in London go smoothly.

Finally, I also want to pay tribute to the work and dedication of the editors of *The Australian Naval Architect,* John Jeremy AM, and Phil Helmore. *The ANA* is extremely highly regarded by Australian Division members and others in the maritime profession in Australia — the Institution would be a much poorer one without it.

I look forward to continuing to be involved with the Institution and I wish the incoming President, Gordon MacDonald, well.

Martin Renilson

Editorial

This last summer of tragic and almost unimaginable fires followed by drenching rains on the east coast of Australia brings to mind, perhaps inevitably, the words of Dorothea Mackellar: 'I love a sunburnt country, a land of sweeping plains, of ragged mountain ranges, of drought and flooding rains.' The scale of the fires was stunning and, for those affected or nearby, surely terrifying.

As one might expect, anxious, angry and hurt people try to find someone or something to blame. The debate has not always been rational, but understandable in the circumstances. Climate change inevitably has taken centre stage, even though some say it was really just weather, citing lower than usual water temperature in the eastern Indian Ocean, the late start of the monsoon in Northern Australia and other factors. Nevertheless, the tragic fires have attracted the world's attention and focussed many people's minds on the need to combat global warming by reducing our consumption of fossil fuels.

Whilst man has used coal as a fuel for centuries, it is only a bit over one century since the world began to make use of oil to power transport and industry. One hundred years ago, the world's consumption of oil was about 0.7 billion barrels per annum. By 2015 it had risen to over 26 billion barrels per annum. Most of this enormous increase has occurred since the mid-1950s. Regardless of the impact of this use of fossil fuel, or stored sunlight, on earth's atmosphere and the consequent global warming effect, such profligate use of a non-replaceable resource clearly cannot continue. The next century must see changes in fuel technologies at least as dramatic as those of the last century.

The popular press seems to thrive on the negative aspects of the world in which we live, but I prefer to see the challenges which will present themselves in coming decades as great opportunities. For scientists and engineers there is an exciting future in creating our new sustainable world.

The sun, the source of almost all the power we have ever used on earth (apart from nuclear energy, perhaps) can provide us with the means of powering our new, sustainable world. New fuel sources like hydrogen, ammonia and synthesised hydrocarbons can be generated by wind and solar energy as well as electricity for which, by itself, we would probably need more batteries than we can ever make.

Some people feel that nothing is being done to meet this challenge. That is wrong, of course, and in our maritime world there are interesting and promising developments all around us. More ships are being built with hybrid propulsion systems and, some on short routes, with fully electric propulsion. Hydrogen, generated by surplus wind power, will power some small ferries, and it is making headway as a more-widely used fuel despite the handling and storage challenges of a gas which liquefies at near absolute zero temperature. The world's first liquefied hydrogen tanker, *Suiso Frontier*, was recently launched by Kawasaki Heavy Industries in Japan. When complete late this year, the ship will be used to demonstrate the feasibility of an international hydrogen energy supply chain in which hydrogen produced in Australia will be shipped to Japan. The supply will initially come from Victoria using brown coal, but the future lies in solar electrolysis.

In Europe, work is progressing towards building zero-emission cruise ships, with some work seeking to supplement low-emission LNG with hydrogen fuel cells. In this edition of *The ANA*, we report on a presentation to the NSW Section by Lachlan Colquhoun, of MAN Energy Solutions, on *Controlling Marine Engine Emissions*, which provides insight into the development of modern low-emission propulsion engines.

In Australia, the recently-opened Blue Economy Cooperative Research Centre in Launceston will be making a contribution towards the development of marine renewable energy.

By themselves, these developments won't solve the world's energy problems, but they demonstrate that engineering solutions do exist which are likely to become part of our lives much faster than most people realise.

John Jeremy

COMING EVENTS

Queensland Section AGM

The Annual General Meeting of the Queensland Section of RINA was held on Tuesday 18 February 2020 at 6:00 pm at Aus Ships Group, 12/17 Rivergate Place, Murarrie; see notice emailed to Queensland Section members.

The AGM covered annual reports and a new committee was be elected for the coming year. The AGM is your best opportunity to influence change in RINA Queensland Section as we strive to improve the organisation and what it can provide for its members each year. Your attendance next year will be appreciated, and you are encouraged to consider volunteering in some capacity for the year ahead.

WA Section Technical Meeting

Kim Klaka will make a presentation on *Why Yacht Rudders Fail* to a meeting of the WA Section at the Flying Angel Club, Fremantle, on Thursday 27 February at 5:30 for 6:00 pm.

For most sailing yachts, losing a rudder is probably the most catastrophic structural failure other than losing the keel. Rudder failures happen with distressing regularity — perhaps ten times as often as keels falling off. Why is such a catastrophic failure so common?

Whilst a few rudder failures are doubtless due to corrosion, this presentation examines the hypothesis that the underlying reason is design failure. First-principles rudder-force calculations are presented and compared with design codes. The results are startling: choice of design speed and allowable stress are critical. Calculating the rudder load when falling off a wave is also explored, with puzzling results.

Kim Klaka is a naval architect with over 40 years' experience, much of it in small-craft commercial research. He holds a master's degree and PhD in sailing yacht performance, and has completed more than 30 000 n miles of offshore and ocean sailing. He was Director of the Centre for Marine Science and Technology at Curtin University, founding Chair of the WA Section of RINA and founding Editor of *The Australian Naval Architect* journal. He is currently a member of the Editorial Board of RINA's *International Journal of Small Craft Technology*.

NSW Section AGM

The Annual General Meeting of the NSW Section of RINA will be held on Wednesday 4 March immediately following the scheduled technical meeting of RINA (NSW Section) and IMarEST (NSW–ACT Branch) at 6:00 for 6:30 pm in the Harricks Auditorium at Engineers Australia, 44 Market St, Sydney; see notice emailed to NSW Section members.

NSW Section Technical Meetings

Technical meetings are generally combined with the Sydney Branch of the IMarEST and held on the first Wednesday of each month at Engineers Australia, starting at 6:00 pm for 6:30 pm and finishing by 8:00 pm. Engineers Australia offices are currently at 8 Thomas St, Chatswood, but will move to 44 Market St, Sydney, in mid-March.

Meetings are subject to change at short notice so, if you are making extensive arrangements to attend, then please confirm the venue, date and time with the Secretary of the Section.

The program of meetings for 2020 (with exceptions noted) is as follows:

5 Feb	Lachlan Colquhoun, Marine Engine Sales Manager Australia and New Zealand, MAN Energy Solutions *Controlling Marine Engine Emissions*
4 Mar	Bruce Cartwright, Research Associate, University of Newcastle, and Senior Simulation Engineer, Pacific ESI, at Engineers Australia, 8 Thomas St, Chatswood. *Structural Integrity of Ships*
4 Mar	NSW Section Annual General Meeting

1 Apr	IMarEST, at Engineers Australia, 44 Market St, Sydney
6 May	Levi Catton, Program Director/SEA5000 Technical Advisor Ship Integration, Gibbs & Cox Australia *Design and Construction of the RAN's New Hunter-class Frigates*
3 Jun	IMarEST
1 Jul	RINA
29 Jul	IMarEST at Sydney Mechanics School of Arts, 280 Pitt St, Sydney
2 Sep	RINA, at Engineers Australia, 44 Market St, Sydney
1 Oct	IMarEST
3 Dec	SMIX Bash 2020

Victorian Section AGM

The Annual General Meeting of the Victorian Section of RINA will be held on Thursday 19 March 2020 at 5:30 pm for 6.00 pm at Deloitte, 550 Bourke St, Melbourne; see notice emailed to Victorian Section members.

The AGM will be followed immediately by a technical presentation to be advised.

Australian Division AGM

The Annual General Meeting of the Australian Division of RINA will be held on Tuesday 31 March at 5.30 pm for 6.00 pm at Smartship Australia Offices, 6–12 Boronia Rd, Brisbane Airport; see notice elsewhere in this issue.

Queensland Section Technical Meeting

The Australian Division AGM will be followed immediately by a technical meeting of the Queensland Section featuring a number of practitioners' presentations on *Design Highlights of 2019 in South East Queensland — Record Naval Architectural Accomplishments.*

AOG 2020

The Australasian Oil and Gas Exhibition and Conference will be held in the Perth Conference and Exhibition Centre from 11 to 13 March 2020. AOG is a showcase of the latest oil and gas products and services and attracts over 8000 global visitors, providing opportunities to network and learn about the latest technological and innovative breakthroughs which will drive the industry into the future.

In addition to the Exhibition, the Conference provides:

- The Collaboration Forum, which focuses on enhancing collaboration between operators, contractors and the supply chain to drive a greater understanding of challenges and access to opportunities.
- The Subsea Forum, which focuses on how the Australian Subsea industry can adjust to the evolving market; partnering with the Society for Underwater Technology (SUT), Subsea Energy Australia (SEA) and Subsea UK.
- The Knowledge Forum, which brings specialised industry sectors together to discuss the latest techniques and technologies which will enable the industry to overcome both current and future challenges.

AOG 2020 Knowledge Forum

In 2020, the Royal Institution of Naval Architects is again hosting a whole-day stream of the AOG Knowledge Forum, entitled *Offshore Marine Technology*. Speakers were sought to give a 20 minute presentation, with 10 minutes of dedicated question time at the end. No written papers were required.

Session Topics

Technical and/or commercial submissions were sought for the following three sessions:

- Floating Solutions: Fixed and floating offshore structures.
- Offshore Operations: Ships for offshore operations; offshore installation.
- Marine Renewable Energy: Renewable-energy offshore structures and systems.

Evaluation Criteria

- Submissions were evaluated based on their technical content, innovation and relevance to the offshore industry.
- Submissions referring to case studies were highly regarded.
- Prior to submission, company and joint venture-clearances were obtained.
- Ideally, submissions were not previously presented and contain new information.

Two presentations were selected for each of the session topics and were evaluated on their technical content, innovation and relevance to the offshore industry.

Thanks to the support of our hosts and sponsors, delegate attendance at the Knowledge Forum will be complimentary.

Queries may be directed to the Technical Chair, Dr Tim Gourlay, by email to wa@rina.org.uk, or phone +61 416 328 883.

NEWS FROM THE SECTIONS

ACT

Corrosion within the Royal Australian Navy

David Anderson-Smith, Materials Technology Manager, Navy Technical Bureau, gave a presentation on *Corrosion within the Royal Australian Navy — a Navy Technical Bureau Perspective* to a meeting of the ACT Section on 10 December 2019 at the Campbell Park offices.

David graduated from the Australian National University in 2005 with a bachelor's degree in engineering. He worked within the defence industry as a mechanical engineer until 2007 when he joined the Directorate of Naval Platform Systems, now the Navy Technical Bureau. In 2011 he became the Materials Technology Manager, having a strong focus on corrosion and related mitigation strategies such as protective coating systems, cathodic protection and selection of materials for ships. David is chartered in mechanical and systems engineering, is a member of the National Association of Corrosion Engineers, the Australasian Corrosion Association and represents Navy on a number of corrosion- and ship-material-related panels, both in Australia and internationally.

David began his presentation by giving an overview of the fundamental concepts associated with the corrosion of ships. This was followed by a general outline of various corrosion-related issues within the RAN Fleet. Lively discussion and questions were raised by the members present regarding the corrosion of shafts, propellers, appendages, systems and the hull. The presentation highlighted the performance and design considerations associated with the use of cathodic protection systems using both impressed current and fixed anodes, either with steel or aluminium hulls. David presented a very interesting and engaging presentation on what, at face value, may have been considered by naval architects a pretty dry subject.

Following the presentation, many members attended an informal end-of-year dinner at Olims Bar and Bistro in Braddon.

Ray Duggan

Victoria

RSV *Nuyina*: Australia's New Icebreaker

Clive Evans, Maritime Systems Lead—Research Supply Icebreaker Project, Australian Antarctic Division, gave a presentation on *RSV* Nuyina*: Australia's New Icebreaker*, to a combined meeting of RINA and IMarEST attended by 30 on 21 November in the Deloitte Building at 55 Bourke St, Melbourne.

Australia will soon take delivery of an extraordinary new icebreaker vessel to support our Antarctic Program. The multi-role RSV *Nuyina*, which will replace *Aurora Australis*, will deliver significantly increased ship performance, cargo logistics and marine science support facilities over her much-loved but aging predecessor. In this presentation Clive summarised the design and construction process so far and discussed some of the challenges faced along the way. [*The vessel is due for delivery to Hobart in October 2020*—Ed.]

Clive Evans is a naval architect originally from the UK but now living in Hobart. He has a background in the design and construction of ro-pax vessels of around ten years during periods at Houlder, Lightning Naval Architecture and BMT Nigel Gee. In 2017 he joined the Australian Antarctic Division's *Nuyina* project team; where he provides technical support to the design, build and commissioning process.

Karl Slater

RSV *Nuyina*
(Image from Australian Antarctic Division website)

Victorian Section Committee

The Victorian Section would like to thank Sigrid Wilson, who had been on the committee for a relatively short time but made a big impact; however, by the time this issue of *The ANA* goes to press, she'll have moved on from Victoria, having left AMSA to join Naval Group to support the Future Submarine Program in Cherbourg, France and Adelaide. Sigrid was part of a shuffling of the deckchairs to improve our ability to deliver actions which we hope will improve service delivery to our members.

With Sigrid's seat now empty, the Victorian Section Committee currently stands at 10 members:

Chair	Jesse Millar
Secretary	Owen Tregenza
Treasurer	Tom Dearling

Nominee to ADC Members	Karl Slater
	Alex Conway
	Jon Emonson
	James Nolan
	Keegan Parker
	Luke Shields
	Nathan Wallace

Throughout 2019 the Committee trialled several options for holding committee meetings. Currently it is the Committee's preference to hold the meetings in the early morning before work hours at the offices of one of the Committee members. Those unable to attend the offices have the option to dial in and contribute via the phone or Skype. Furthermore, we have moved to a six-weekly cadence to assist in progressing actions and building momentum.

Visit of RINA President

The Victorian Section Committee was privileged to have the presence of the RINA President, Prof. Richard Birmingham, who joined in the Committee's first meeting of the year on 16 January 2020. At the completion of the meeting, an invitation was extended to the Victorian maritime industry to meet Prof. Birmingham over lunch at LaDiDa bar/restaurant in Melbourne's CBD on the following day, 17 January.

Nathan Wallace

Queensland

Student Scholarships

Gerard Anton, mechanical engineering student at Queensland University of Technology (QUT), student member of RINA and Social Coordinator for RINA South East Queensland, has recently been awarded two individual scholarships to pursue his career aspirations of naval architecture, ship design and port development:

- The 2020 New Colombo Plan Scholarship — this is one of the most prestigious Australian scholarships available and recipients were announced by the Minister for Foreign Affairs, Senator the Hon. Marise Payne on 25 November. This scholarship enables him to enrol at the University of Technology Malaysia for Semester 2 next year to study naval architecture and complete a mentorship with the Marine Technology Centre there. He will also undertake a shipbuilding internship with Mitsubishi Heavy Industries in Japan, and attend conferences like Asia Pacific Maritime Singapore to learn about new technology and upcoming trends.
- The National Naval Shipbuilding Scholarship — this is a pilot scholarship which was released in November last year to QUT. The scholarship provides a 12-week work experience within the $90 billion Australian Naval Shipbuilding Enterprise, and financial support through his studies.

  Details of the scholarship can be found at https://www.rmit.edu.au/students/work-study-opportunities/scholarships/browse-scholarships/naval#eligibility.

Gerard Anton

Western Australia

Fremantle Maritime Day

RINA Western Australian Section exhibited at the Maritime Day hosted by Fremantle Ports on Saturday 2 November 2019. This annual public outreach event is popular with families and children. At the RINA stand, apart from promoting the Institution to students and professionals in the maritime industry, there was a number of attractions and activities for children to spark their interest in naval architecture. These included a highly detailed 15 000 piece Lego model of the new Australian Icebreaker, RSV *Nuyina* with many working features, a virtual-reality tour of the icebreaker, and a test tank where children could build and test Lego boats and learn about ship stability. The RINA stand was very popular with the public and busy throughout the day. RINA Western Australian Section looks forward to participating in future Maritime Day events.

QUT Vice-Chancellor and President, Professor Margaret Shiel (C) with students (L to R) Gerard Anton, Lily Kennedy, Haard Shah, Benjamin Davie and Gemma Price
(Photo from QUT website)

The RINA WA Section stand at Fremantle Maritime Day
(Photo courtesy Ken Goh)

Floating Lego model in the test tank
(Photo courtesy Ken Goh)

Testing the stability of a Lego model in the test tank
(Photo courtesy Ken Goh)

Sammar Abbas FIEAust

Sammar Abbas, Chair of RINA WA Section, became a Fellow of the Institution of Engineers Australia (FIEAust) and received his certificate in the *Centenary End-of-year Sundowner* event hosted by the WA Division of Engineers Australia on 28 November, 2019.

Sammar Abbas (R) receiving his FIEAust certificate
from Paul Young
(Photo courtesy Engineers Australia, WA Division)

InterMoor Expands the Team

InterMoor has announced that Gino Parisella has joined the team in the role of Senior Mooring Engineer, based in the Australian office in Perth. Gino brings his substantial experience to the InterMoor APAC Engineering team and the company is extremely happy to have recruited him. Gino will also pursue the completion of his PhD studies while at InterMoor. With the addition of Gino, InterMoor is consolidating what they believe is the best mooring-engineering team of the region.

Matthew White

Wave Induced Motions and Loads in Ships

Bruce Cartwright, Research Associate at University of Newcastle and Senior Engineer at Pacific ESI, gave a presentation on *Wave-Induced Motions and Loads in Ships using the Smoothed Particle Hydrodynamics Technique* to RINA (WA Section) on 11 December 2019 in the Auditorium at Engineers Australia, 712 Murray St, West Perth.

Bruce's presentation outlined the development and current results of a technique to visualise and assess the stresses in a ship as it traverses a series of large waves. The waves were modelled using the smoothed-particle hydrodynamics (SPH) numerical method. SPH is a mesh-free numerical technique which is well-suited to modelling fluid-structure interactions, wave-breaking, turbulence and other complex fluid-flow and free-surface phenomena. By including a full structural finite-element model of a ship in waves within the one software code, the wave-induced stresses are predicted as a consequence of the inherent fully-coupled fluid-structure interaction analysis. The current development of the technique is enabled through an Australian Research Council funded project, *Structural Integrity of Maritime Platforms*. The aim of the project is to assess structural deterioration through corrosion or cracking on the ability of the ship/platform to resist limit-state loads. Hence, a particular use of the tool may be to assess life-extension projects, or damaged vessel survivability limits. The tool may also be useful in application to other floating maritime structures

End-of-year Catch-up

Following the technical presentation by Bruce, RINA (WA Section) members joined the Committee at the Mayfair Lane Pub and Dining Room in West Perth for a self-funded end-of-year catch-up.

RINA *Western Bulletin*, November 2019

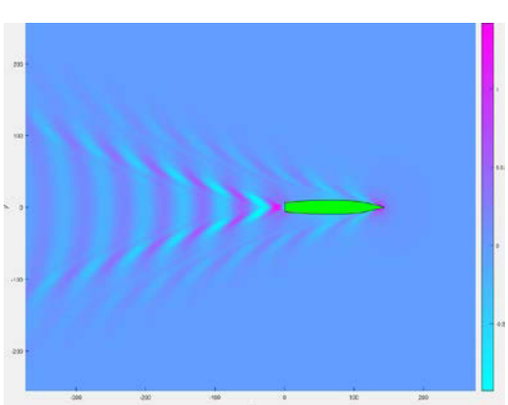
New Australian Ship Wave-making Code

Perth Hydro has developed a new computer code *phFlow* for calculating wave patterns and wave-making resistance of ships and boats. The method is fully-nonlinear and offers improvements over thin-ship theory. It uses Rankine source panels on the hull and above the free surface, similar to other international panel codes, with new methods for free-surface iteration and transom-stern treatment.

The code has now been validated against model test results for the Kriso Container Ship and the DTMB 5415 destroyer hull. The next validation case will likely be a high-speed catamaran.

For further information, please visit www.phflow.com.

Tim Gourlay



Flow around DTMB 5415 full-scale destroyer hull at 18.1 knots
in deep water as calculated using phFlow;
colours show free-surface height in metres
(Image courtesy Perth Hydro)

New South Wales

SMIX Bash

The 20th SMIX (Sydney Marine Industry Christmas) Bash was held on Thursday 5 December aboard the beautifully-restored *James Craig* alongside Wharf 7, Darling Harbour, from 1730 to 2130. The Bash was organised jointly by the RINA (NSW Section) and IMarEST (NSW–ACT Branch). About 200 guests came from the full spectrum of the marine industry, including naval architects, marine engineers, drafters, boatbuilders, machinery and equipment suppliers, regulators, classifiers, surveyors, operators, managers, pilots, navigators, researchers, and educators. Equally importantly, the full spectrum of age groups was represented, from present students to the elders of the marine community.

James Craig at her berth at Wharf 7
(Photo Phil Helmore)

It was also great to see intrastate, interstate and international visitors in the throng, including the President of the Australian Division of RINA, Martin Renilson from Launceston, Nic Bender, Jon Duffy, Nick Johnson, Gregor Macfarlane and Brian Winship from the Australian Maritime College, Paul Gay from Adelaide, Michelle Grech from Canberra, Liz Hay from Brisbane, Terry Hewitt and Tim Speer from Perth, Michael Uberti from Melbourne, and Tony Armstrong (the younger) and his wife Therese from Vancouver, Canada.

Sydney turned on a beautiful evening, albeit with some smoke haze around from the recent bushfires, and many partners in attendance enjoyed the view from the decks of *James Craig*. Drinks (full-strength and light beers, Australian sparkling, cabernet merlot and cabernet sauvignon wines, and soft drinks) and canapés (Peking duck pancakes, roast pumpkin and fetta tartlets, Thai-style spring rolls with sweet chilli, parmesan-crusted chicken skewers, and salt-and-pepper prawn cutlets with a chilli glaze) were provided. A delicious buffet dinner (roasted beef fillet served with a shiraz jus, seasoned turkey breast roast with cranberry, honey leg ham, roasted seasonal vegetables, herb buttered chat potatoes, penne pasta, Sydney rock oysters, smoked salmon, BBQ marinated octopus and calamari, and Greek, coleslaw, Caesar, Tabouli, and Vietnamese noodle salads, with brewed coffee and tea selection) was served in the 'tween decks, with afters (individual ice creams, mini mixed tarts and cream, and Australian cheese and crackers) served on deck, and many tall tales and true were told.

Some of the crowd enjoying drinks and canapés
on board *James Craig*
(Photo John Jeremy)

More of the crowd enjoying drinks and canapés
(Photo John Jeremy)

The buffet servery in the 'tween decks
(Photo Phil Helmore)

Dinner in the 'tween decks
(Photo Phil Helmore)

Differential pricing for members and non-members was introduced this year and was successful, and most tickets were sold before the event.

Formalities were opened by the Chair of the NSW Section of RINA and Chair of the SMIX Bash Organising Committee, Valerio Corniani, who welcomed the guests and thanked the industry sponsors.

Valerio Corniani welcoming the guests and thanking the sponsors
(Photo John Jeremy)

The President of the Australian Division of RINA, Martin Renilson, then gave the background to the Bob Campbell Award. Bob Campbell was born in Scotland (like Martin himself) in 1925 and obtained his degree in naval architecture from the University of Glasgow (also like Martin), and then found employment with Barclay Currle & Co. on the Clydeside. In 1965 he came to Australia to take up a position at the Australian Shipbuilding Board. In 1981 he moved to the Ship Technology Unit, and retired from there in 1987. He chaired the Organising Committee for the Sea Australia Conferences from 2000 to 2004, and these conferences morphed into the highly-successful Pacific IMCs which we have now. In his will, Bob left a grant for the establishment of an award for the best written paper and presentation at the conference.

Martin said that it gave him much pleasure to make the inaugural Bob Campbell Award to Michelle Grech for her paper at Pacific 2019 IMC, *Assessing the Determinants of Safety Culture in the Maritime Industry*. [*The paper has been reproduced in this edition of* The ANA*, see Page 31* — Ed.]

Michelle Grech accepting the inaugural Bob Campbell Award
from Martin Renilson
(Photo John Jeremy)

The raffle prizes were generously donated by our Platimum Sponsor, Teekay, and Tony Armstrong (the younger), Vice-President, Teekay, Vancouver, Canada, said that he was proud to contribute to the organisation, and expressed his thanks to the SMIX Bash Organising Committee. We all know that we are not in the game to make money, but because we have a passion for ships and boats. We are all here to catch up with old friends and make new ones, and there is only one rule for tonight: there will be no discussion of IMO 2020 or scrubbers!

The raffle was drawn by Tony's wife, Therese, and the winners of Moet and Gourmet Nibbles Hampers, delivered to their doors, were:

Matt Buchanan of Saratoga, NSW
Michelle Grech of Watson, ACT

Tony Armstrong (the younger) addressing the guests
(Photo John Jeremy)

Therese Armstrong drawing the raffle and announcing the winner
to Valerio Corniani and Adrian Broadbent
(Photo John Jeremy)

The Lucky Door prize was drawn by the Capability Manager, Atlantic & Peninsula Australia, Stephen Morant. The winner of a Christmas Bites Hamper, delivered to her door, was

Claire Mitchell of Rose Bay, NSW

Stephen Morant (C) about to draw the Lucky Door prize
(Photo John Jeremy)

This year's event was sponsored by the following organisations:

Platinum

- Teekay

Gold

- Advanced Multihull Designs
- Atlantic & Peninsula Australia
- Ausbarge Marine Services
- Australian Maritime College
- DNV GL
- Electrotech Australia
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- Rolls-Royce
- Sydney City Marine
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Silver

- ASO Marine Consultants
- Australian Commercial Marine Group
- Cummins
- Damen
- Lloyd's Register
- McConaghy
- MAN Energy Solutions
- Polaris Marine
- Thompson Clarke
- Valvoline

Bronze

- Australian Shipbuilding and Repair Group
- Lightning Naval Architecture
- One2three Naval Architects

Our thanks to all of them for their generosity and support of SMIX Bash 2019, without which the Bash could not happen.

Committee Meetings

The NSW Section Committee met on 3 December and, other than routine matters, discussed:

- SMIX Bash 2019: Some sponsors have reduced or withdrawn sponsorship, so we will be expecting a loss this year; arrangements for the registration desk are in hand.
- Technical Meeting Program 2020: Presentations have been secured for March and May; further presentations proposed and to be followed up.
- Recording of Technical Presentations: *Screen Recorder Pro* software successfully trialled for the September presentation, and recording now up on the new RINA YouTube website. It is expected that recording facilities will be available at the new Engineers Australia venue, with a fall-back of our *Screen Recorder Pro* software.
- Engineers Australia New Premises: EA is moving their Sydney member services and facilities to 44 Market St in the CBD on 2 March 2020, so our technical presentations will also move there; EA Sydney Division administration will remain at Chatswood.
- Registration of Engineers in NSW: There have recently been two bills in the NSW Parliament regarding registration of engineers in NSW, one a Government bill which was a really watered-down version of similar legislation in Queensland, and would not have affected engineers in NSW very much. The other was a private members' bill, and had the potential to affect engineers in NSW significantly. However, both bills were defeated in the NSW Parliament in November, and so nothing is likely to happen until the new year. Watch this space!

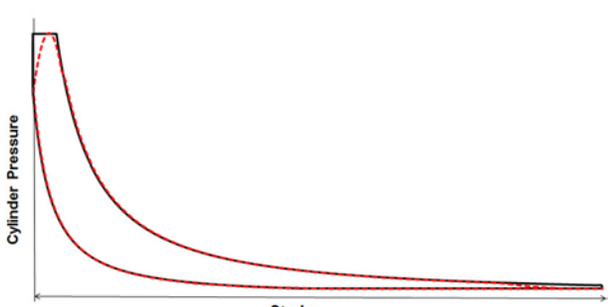
The next meeting of the NSW Section Committee is scheduled for 25 February.

Controlling Marine Engine Emissions

Lachlan Colquhoun, Marine Engine Sales Manager Australia and New Zealand, MAN Energy Solutions, gave a presentation on *Controlling Marine Engine Emissions* to a joint meeting with the IMarEST attended by 42 on 5 February in the Boardroom at Engineers Australia, Chatswood.

Introduction

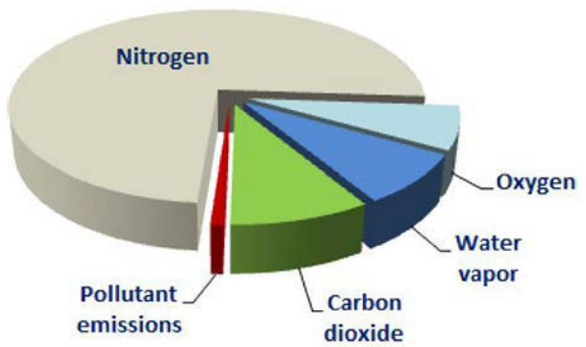
Lachlan began his presentation by asking, what do we mean by marine engine emissions? The diesel engine was invented by Rudolf Diesel (1815–1913) in the MAN facility in Augsburg, Germany. The principle of the engine is shown in the P-V diagram of the diesel cycle, with the ideal cycle shown in black, and the practical cycle in red.



P-V diagram of the diesel cycle
(Diagram courtesy MAN Energy Solutions)

The diesel cycle has a number of advantages for internal combustion engines, including the highest thermal efficiency, the lowest unburned hydrocarbons, the largest

range of available fuel types, and superior combustion control under dynamic and ambient conditions. By increasing the combustion temperature/pressure, we can get more efficiency, but at the expense of more NOx emissions. Diesel engines, like other internal combustion engines, convert chemical energy contained in the fuel into mechanical power. Diesel fuel is a mixture of hydrocarbons which—during an ideal combustion process—would produce only carbon dioxide (CO_2) and water vapor (H_2O). Indeed, diesel exhaust gases are primarily composed of CO_2, H_2O and the unused portion of engine charge air. The relative concentrations can be shown in a pie chart.



Relative concentration of pollutant emissions
in diesel exhaust gas
(Chart from DieselNet website)

GHG Greenhouse gases: substances which trap heat in the atmosphere, including water vapor (H_2O), carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) and ozone (O_3).

The pollutant gases (shown in red) comprise the following:

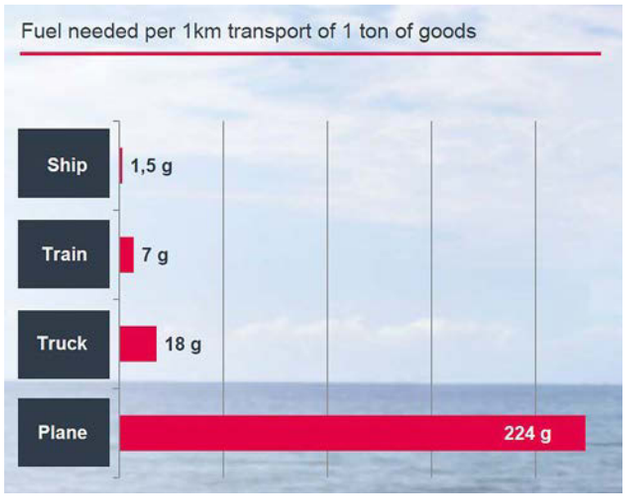
CO Carbon monoxide
HC Unburnt hydrocarbons
NOx Nitric oxide (NO) and nitrogen dioxide (NO_2) which are formed when N_2 and O_2 react at high temperature
SOx Sulphur oxides emitted when fuels contain sulphur
PM Particulate matter: coarse particles, such as fly ash, condensation of materials vaporised during combustion (visible smoke) and unburnt fuel

Shipping Emissions

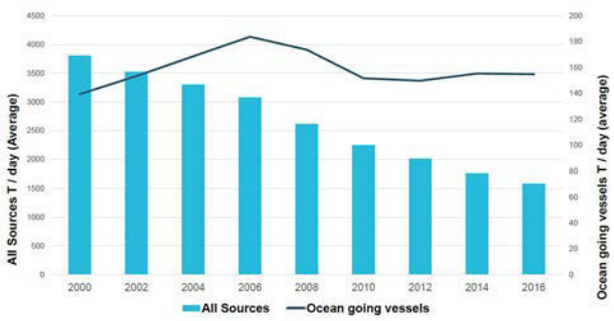
Recent studies indicate that shipping accounts for 94% of all inter-continental transport, 71% of total global trade, 15% of man-made NOX emissions, and 2.2% of man-made CO_2 emissions.

Comparing the transport efficiency of the main modes of goods transport, we see that the fuel needed for the transport of goods is lowest for ships (1.5 g/t-km) and highest for planes (224 g/t-km).

California has been very successful in reducing NOx emissions from land-based transport (truck and rail) over time, but shipping has been lagging behind. However, the current limits placed on shipping emissions should provide reductions in the future as older tonnage is replaced. Regardless of the long-term effect of current marine NOx regulations, the overall trend in California demonstrates that existing NOx reduction technologies can be very effective in reducing NOx emissions.



Relative concentration of pollutant emissions
in diesel exhaust gas
(Chart courtesy MAN Energy Solutions)



California NOx emissions trends
(Chart courtesy MAN Energy Solutions)

Current and Future Regulations

Current and future regulations on emissions can be shown in a timeline diagram (see top of next page). The new regulations and the strengthening of IMO's Energy Efficiency Design Index make it more difficult to design inefficient ships. In addition to existing emission control areas (ECAs), the Baltic, North Sea and USA regulations are likely to be expanded to other areas where pollutant emissions like NOx are having a more-pronounced detrimental effect on air quality.

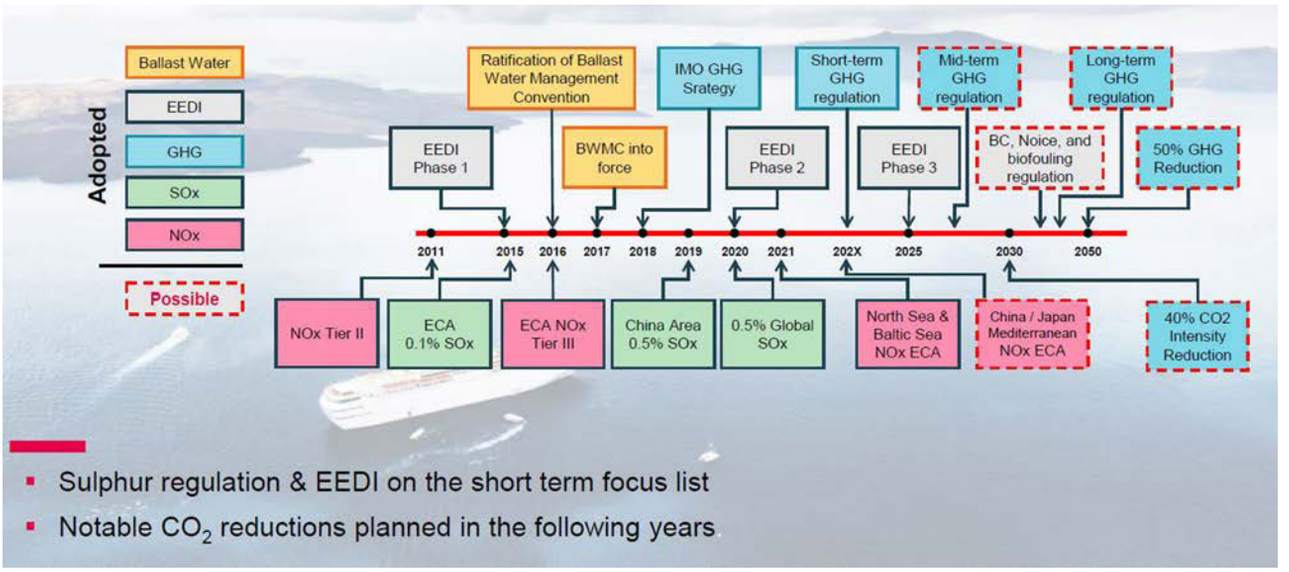
IMO Resolution MEPC.304(72) shows the IMO strategy on reduction of GHG emissions from ships, aiming for a 50% reduction of GHG emissions by 2050 relative to 2008. Also, the carbon intensity of ships, aiming for a 40% reduction per unit of transport work by 2030 relative to 2008, and 50% reduction by 2050.

Short-term Measures (2018–2023)

- EEDI improvement (Energy Efficiency Design Index)
- SEEMP improvement (Ship Energy Efficiency Management Plan)
- Speed regulation
- Methane slip regulation
- VOC regulation (Volatile Organic Compounds)

Mid-term measures (2023–2030)

- Low-carbon/zero-carbon fuels introduction
- Operational energy efficiency requirements
- Market-based measures



Current and future emission regulations
(Chart courtesy MAN Energy Solutions)

Long-term measures (>2050)

- Zero-carbon/fossil-free fuels for 2050 and later

Alternative Fuels

Alternative fuels include liquefied natural gas (LNG), liquefied petroleum gas (LPG, including propane and butane), ammonia and hydrogen. The fuels and their properties and emission reductions are compared to HFO (heavy fuel oil) Tier II in the accompanying table. Batteries including market leaders Corvus battery rack and Tesla Model 3 battery cells are included for reference purposes.

Ammonia and hydrogen both have advantages in that there is no CO_2 produced in their combustion.

Batteries have a role to play in short voyages (typically ferries), but the volume required and their endurance mean that they are not in picture for long-haul sea transport anytime soon, except as a medium for improving the efficiency of power generation by internal combustion engines.

Significant emissions reductions are possible with alternative fuels. *Lindanger,* the world's first ocean-going vessel capable of running on methanol, is one of nine 50 000 dwt chemical/oil tankers powered by MAN B&W ME-LGI two-stroke dual-fuel engines. The engine is Tier III compliant when run on methanol using HFO, MDO or MGO as pilot fuel. *Lindanger* was built in 2016 by Hyundai MIPO Dockyard in Ulsan, South Korea, for Norwegian firm Westfal-Larsen for charter by global marine transportation company Waterfront Shipping.

Lindanger
(Photo from Methanex Corporation website)

Lachlan then discussed the merits and development status of two examples of alternative fuels. The first, LNG, has been

Energy storage type	Specific energy MJ/kg	Energy density MJ/L	Required tank volume m³. (1)	Estimated PtX efficiency	Emission reduction compared to HFO Tier II			
HFO	40,5	35	1000		SO_x	NO_x	CO2	PM
Liquefied natural gas (LNG -162 °C)	50	22	1590	0,56	90-99%	20-30%	24%	90%
					90-97%	30-50%	15%	90%
LPG (including Propane / Butane)	42	26	1346		90-100%	10-15%	13-18%	90%
Methanol	19.9	15	2333	0,54	90-97%	30-50%	5%	90%
Ammonia (liquid -33 °C)	18,6	12,7	2755	0,65				
Hydrogen (liquid -253 °C)	120	8.5	4117	0,68				
Marine battery market leader, Corvus, battery rack	0,29	0,33	106,060					
Tesla model 3 battery Cell 2170 (2)	0,8	2.5	14,000					

(1) Given a 1000 m³ tank for HFO. Additional space for insulation is not calculated in above diagram. All pressure values given for high pressure Diesel injection principle.
(2) Values for Tesla battery doesn't contain energy/mass obtained for cooling/safety/classification

Alternative fuel properties and emission reductions
(Table courtesy MAN Energy Solutions)

in use for many decades in the marine sector. Ammonia is a marine fuel in the early stages of its development.

Liquefied Natural Gas

Liquefied natural gas (LNG) is seen by many in the marine industry as a good transition fuel to lower-carbon fuels. It produces less CO_2, almost completely eliminates SOx and particulates, and is NOx Tier III complaint without exhaust after-treatment in many applications. There are issues with the quality of the gas, in particular the variation in methane number which can cause some engines to de-rate. The four-stroke Otto-cycle engines using natural gas are generally less responsive than equivalent diesel engines. MAN has invested a lot in the development of its four-stroke natural gas engines to minimise these disadvantages. LNG engines and fuel-gas supply systems (FGSS) for the marine sector are relatively mature technologies, and LNG as a marine fuel is growing strongly, particularly in Europe. The main hold-up is the lack of bunkering facilities, but these are increasing. A joint-industry-partnership (JIP) to promote LNG as a fuel for the Pilbara iron-ore trade concluded in 2018. JIP member BHP has recently announced its intention to charter ten LNG-powered Newcastlemax VLOCs for the iron-ore trade, with other miners currently assessing similar plans. A similar JIP has recently been established to promote LNG as a marine fuel on Australia's east coast.

Some of the benefits of a typical marine LNG installation include:

- SOx emissions are largely eliminated (90–99% reduction)
- NOx emissions from four-stroke engines are Tier III compliant without SCR
- 24% reduction in CO_2, which is partially offset by methane slip
- 90% reduction in particulate matter
- Readily accommodates synthetic methane which could be generated by renewable energy

An issue relevant to natural gas engines is 'methane slip' which is the term widely used to describe the release of unburned methane into the atmosphere via the crankcase and exhaust funnel. According to the current IPCC report, methane has twenty-eight times the GHG effect of CO_2. A study by Energetics for Woodside Energy in 2019 compared the methane slip of competing two-stroke engines running on diesel (high-pressure injection) or Otto (low-pressure) heat cycles.

Life cycle emissions of LNG from Woodside fuelling iron ore shipping from the Pilbara
(Chart courtesy Energetics)

The study showed that both technologies reduced equivalent CO_2 (eCO_2) emissions, with the high-pressure injection system comparing favourably to the low-pressure system. Four-stroke Otto cycle engines also exhibit higher levels of methane slip compared to the high-pressure two-stroke gas engines. Industry is variously conducting research into ways to remove or 'scrub' methane from exhaust emissions to mitigate this issue.

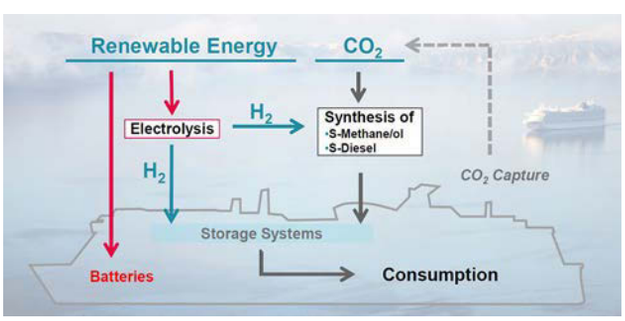
Ammonia

Previous research shows that ammonia works as a fuel in internal combustion engines. MAN Energy Solutions has a programme to adapt the MAN B&W ME-LGI dual-fuel engine to run on ammonia using diesel as a pilot fuel to initiate combustion. Development of this engine is estimated to be 2–3 years. Some of the features and challenges of an ammonia engine include:

- No CO_2 emissions produced when combusted
- Similar engine design and fuel storage systems to LPG
- Ammonia is a widely-traded commodity for fertiliser and pharmaceuticals
- There is a ready market to fuel the global ammonia carrier fleet
- There are IGC Code development issues to overcome
- Ammonia slip (release of unburned ammonia to the atmosphere) is a concern due to odour and toxicity, but it is expected that this can be addressed by after-treatment.
- There is no industrial-scale supply chain for 'green' ammonia
- Higher NOx emissions than diesel, but Tier II & III compliance is achieved with existing technology

Power-to-X

Power-to-X refers to a number of electricity conversion, energy storage, and reconversion pathways which use surplus electric power, during periods where fluctuating renewable energy generation exceeds load, or dedicated renewable energy supply. Power-to-X conversion technologies allow for the decoupling of power from the electricity sector for use in other sectors (such as transport). It is suggested that, in the long term, Power-to-X has the potential to replace fossil fuels in the marine sector using pathways such as power-to-ammonia, power-to-gas (synthetic methane), power-to-hydrogen and power-to-liquid (diesel, methanol or ethanol),



The principle of Power-to-X
(Diagram courtesy MAN Energy Solutions)

There is a lot of work under way in the area of electrolysis and synthetic natural gas. For example, Audi has a plant manufacturing synthetic natural gas (SNG) as an e-fuel for Audi customers.

Wes Amelie is a 1036 TEU feeder container ship, operated by Unifeeder, which had its four-stroke main engine retrofitted to enable dual-fuel operation. She will become the first vessel in the world to run on SNG generated by wind energy. To demonstrate that SNG can successfully be used as a marine fuel, 20 of the 120 tons of LNG which *Wes Amelie* typically uses per round trip will be replaced by climate-neutral SNG. As a result, CO_2 emissions are expected to decline by 56 tons (57 t) for the round trip. Automobile manufacturer Audi's Power-to-Gas facility in Werlte, where a liquefaction plant is currently under construction, will provide the SNG, which will be generated by wind energy and is thus 100% climate-neutral. The first SNG voyage is expected to take place after the completion of the liquefaction plant in Q2 2020. The retrofit is expected to enable *Wes Amelie* to reduce SOx emissions by >99%, NOx by approximately 90%, and CO_2 by up to 20%. As a result, the vessel now meets both Tier II and Tier III emission requirements set by the International Maritime Organisation.

Wes Amelie
(Photo from Shipspotting.com website)

NOx Reduction Technologies

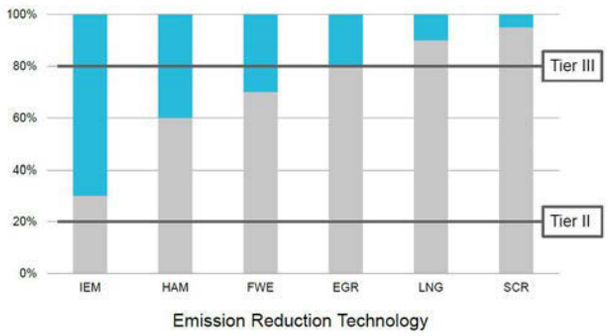
Nitrogen oxides (NOx) are produced in high temperature mixtures of atmospheric nitrogen and oxygen which occur in the combustion cylinder, and this usually occurs at peak cylinder pressure. For this reason, there is a basic trade-off between engine efficiency (specific fuel oil consumption, SFOC) and NOx emissions. As the flame temperature/combustion pressure increases, the efficiency (SFOC) increases, and the NOX emissions increase. Accordingly, we can reduce NOx emissions at the expense of increased SFOC.

Engine OEMs employ a diverse range of technologies to reduce NOx emissions, including:

IEM Internal engine modification
HAM Humid air motor
FEW Fuel-water emulsion
EGR Exhaust gas recirculation
SCR Selective catalytic reduction
LNG Liquefied natural gas

The table is a generalisation, but shows the relative effectiveness of each of the technologies in reducing NOx.

EGR is a NOx emissions-reduction technique used in diesel engines and works by recirculating a portion of the engine's exhaust gas back to the engine cylinders. This dilutes the



NOx reduction technologies and IMO tier compliance
(Diagram courtesy MAN Energy Solutions)

O_2 in the incoming air stream and provides gases inert to combustion to act as absorbents of combustion heat to reduce peak in-cylinder temperatures. MAN Energy Solutions utilises EGR in two-stroke applications to achieve Tier III compliance.

SCR is a proven technique and has high NOx-reduction potential (up to 90%). It is the dominant technology used to achieve Tier III compliance in diesel-fuelled engines. However, there are challenges, including the need for an additional consumable (i.e. the urea solution), exhaust-gas temperature control, and the space and mass requirements for the system.

Other Emissions-reduction Technologies

Other technologies being investigated to control emissions from marine diesel engines include:

- Diesel particulate filters: Not currently being used in the marine field, as emission levels of current diesel fuel and LNG don't require, although it may be required in the future as limits become more stringent.
- SOx reduction.
- Catalytic oxidation is used to reduce carbon monoxide but may be applicable as a means of reducing methane slip
- Methane slip scrubbing/capture: There is a lot of effort being put into this area to reduce eCO_2 emission of LNG.

Technology Summary

Lachlan then showed a video of the latest technology from VW showing the technology which they have developed to meet the more stringent Euro 6 emissions requirements for passenger vehicles and their commitment to diesel engines. The animation showed the workings of many of the emissions technologies outlined above and may be a window to what may be ahead in the marine sector.

Conclusion

There are different types of emissions produced by internal combustion engines used in marine applications, and key drivers behind current and future emission limits set by the International Maritime Organisation and local regulators. There are existing and emerging marine fuels and they have relative benefits from the emissions-reduction, shipbuilder's and operator's perspectives. There are existing and emerging technologies employed by engine manufacturers to reduce or scrub emissions, and areas of development.

Questions

Question time was lengthy and elicited some further interesting points.

Slow steaming is an interesting option. If a vessel has to convert to slow steaming, and run at 40% load rather than 80%, then there are usually no problems with these technologies as they are designed to run at lower loads. However, the engine itself is usually less efficient at a lower load, and so you are really better off designing for a slower steaming speed in the first place as a long-term solution. For existing ships, a permanent de-rating of the engines or optimisation of the engine at lower loads can be implemented for a turbocharger retrofit, or changes to fuel-injection equipment may have short payback periods.

Ammonia in a dual-fuel engine requires pilot diesel fuel to initiate combustion. There is a lot of development work going on at the moment into how much diesel is required to ignite the gas.

Hydrogen as a marine fuel is currently limited to small-scale projects. MAN is currently involved in a project for a fjord ferry in Norway. The benefit of using hydrogen is that there are no CO_2 emissions. Limitations of hydrogen in marine applications are that the storage volume required is approximately four times that of diesel fuel, and the boiling point is considerably lower at –253°C and, accordingly, the energy required for liquefaction is considerably higher than that for LNG. Hydrogen is a very 'tight' gas, meaning that piping and valving requirements are all more stringent. Finally, hydrogen is significantly more flammable than LNG at ambient conditions, meaning that safety considerations are more demanding. Whilst the safety issues can be addressed, MAN thinks that implementation in the marine field on the scale required for large ocean-going vessels is a long way off.

The vote of thanks was proposed, and the certificate and "thank you" bottle of wine presented, by Geoffrey Fawcett.

Phil Helmore

Lachlan Colquhoun (L) accepting his certificate and "thank you" bottle of wine from Geoffrey Fawcett (Photo Phil Helmore)

CLASSIFICATION SOCIETY NEWS

Innovative LNG Carrier *Saga Dawn* Delivered

ABS-classed *Saga Dawn*, the world's first LNG carrier to be fitted with an innovative cargo containment system based on IMO requirements for independent Type A tanks, has been delivered to Saga LNG Shipping. The 45 000 m^3 Saga LNG Shipping vessel, which completed gas trials in June 2019, was constructed by China Merchants Heavy Industry at its Jiangsu shipyard in Haimen, China.

"ABS has a track record of working with innovators in gas worldwide, and we are proud that this project joins the list of successful projects," said Eric Kleess, ABS Senior Vice President, Eastern Hemisphere Operations. "Innovation is essential to move our industry forward and it is our mission to work with the designers and builders to harness the benefits of these designs while keeping safety at the forefront."

The LNT A-BOX® system was developed by LNT Marine. It features IMO independent prismatic Type A tanks as the primary containment. The tanks are supported by laminated wooded supports and a liquid-tight thermal insulation attached to the hull compartment as an independent secondary barrier.

"After nearly 10 years of research and development, we are delighted to see the completion and delivery of the first LNG carrier based on our LNT A-BOX® technology. We would like to thank CMHI, Saga and ABS for excellent cooperation throughout the project," said Kjetil Sjølie Strand, CEO, LNT Marine.

ABS *Press Release*, 18 December 2019

Saga Dawn
(Photo courtesy Saga LNG Shipping)

Bureau Veritas Certifies Ørsted's Borkum Riffgrund 2 Offshore Wind Farm

Bureau Veritas has issued Ørsted, the global leader in offshore wind, a Project Certificate for the 450 MW Borkum Riffgrund 2 offshore wind farm. Located in Germany's

North Sea, 56 km off the coast of Lower Saxony, the project consists of 56 MHI Vestas V164-8.3MW turbines with two different types of foundations — monopiles with bolted transition pieces and suction bucket jackets. Borkum Riffgrund 2 supplies 460 000 households with clean energy.

The Project Certificate concludes a "double certification process" started in 2015 — both to the internationally-recognized scheme IEC 61400-22 and to the German BSH standards. The scope of the evaluation included all assets, including the wind turbines, their foundations, the offshore sub-station and the inter-array cables, and covered all project phases, from design and manufacturing, to installation and commissioning.

Volker Malmen, Managing Director of Ørsted in Germany, said "I am delighted that Borkum Riffgrund 2 has reached its final milestone with the receipt of the project certificate. We are extremely pleased with the outstanding and constructive collaboration with Bureau Veritas."

"The close collaboration between all parties and the deep expertise of our technical teams allowed us to carry out this project. The IEC project certificate positively concludes Bureau Veritas' evaluation and demonstrates the overall quality of the project." explains Eric Rouaix, Wind Certification Director at Bureau Veritas.

Andreas Klatt, Industry Director of Bureau Veritas Germany, said "We look forward to continuing our cooperation with Ørsted on this project throughout the operations and maintenance phase over the coming years. Bureau Veritas is a reliable partner for the entire life-cycle."

We are proud to support a renewable-energy player as part of our many projects to accelerate the ecological transition to a greener world. The collaboration between Bureau Veritas and Ørsted will not stop here, as Bureau Veritas has been awarded the Operation and Maintenance surveillance contract for Borkum Riffgrund 2, and is providing certification for the Borssele 01&02 offshore wind farm in the Netherlands.

Bureau Veritas *Press Release,* 19 November 2019

Ocean Farm 1 Receives First-ever Offshore Fish Farming Class Certificate from DNV GL

Developing and expanding sustainable aquaculture will be essential as the demand for fish grows around the world. Owned and operated by SalMar, *Ocean Farm 1* is the first salmon farm designed and built for exposed operation, with a novel design which combines solutions from aquaculture and the offshore industry. The certification of *Ocean Farm 1* to a new DNV GL standard for offshore fish-farming installations represents a vital first step towards the utilisation of new ocean spaces for aquaculture.

The unit was delivered in June 2017 from Wuchang Shipbuilding Industry Group in Qingdao, China, and transported to Norway for installation. DNV GL provided third-party verification and certification covering the design, construction, transport and installation, enabling *Ocean Farm 1* to meet the Norwegian NYTEK regulations and to operate safely for salmon farming. The unit was also awarded the new OI Offshore fish farming installation POSMOOR class notation, which confirms that *Ocean Farm 1* was built in accordance with DNVGL-RU-0503 Offshore fish farming units and installations. *Ocean Farm 1* is, in part, a pilot project to test the concept of offshore fish farms in exposed locations.

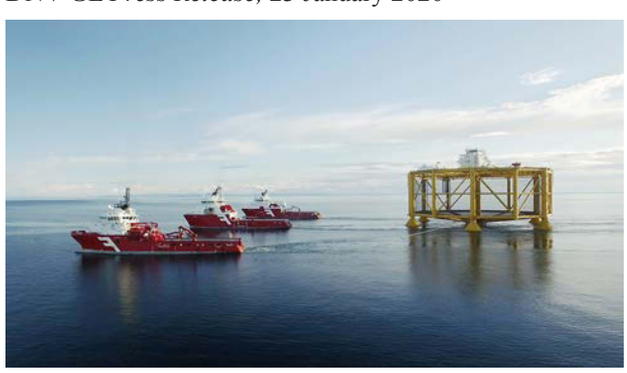
"The expansion of fish farms into exposed locations is based on a combination of two well-known concepts — offshore technology and fish farming," said Olav Andreas Ervik, CEO of SalMar Ocean. "Applying offshore and maritime competence in a new context offers new possibilities in open ocean aquaculture. In ground-breaking projects such as *Ocean Farm 1*, it is essential that we have top-of-the-line risk reduction and quality assurance in place, and throughout every phase of this project, DNV GL's contributions have been essential to ensure its success and operational excellence."

"This has been a very exciting project which has enabled us to demonstrate the broad range of technical competencies that DNV GL can bring to innovative projects," said Geir Fuglerud, DNV GL's Director of Offshore Classification. "*Ocean Farm 1* is the first of several aquaculture projects planned for more-exposed ocean installation in Norway, and with the experience we and the industry gain from this installation we hope that this marks the beginning of a new era for sustainable aquaculture."

Principal Particulars of *Ocean Farm 1* are

Height	69 m
Diameter	110 m
Volume	250 000 m^3

DNV GL *Press Release,* 23 January 2020



Ocean Farm 1 under tow
(Photo from DNV GL website)

LR Joins Forces on Ammonia-fuelled Tanker Project

Lloyd's Register, MISC Berhad, Samsung Heavy Industries (SHI), and MAN Energy Solutions have announced that they will work together on a joint development project (JDP) for an ammonia-fuelled tanker to support shipping's drive towards a decarbonised future. The creation of the alliance has been motivated by the partners' shared belief that the maritime industry needs leadership and greater collaboration if shipping is to meet the International Maritime Organisation's 2050 greenhouse gas (GHG) emissions target, an ambition which requires commercially-viable deep-sea zero-emission vessels (ZEVs) to be in operation by 2030.

Ammonia is just one of the pathways towards zero-carbon emitting vessels. The partners recognise that the shipping industry will need to explore multiple decarbonisation pathways and hope that their collaboration will spur others

in the maritime industry to join forces in addressing this global challenge. The partners believe that the creation of such alliances will send a clear message that shipping can progress itself to fit times and circumstances, ahead of regulatory action.

The drive to decarbonise shipping will be a dominant focus of the decade ahead and follows a year of action in 2019 which saw the launch of the Getting to Zero Coalition, an alliance of leading maritime, energy, infrastructure and finance companies committed to getting commercially viable deep-sea ZEVs powered by zero-emission energy resources into operation by 2030.

Shipping's decarbonisation as a shared obligation was also a key talking point during the Global Maritime Forum held in Singapore in October 2019, where more than 220 industry leaders congregated to discuss the challenges facing the shipping industry.

Yee Yang Chien, President and Group CEO, MISC Berhad, said "At MISC, we believe that the global maritime industry needs to be more collaborative in defining our future together, rather than being confrontational and fragmented in our efforts. I am very glad that our distinguished partners have come together with MISC to showcase joint leadership in developing one of the pathways towards a zero-carbon future for the maritime industry. We need more shining examples of partnerships and collaborations in our industry and it is my hope that this will encourage our peers in the industry to also join hands with others to advance the zero-carbon agenda."

Joon Ou Nam, President and CEO of Samsung Heavy Industries, said "We are delighted to be a key member of this meaningful industry collaboration together with competent partners. We all know that the industry-wide movement is vital, and new zero-carbon fuel technologies, such as ammonia, are to be brought on the table in order to take action proactively on maritime GHG emissions in accordance with the IMO's ambitious road map. We hope SHI's experience and expertise in novel ship design development will effectively contribute to this joint development project and all JDP partners could get better insight into the feasible and sustainable zero-carbon fuel vessel design solutions."

Nick Brown, Marine and Offshore Director, Lloyd's Register, said "As we start the 2020s we are proud to be among a four-party team to make deep-sea ZEVs a reality within this decade. The IMO's 2050 GHG ambitions, which prescribe that international shipping must reduce its total annual greenhouse gas emissions by at least 50% of 2008 levels by 2050, require substantial and collaborative input from all maritime stakeholders, and we are confident that the lead taken by this partnership will encourage others to work collectively to address the challenge. These are exciting times as we commence the industry's fourth propulsion revolution as, during LR's history, we have supported the transition from wind to coal to oil and now look forward to safely decarbonising."

Bjarne Foldager Jensen, Senior Vice President, Head of Two-stroke Business at MAN, said "Joining this project makes perfect sense for MAN Energy Solutions as system technologies which help our customers to reduce emissions and lead the way to a carbon-neutral future form a significant part of our business strategy. Low-speed diesel engines are the most efficient propulsion system for trans-oceanic shipping and already run on a sizable number of emission-friendly fuels. We look forward to adding ammonia to the list and welcome the opportunity to work with industry partners in this venture."

LR *Press Release,* 15 January 2020

Wageningen F-Series Propellers from MARIN

In a Joint Industry Project (JIP), a standard series of fixed-pitch propellers will be developed which encompasses design features of contemporary propellers. The new series will be designed for best achievable efficiency, while simultaneously taking into account requirements on cavitation, noise and vibrations. The need for the series results from the growing awareness of safety, ecological and comfort aspects in ship design, and the increasing electrification of ship propulsion systems.

Multi-dimensional Design Space

The series will contain more than 100 propellers in the usual design space of blade number, blade area ratio and pitch ratio. Geometry details like skew, radial pitch and camber distribution, and blade section shape will depend on these three main variables. The geometries will form a continuous and smooth design space. The additional dimension consists of a function to find trade-offs between various design requirements (for instance efficiency against noise) for a selected series propeller. The benefit for the users is that each search in this series results in a practical and contemporary propeller design (geometry and performance data are output) which has a high efficiency, and is balanced with cavitation, noise and vibration requirements. In this way, the time and costs needed for ship and propeller design are expected to reduce, as risks can be assessed at a very early stage.

Performance Data for any Operational Condition

For every propeller of the series the full four-quadrant data will be made available. These data can be used to determine ship speed, power, towing force and bollard pull, as well as thrust and torque for crash stop, backing, trailing and blocked-shaft conditions. Having reliable performance data available for all these conditions is of great benefit for the users of the series, and may help avoid costly corrections to vessels in service.

Design approach

In an extensive design phase, propellers will first be optimised for seven selected ship types in different wake fields and operational conditions. Efficiency will be maximised within the typical constraints of each ship type and operational condition.

Next, a local search around the optima found in the first phase will be carried out, using design-of-experiments and free-form deformation techniques. Finally, designs at the nodal points of the blade number–blade area ratio–pitch ratio space will be selected.

State-of-the-art Tools

Multi-objective optimisation tools, in combination with both boundary-element methods (BEM) and Reynolds-averaged Navier-Stokes (RANS) CFD methods will be used in the design stage. All propeller models will be manufactured on a new 5-axis milling machine, and tested in open-water conditions using the quasi-steady measurement technique, which was successfully deployed for the previous CD-series propellers.

Expertise and Experience

MARIN's propeller design and research team has significant expertise in developing and applying propeller design and analysis software. The application of optimisation tools has become standard practice in recent years. MARIN has vast experience in developing systematic propeller series. This ranges from series with standard geometries, to modern series like the CD-Series, for which the propeller geometry varies in accordance with the typical operational requirements of the envisaged propeller.

Time Schedule

The kick-off meeting was scheduled for November 2018, and the project will take three years to complete.

Organisation

The work is conducted as a Joint Industry Project (JIP), executed by MARIN. Results and costs are shared with participating organisations which have signed the JIP Participation Agreement. Twice a year these organisations will be invited to the progress meetings which will be held in conjunction with the Vessel Operator Forum (www.vesseloperatorforum.com). All participants will have full and exclusive access to the project reports, software and other information through the confidential project website.

Typical Ship Types

These propellers will be suitable for car carriers, container ships, cruise liners, ferries and yachts, general cargo vessels and coasters, LNG carriers, research vessels, tankers and bulk carriers.

Related Products

Wageningen CD-propeller series (2015) of open and ducted controllable-pitch propellers.

Wageningen TT-propeller series (2018) of controllable and fixed-pitch tunnel-thruster propellers, including rim-driven propellers.

For more information contact Jie Dang at MARIN by phone + 31 317 49 35 25 or email j.dang@marin.nl.

MARIN Brochure VD5/28 Ships

A Wageningen F-Series propeller
(Photo courtesy Wärtsilä Netherlands)

[*Contact with MARIN has revealed that the results of the F-series will only be available to the participants in the JIP during the project itself and during three years after completion. After that, the data will be released to others as well. The F-series project is envisaged to be completed by the end of 2022, so the results will be confidential until the end of 2025. Hence, from 2026 on, the results will be available to organisations outside the group of JIP participants. However, it is still possible to join the F-series JIP. This has the advantage that the results are available immediately, and that participants have influence on choices made during the project. It is even possible to "join" the project in the three year after its completion. In that case all results are*

immediately available, but influencing the project is not an option. — Ed.]

WWSR *Spirit 2*

On 17 November, *60 Minutes* aired a documentary on Dave Warby and the Warby Motorsport Team making their bid for the world water speed record with *Spirit of Australia 2*. The documentary is available at

https://www.9news.com.au/national/60-minutes-dave-warby-one-step-closer-to-breaking-fathers-world-record/9897d672-3880-43d8-8d38-a4004fe39f25

WWSR *Longbow*

Britain has re-entered the contest for the World Water Speed Record with a new vessel, *Longbow*, having commenced construction in April 2018.

Construction of the jet hydroplane *Longbow* is proceeding, and the hull was turned upside down in early December 2019 for the addition of the bottom plywood sheeting to the hull. The plywood and hull longitudinal timbers were coated with West System epoxy, and the plywood carefully lifted into place and held with stainless-steel screws to provide a mechanical fix whilst the West System epoxy was allowed to cure.

[*For monthly updates and photos, see the Longbow website at https://www.jet-hydroplane.uk/news/* — Ed.]

Bottom plywood on *Longbow* completed
(Photo from Longbow website)

Team Britannia

Team Britannia is a multi-million-pound British bid led by ocean adventurer, Alan Priddy, to design and build *Excalibur,* the fastest and most fuel-efficient wave-slicing powerboat to circumnavigate the globe for the much-coveted Union Internationale Motonautique world record, currently held by New Zealander Pete Bethune at 60 days 23 h 49 min in *Earthrace*.

Excalibur was launched on 2 October, and fitting out continues at the Hayling Yacht Company, Hayling Island, Hampshire, UK, with the inflatable sponson tubes being fitted in early December, increasing the overall beam of the vessel by 2 m! Each tube is 19 m long, with a mass of 250 kg, so just manhandling them was a major effort! There are 116 fixing bolts per tube, all of which had to be drilled, tapped and special inserts fitted into the hull to accommodate the bolts.

Meanwhile, the inside work party was busy completing the fit-out of the two 2-berth cabins at the rear of the wheelhouse and the stairwell and forward cabin. The wheelhouse has been fully fitted with "hurricane proof" windows, and the plinths for driver and navigator seats and the console housings have been completed.

Excalibur with sponsons fitted
(Photo from Team Britannia website)

Bluebottle Development Continues

In December, the Ocius Technology bluebottle development team attended the Summerfest 2019 marine autonomy trials at HMAS *Creswell*, Jervis Bay, driven by a collaboration between Defence Science and Technology (DST), the Royal Australian Navy (RAN), academia and industry. This activity involved two autonomous underwater vehicles (AUVs), a bluebottle unmanned surface vessel (USV), support boats, support personnel and observers.

The aim of Summerfest was to demonstrate the enhanced speed of maritime autonomous-systems mine hunting and disposal by allowing activities which are currently conducted in series (with delays for data handling and analysis) to happen in parallel. This involved automated target recognition (ATR) running in real-time on mine-hunting systems cueing other systems for classification, identification and disposal as soon as suspect objects were discovered.

In an Australian first, DST and Ocius demonstrated remote mine hunting. A bluebottle USV was tasked over a minefield as a 'Communications Gateway', relaying information and data between a DST *Remus* AUV in the minefield and a manned vessel, MV *Kimbla*, standing off at a safe distance. The ATR on the *Remus* AUV was able to report positions of mine contacts immediately via the acoustic relay on the bluebottle USV, back to the command-and-control (C2) centre.

The DST *Remus* AUV then surfaced and sent snippets of side-scan sonar data representing the ATR contacts via wi-fi to the bluebottle USV and then back to the C2 centre on board MV *Kimbla* standing off, safely out of range, whilst the *Remus* AUV was still in the water over the minefield.

The human operators at the C2 centre were then able to re-task the *Remus* AUV via the Bluebottle USV, with 'reacquire' missions based on the operator's analysis of the ATR snippets.

Technical Achievements:

- Escorted AUVs from a safe point to the edge of the active mine hunting zone.
- Enabled operators to instruct the AUV to enter the active mine hunting zone and conduct a search using sidescan

sonar with ATR enabled.

- Enabled HQ to see the mine-like contacts reported by the AUV
- Allowed the operators to remotely view the live status of the vehicle when it was on the surface via a network link through the USV, allowing HQ to restart or reconfigure the vehicle and change its mission.

The trials at Summerfest demonstrated the feasibility of rapidly passing images of contacts detected automatically by AUVs to human analysts situated at a remote distance from the minefield, allowing the humans to select contacts for further action. This is potentially an important step in achieving trusted autonomy.

Ocius would like to thank Stuart Anstee, Neil Tavener and Phil Chapple from DST's Underwater Group at Eveleigh for their support, including embedding one of their engineers, Russ Webber, in their team at Ocius' R&D facility at UNSW for the previous month. This mine counter-measures workflow was a major achievement and built on work they have been doing together since before AW18 Wargames in November 2018.

Ocius would also like to thank all the observers and industry participants. They showed that Navy, DST and industry working together collaboratively can definitely speed the innovation cycle.

Particularly, they would like to thank Lieutenant James Keane, RAN, who organised this event. James has been doing research in autonomous underwater vehicle homing, and was the recipient of this year's Holthouse Memorial Scholarship.

Ocius has had much positive feedback from the compilation video which they presented at Pacific 2019. [*If you missed it, then you can see it on the website*

https://www.youtube.com/watch?v=7vhvKcc-UPk&feature=youtu.be—Ed.]

Ocius, December 2019 Update

World's Largest Ferro-cement Ship Dismantled

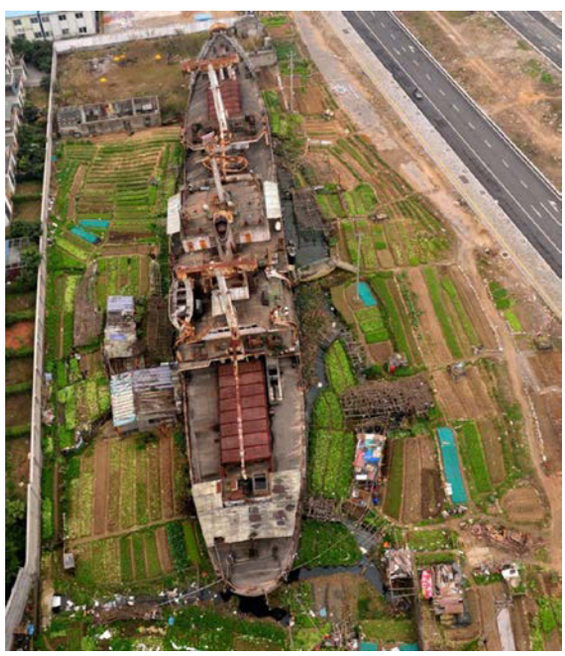
The world's largest ferro-cement ship, *Gu Tian*, was built during the 1970s, when there was a lack of steel in China, as a cheap solution during the 'cultural revolution'. It was launched to herald in a new age where China had mastery of the seas. But after her first voyage in 1974, Communist officials realised that it cost far too much to power a ferro-cement ship through the water, and she was driven ashore and grounded in Fuzhou, capital of southeast China's Fujian Province.

Gu Tian, which is 345 ft (105.1 m) long, 48 ft (14.6 m) wide, 26 ft 7 in (8.1 m) deep, became a squat for locals and a minor tourist attraction, and spent 40 years beached on the bank of the Mingjiang River. It was also used as a training base for Fujian Ship Communications Vocational College.

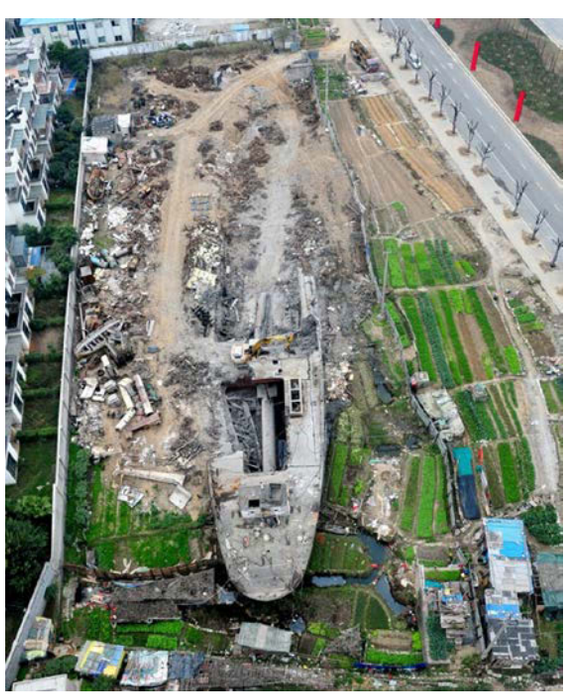
It has previously been ruled too expensive to destroy but, since the land was bought by a re-development scheme, the process began to dismantle it to build a block of flats. Work to destroy the 3 000 ton (3048 t) ferro-cement ship began in November 2019 and was completed in mid-January.

Martin Grimm

Gu Tian grounded in Fuzhou
(Photo from Aggregate Research website)



Gu Tian before dismantling
(Photo from Aggregate Research website)



Gu Tian with dismantling nearly complete
(Photo from Aggregate Research website)

GENERAL NEWS

Austal Launches 118 m Trimaran Ferry

Austal has launched the first of two 118 metre high-speed trimaran ferries currently under construction for Fred. Olsen Express of the Canary Islands.

The high-speed vehicle-passenger ferry, to be named *Bajamar Express*, was launched at Austal's Henderson, Western Australia, shipyard on 4 February 2020, and is now in the final stages of fitting out, prior to scheduled delivery later this year.

Austal's Chief Executive Officer, David Singleton, said that the launch of the new trimaran highlights Austal Australia's competitiveness in the global shipbuilding industry and continued leadership in trimaran design technology.

"With today's launch of *Bajamar Express*, our internationally competitive Australian team has again demonstrated an inherent capability to design and construct advanced, cutting-edge vessels efficiently and cost effectively," Mr Singleton said.

"Austal developed the world's first and largest high-speed passenger trimaran ferry, *Benchijigua Express*, here in Henderson, Western Australia, and it is with great pride that we now launch the latest evolution of that highly successful, proven design.

"This latest trimaran will provide Fred. Olsen Express with class-leading seakeeping, improved fuel economy and greater passenger comfort which builds upon the unrivalled reputation of the iconic *Benchijigua Express*."

Bajamar Express (Austal's Hull 394) is a 118 m aluminium trimaran, capable of transporting more than 1100 passengers and 276 cars at speeds up to 38 kn. Along with her sister ship, *Bañaderos Express* (Hull 395) under construction at Austal Philippines, the ship features an optimised trimaran hullform and is fitted with Austal's industry-leading motion-control technology which delivers a smoother ride and an enhanced onboard experience for both customers and crew.

Bajamar Express features class-leading interior amenities and facilities, including multiple bars, kiosks, a retail shop and children's play area and will operate on Fred. Olsen Express' Santa Cruz, Teneriffe and Agaete, Las Palmas routes in the Canary Islands.

Lifting the superstructure module prior to the roll-out of the hull of *Bajamar Express*
(Photo courtesy Austal)

Placing the superstructure module on the hull of *Bajamar Express*
(Photo courtesy Austal)

Afloat for the first time — *Bajamar Express* for Fred. Olsen Express of Canary Islands
(Photo courtesy Austal).

Austal to Build 41 m Ferry for SGTM Mauritius

On 22 January Austal announced that it has been awarded a $A15.5 million contract for a 41 m high-speed catamaran. The vessel will provide production continuity to Austal Vietnam as it completes the fabrication of a 94 m ferry for a customer in Trinidad and Tobago. The contract was to become effective when the required down payment was received, expected within days.

The new vessel is based on an existing and proven Austal Australia designed vessel, with customer-defined design modifications to be undertaken in Vietnam before construction commences there by March 2020 with delivery approximately one year later.

Austal's Chief Executive Officer, David Singleton, said that the new contract was welcome as Austal continued to build on its investment in facilities and people in the company's new Vietnam shipyard. Demand for vessels in this size category indicates the potential for follow-on vessels.

"We're very excited to be building this new ship for SGTM, our first destined for the Comoros Islands, and especially pleased that our proven vessel design continues to evolve to meet the needs of operators worldwide," Mr Singleton said.

"In the highly competitive 40–50 m high-speed catamaran market, Austal has led the global marketplace, with 80 vessels now built by the company since the early 1990s."

At the awarding of the contract, SGTM Director, Mr Michel Labourdere, highlighted the company's great trust in Austal to build its first new ferry, based on the success of the pre-owned vessel *Ntringui Express* (ex *Marine View,* Austal Hull 58) which SGTM has operated since 2013.

"Based on the outstanding performance of *Ntringui Express*, which was originally delivered to Japan in 1997 and bought by us in 2013, we knew we had to talk to Austal about our first new build," Mr Labourdere said.

Established in 2004, SGTM is the Comoros' leading ferry company, operating three passenger vessels and two freight transport ships between the islands of Mayotte, Anjouan and Great Comoros, carrying more than 100 000 passengers annually.

The Passenger Express 41 catamaran features a length overall of 41.2 m, beam of 10.9 m, and draft of 2.0 m. Over two decks, the vessel can accommodate 400 passengers and mixed cargo of up to 20 t, loaded via two ramps. To be fitted with Austal's renowned motion-control system (including active interceptors and T-foils), 4×MTU 12V2000 M72 engines and 4×Kamewa 56A3 waterjets, the new catamaran will achieve 31.5 kn at 100% MCR with a range of approximately 370 n miles.

The Passenger Express 41 to be constructed by Austal's shipyard in Vietnam will accommodate 400 passengers and 20 t of cargo over two decks
(Image courtesy Austal)

Hydrographic Mapping Partnership

A panel of six Australian and one New Zealand hydrographic companies have been selected to collect environmental data to survey shipping routes, commercial ports and maritime approaches within the Australian Charting Area.

On 20 December 2019, the Minister for Defence, Senator the Hon. Linda Reynolds CSC, said that the $150 million partnership secures a sovereign capacity to produce hydrographic information over the next five years.

"It is vital to our national interest that the ADF can operate in Australian waters and that both commercial and naval vessels can safely navigate these waters," Minister Reynolds said.

"Given that Australia's sea charting area covers 10% of the Earth's surface, this commercial deal also frees up Defence's specialist workforce and capabilities to focus on military geospatial requirements," Minister Reynolds said.

Defence is also investigating options to replace Navy's current military hydrographic survey capability.

"This is as part of the Government's commitment to building a hydrographic vessel and two mine-warfare support vessels at Henderson in Western Australia," Minister Reynolds said. The scoping study includes an option for a specialist vessel based on the Arafura-class offshore patrol vessel.

Nuyina comes to Life

The propulsion system of Australia's icebreaker, RSV *Nuyina*, has heaved to life with the turning of the starboard propeller for the first time in early February.

The rotation of the 43.5 t propeller and another 80 t of shaft line marks another major milestone in the ship's construction.

General Manager of the Australian Antarctic Division's Assets and Infrastructure Group, Rob Bryson, said that it was exciting to watch the ship come to life.

"The Damen shipyard commissioning team activated the advanced electric drive, which is connected to the shaft line, and used the ship's diesel generators to power that drive and rotate the propeller," he said.

"It made four revolutions over two minutes, which doesn't sound like much, but it was turning about 120 t of high tensile steel."

The shipyard team also started the main engine and will began work to commission the port propeller over coming weeks.

During his visit to the Romanian shipyard, Mr Bryson also took in the internal fitout of the ship.

"The construction program is very advanced and the internal fitout is about 95% complete," he said.

"The cabins are almost complete, the bridge looks like a bridge, the scullery, dining room and theatrette are top notch, and the colour scheme is sensational.

"Not only is she a good looking ship but she will also be the most powerful icebreaker in Antarctica when she goes online at the end of the year."

Sailing the Green Seas

Australia's new Antarctic icebreaker, RSV *Nuyina*, is a big ship, but that doesn't mean her environmental footprint has to be big too.

The RSV *Nuyina* Project team has worked hard to ensure that the ship complies with mandatory strict Antarctic environmental regulations, as well as at least 12 voluntary ones.

These optional Lloyd's Register ECO notation pollution controls include additional requirements for dealing with such things as ballast water, grey water, refrigeration systems, exhaust emissions, and the ship's energy efficiency management.

For example, the ship has two sewage treatment plants for grey and black water from the ship's showers, toilets and kitchen. For biosecurity, ballast water is treated in its own plant, before it is used in the ship, and again before disposal. The ship also has an oily-water separator which removes three times as much oil as a standard ship's plant.

The sewage treatment plants onboard *Nuyina*
(Photo by Michiel Jordaan courtesy AAD)

Nuyina fitting out at Damen's Romanian shipyard
(Photo by Rob Bryson, courtesy AAD)

Garbage management on a ship designed for 90 day voyages and up to 150 people is also a complex issue which has kept the team busy. The draft Garbage Management Plan is already 80 pages long, and growing.

Wheelie bins from the kitchen and around the vessel will be managed in a waste-handling area on Deck 3. Here, waste will be sorted and directed to an incinerator, a glass shredder, or a cardboard compactor.

The incinerator can burn oil coming from waste oil and the oily water separator, and generates the high temperatures required to cleanly dispose of combustible waste.

While *Nuyina* is bigger than *Aurora Australis,* it will have greater fuel efficiency overall, through its ability to resupply two stations in a single voyage. The hull of the vessel is also longer and narrower than the average icebreaker, to improve fuel efficiency during the Southern Ocean transit.

Nuyina will use less fuel per cargo container than *Aurora Australis,* as she can carry three times more cargo inside her holds, and she will provide more bang for the science buck, with her ability to collect and analyse more underway data and samples.

Other environment-related measures on the ship include:

- A fuel-spill recovery capability, with booms which can encircle the ship or protect high-environmental-value areas if there is a fuel spill.
- Special heli-deck drains which can capture fuel which may be spilt.
- Laboratory sinks and aquaria waste outlets which can be directed to holding tanks for quarantine purposes.
- Two boilers for waste-heat energy recovery from the exhaust gas lines.
- Low-level external lighting to minimise bird strike.
- Complying with the Hong Kong International Convention for the Safe and Environmentally Sound Recycling of Ships, 2009.

New Lobster Boat from Dongara Marine

Geraldton-based David Perham is the latest operator from Australia's Western Rock Lobster fishery to order a new lobster boat from Dongara Marine. The 22.4 m Southerly Designs monohull will, like other recent fishing and pilot boat new builds, combine an aluminium hull and composite superstructure.

Dongara Marine has overall project responsibility for the vessel and in November was in the process of fitting out the hull, which had arrived in Port Denison after being fabricated in Geraldton by Xtreme Marine. This includes all the main machinery as well as the many mechanical, hydraulic and electrical systems that go in to a modern Australian high speed lobster boat.

Based in Port Denison, Western Australia, Dongara Marine has already completed manufacture of the resin-infused composite wheelhouse structure, which is also now in the fitout stage.

Once the wheelhouse and hull fitout stages are complete the superstructure will be lifted onto the hull just prior to the new boat's launch, which is scheduled for April 2020.

The profile of the 22.4 m lobster boat from Dongara Marine
(Image courtesy Dongara Marine)

The new boat will replace Perham's current vessel, the 19.1 m *Natural Selection*, which was built in 1994. That boat has been Scania-powered since new, including two re-powers, and the new boat keeps that relationship alive. Twin

The 35 m catamaran ferry *Geelong Flyer* was recently completed by Incat Tasmania for Port Phillip Ferries for service on their Melbourne–Geelong route
(Photo courtesy Incat Tasmania)

Scania DI16 072M diesels, each rated at 662 kW, will drive fixed-pitch propellers via ZF gearboxes. This is expected to give a maximum speed of around 23 kn and 17 kn cruise.

The new boat will have live-tank capacity for 90 baskets of lobsters, 7000 L fuel capacity and 800 L of fresh water.

Mar de Cies from Incat Crowther

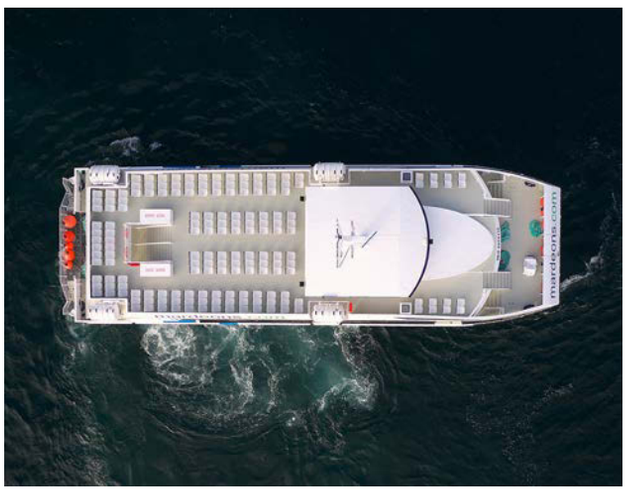
Incat Crowther has announced the launch of *Mar de Cies*, an Incat Crowther 32 built by Astilleros Armon for Spanish operator Mar De Ons. Designed specifically for the operation, the vessel demonstrates many benefits of a customised design solution.

Mar De Ons operates to a variety of destinations around the Bays of Vigo and Pontevedra, with varied dockside infrastructure throughout the network. This offers a range of challenges such as dock heights, draft restrictions and interface methods. *Mar de Cies* has multiple boarding locations at a range of heights, including aft platforms, main deck gates (aft, mid and forward), as well as bow loading over the foredeck. The extremities of the vessel are tailored to facilitate ease of regular berthing manoeuvres, and custom fendering is installed. The vessel is designed for a low propeller draft to allow access to shallow docks.

The main deck seats 218 passengers at tables, with a large kiosk at the forward end. The open upper deck seats 182 passengers, for a total of 400 passengers. *Mar de Cies* is built to Astilleros Armon's typical high standards, with high-quality interior fit-out and passenger amenities.

Passenger flow is aided by multiple wide staircases and access options to both decks of the vessel. For safety, all bulwarks are full height, all but eliminating climbable rails.

The vessel's aluminium hull, whilst being highly efficient, is also very robust, offering low maintenance. The hullform features ultra-low fuel burn as the vessel operates at modest engine load. The vessel exceeded 29 kn maximum speed on sea trials. The vessel will operate at 25 kn loaded service speed.



Bird's-eye view of *Mar de Cies*
(Photo courtesy Incat Crowther)

Safety compliance is provided in accordance with the latest EU regulations, a process which involved collaboration with Spanish flag authorities to achieve an optimal outcome.

Mar de Cies, a fully customised design solution, reaps rewards in functionality, operational efficiency and low fuel usage.

Principal particulars of *Mar de Cies* are

Length OA		32.5 m
Length WL		31.2 m
Beam OA		10.0 m
Depth		3.10 m
Draft	(hull)	1.10 m
	(propellers)	1.70 m
Passengers		400
Crew		5
Fuel oil		9000 L

Starboard side of *Mar de Cies*
(Photo courtesy Incat Crowther)

Fresh water	2000 L
Sullage	1000 L
Main engines	2×MAN D2862 LE463 each 1029 kW @ 2100 rpm
Propulsion	2×propellers
Generators	1×Kohler 30 kVA
Speed (service)	25 kn
(maximum)	29 kn
Construction	Marine-grade aluminium
Flag	Spain
Class/Survey	BV I ✠HULL ✠MACH HSC Passenger Sea Area 2

Ardea from Incat Crowther

Incat Crowther has announced the delivery of *Ardea*, a 20 m catamaran crew-transfer and support vessel, to Cape Preston in Western Australia earlier in 2019. Built to a high-quality standard by Echo Marine Group, the Incat Crowther 20 design has proven speed, robustness and seakeeping capabilities beyond its size.

With twin Cummins QSK19s, each producing 597 kW at 2100 rpm and twin Kamewa S45-3 waterjets, it reaches an impressive maximum speed of 25 kn. Its performance is owed to a hullform based on Incat Crowther's proven crew-transfer vessels operating all over the world.

Ardea works as a support vessel for the Cape Preston Sino Iron Project. This project involves transhipment of premium magnetite concentrate from a land-based pipeline to offshore ocean-going vessels. Operating in this environment includes many unique challenges.

The vessel is protected from magnetite residue by fine-grade filters over all ventilation ducts. Shower and toilets are externally accessible from the aft deck, expanded-mesh grating is installed over recessed decks, and a shoe-cover dispenser is provided for entry to the main cabin. Exterior seating is provided for up to ten passengers with lightweight awning for weather protection, enabling ease of cleaning and maintenance.

The operation sees frequent heavy weather developed from large Southern Ocean swell. In the first six months of operation through the winter season it has successfully handled these conditions at cruise speeds of over 22 kn.

The forward-mounted superstructure accommodates 21 passengers and a small galley for refreshments. The aft

Ardea being launched
(Photo courtesy Incat Crowther)

deck passenger accommodation includes storage locations for eskies and rubbish bins. The hulls include berths for four crew, accessible via stairs from the main deck cabin. Upstairs a full-height wheelhouse offers great visibility for operations.

Ardea is yet another example of Incat Crowther's competence in technical problem-solving, packing a lot of tailored functionality into an effective package.

Principal particulars of *Ardea* are

Length OA	20.6 m
Length WL	18.9 m
Beam OA	7.50 m
Depth	2.80 m
Draft (hull)	1.00 m
Crew	4
Passengers	21 (+ 10 external)
Fuel oil	6000 L
Fresh water	800 L
Sullage	500 L
Main engines	2Cummins QSK19 each 597 kW @ 2100 rpm
Propulsion	2×Kamewa 45A3 water jets
Generators	2×Cummins 27.0MDKDU each 27 ekW
Speed (service)	23 kn
(maximum)	25 kn
Construction	Marine-grade aluminium
Flag	Australia
Class/Survey	NSCV Class 1B

Stewart Marler

Ardea on trials
(Photo courtesy Incat Crowther)

Ovation of the Seas at anchor in Athol Bight in Sydney Harbour on 14 February
(Photo John Jeremy)

Cruising in NSW

The summer cruise season has moved into high gear, with visits to Sydney in late November by *Maasdam, Pacific Explorer, Radiance of the Seas, Celebrity Solstice, Carnival Spirit, Ruby Princess, Ovation of the Seas, Pacific Aria, Majestic Princess,* and *Voyager of the Seas.*

The following months saw return visits by most of these vessels, with December adding visits by *Norwegian Jewel, Vasco da Gama, Silver Muse, Regatta, Noordam, Explorer Dream, Carnival Splendor, Seabourn Encore, Le Laperouse, Viking Orion, AIDAura* and *Boudicca.*

January added visits by *Seven Seas Voyager, Ocean Dream, Seven Seas Navigator* and *Sea Princess*, and early February added visits by *Europa* and *Viking Sun.*

Cruise vessels operating out of Sydney have continued to call at Eden, NSW, now berthing at the Eden Cruise Wharf, with passengers going ashore to visit local sights and shops. *Pacific Explorer, Maasdam, Noordam, Regatta, Norwegian Jewel* and *Pacific Aria* all visited (mostly multiple times) between mid-November and mid-February.

Phil Helmore

Pacific Explorer berthed at the Eden Cruise Wharf
on 17 November 2019
(Photo courtesy Robert Whiter)

Majestic Princess departing Sydney on the evening of 1 November 2019, with smoke haze in the west
(Photo John Jeremy)

OPERATION BUSHFIRE ASSIST

Since last September the Australian Defence Force has been providing support for fire fighters during the summer bushfire emergency as Operation Bushfire Assist. In January, MV *Sycamore* and HMAS *Choules* were deployed to Victoria to evacuate people trapped in the town of Mallacoota and to deliver stores and emergency services vehicles. Here *Sycamore* has met with *Choules* off the Victorian coast to transfer personnel to the ship
(RAN photograph)

Shrouded in thick smoke, Royal Australian Navy MH-60R Seahawk Romeo helicopters take off from HMAS *Adelaide* during Operation Bushfire Assist. HMAS *Adelaide* joined the relief effort in mid-January 2020. On 16 February, 5400 ADF personnel, including about 1400 reservists, were still engaged providing support for recovery efforts
(RAN photograph)

Assessing the Determinants of Safety Culture in the Maritime Industry

Michelle Grech (Australian Maritime Safety Authority), Daniela Andrei (Curtin University), Mark Griffin (Curtin University) and Andrew Neal (University of Queensland)

The study approach, findings and the way forward on an Australian Linkage Council funded collaborative research project between the University of Queensland, the University of Western Australia and the Australian Maritime Safety Authority, focusing on safety culture are presented in this paper. The aim of the study was to identify the factors which have the strongest impact on safety onboard international vessels operating in Australian waters, in order to provide recommendations on how to improve safety in the maritime industry. More than 1000 seafarers from 197 ships comprising 23 Flag States were surveyed. The survey assessed safety culture, work demands, fatigue, mental health, and well-being and safety performance. The results are being used to develop a set of recommendations regarding the best ways to improve safety onboard ships. The recommendations centre on improving the quality of work procedures, introduction of effective fatigue-management systems and improving the quality of work design and organisational support. The findings of this study have been presented at a range of industry forums, briefings, and at the International Maritime Organisation.

INTRODUCTION

Safety Climate, Safety Culture, Behaviour and Outcomes

The term "safety culture" refers to the way in which an organisation manages safety, and reflects the core beliefs and attitudes that guide behaviour and decision-making (Casey et al., 2017). There are two broad elements of safety culture. The first are the policies, practices and procedures which the organisation has for managing safety. This first element is sometimes referred to as "safety climate" within the academic literature (Griffin and Neal, 2000; Neal et al., 2000). The second are the values, priorities, norms and motives held by people in the organisation. These two elements reflect the distinction between safety culture as something that an organisation *has* (i.e., policies, practices and procedures), and safety climate as something that an organisation *is* (i.e., people with a shared set of values and beliefs). Measures of safety climate and culture are highly correlated, and are not distinguishable for practical purposes (Casey et al., 2017). In this paper, we use the term "safety culture" rather than "safety climate", because it is a broader term, and is more widely recognised within the maritime industry.

In a recent review, Lützhöft et al., (2011) identified safety culture as a critical risk factor for the maritime industry. They argued that, whilst most accidents at sea are caused by human error, these errors are attributable to conditions created by the organisation. Specifically, safety-related policies and practices relating to communication, commitment, trust, incident reporting, risk management and training play an important role in shaping behaviour, which can either directly or indirectly affect safety. According to Lützhöft et al. (2011) maritime safety culture is a concern, because shipping operators are under significant cost pressures. While there is anecdotal evidence suggesting that maritime safety culture is a critical risk factor, research on maritime safety culture is limited and fragmented. Recent work indicates which the relationship that exists between safety culture, safety behaviour and safety outcomes observed in other high-risk industries may also exist within the maritime industry. While this evidence is encouraging, more is needed to clarify the role of safety culture in the maritime industry, particularly in relation to seafarers aboard vessels operating in Australian waters. The remoteness of the work environment also creates other concerns, with crew having limited social contact and may be isolated for long periods of time with little support, all of which can reduce performance, health and well-being (Oliver et al., 2002). Hence this study also included an evaluation of seafarer mental health and wellbeing in the context of safety culture.

The aim of the study was to identify the factors which have the strongest impact on safety onboard international vessels operating in Australian waters, in order to provide recommendations on how to improve safety in the maritime industry. This paper presents a selection of the findings with a full report available upon request.

RESEARCH METHOD

Measures

For the purpose of this study the *Developmental Safety Culture Survey* (DSCS) developed by the research team was used to measure different levels of safety culture development. The DSCS distinguishes between different levels of safety culture development based on existing theory (Lawrie et al., 2006; Reason, 1997) and was validated during the pilot study. Twelve items were developed to tap into the "Systems and Processes" and "People" aspects of safety culture. An overview of the measurement model is presented in Figure 1.

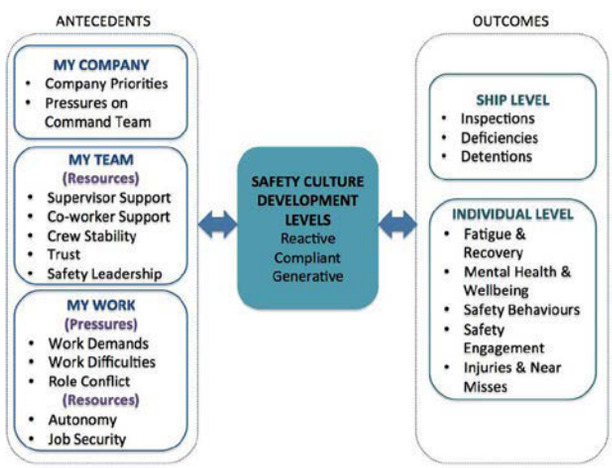


Figure 1: Overview of the overall measurement approach and variables included in this study.

The aspects measured in the "Systems and Processes" section included:

- Safety policies and procedures,
- Safety training,

- communication;
- role definitions;
- reporting systems; and
- operational schedules.

The "People" aspects included:

- safety values;
- norms; and
- motives.

Based on the existing literature, three specific descriptors were developed to reflect:

1. dysfunctional/reactive safety culture;
2. compliance oriented culture; and
3. participative/generative safety culture.

Participants responded on a five-point Likert scale, where 1 received descriptors which reflected a reactive safety culture and 5 represented descriptors which reflected a participative/generative safety culture. Participants indicated the value that best reflects the way each aspect was being managed on their ship. The survey also included a series of individual and work demographic questions. Examples of individual level factors included fatigue and recovery, with participant's quality of sleep also assessed by asking whether they experienced sleep problems onboard the ship. Beyond the general measures of compliance, the quality of safety behaviours was analysed by looking at two types of positive compliance behaviours: *adaptive compliance* and *deep compliance*; and two types of negative safety behaviours: *surface compliance* and *non-compliance*.

Procedure

Participation in the study was voluntary and anonymity was guaranteed. The option of electronic or paper-based surveys was provided. Partnerships with various organisations having direct contact with ships and seafarers were developed to increase survey reach. These included training providers, AMSA inspectors, pilots and seafarer welfare centres.

Participants

The final sample consisted of 1026 seafarers. 164 participants completed the command team survey and 862 participants filled in the survey for the rest of the crew. The difference in surveys was related to *work pressure*, *safety behaviours* and *safety engagement* questions. For the command team, the *work pressure* measures were supplemented with an extra measure of *role conflict* arising from their critical position as mediators between company and crew. The safety behaviours and safety engagement measures had different referents in which the command team were asked to provide an overall assessment of their crew behaviours using the same items, while the crew were asked to only report on their own work behaviours and safety engagement.

97.9% of the participants were male with an average age of 34.7 years (*SD*=10.4 years). The age range for 57.8% of the participants was between 18 and 37 years. Participants were mostly experienced seafarers, with an average overall tenure at sea of around 10 years (*M*=9.76, *SD*=8.78 years at sea). Most participants worked long contracts — in the region of nine months to one year, especially evident for the officers and ratings. Most participants reported four months or less onboard the ship, with very few having been onboard for more than nine months. The sample was represented by more than 16 nationalities with most of the participants coming from the Philippines. Participants were also asked to report how many different nationalities were onboard their ship. On average, participants indicated that there were about four different nationalities onboard the ship on which they were working.

Ship-level Data

All responses from seafarers on the same ship, identified by its IMO number, were averaged to obtain an overall score for the ship. 195 distinct ships were identified across the sample. The ships were then categorised into the following ship types (Figure 2).

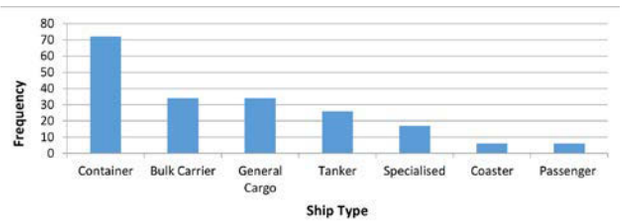


Figure 2: Type of ships surveyed

The breakdown of Flag States represented in this study was fairly consistent with the flag-state population of vessels coming into Australian ports during the same year this survey was conducted. Panama (*N*=30) was the most frequently represented, followed by Singapore (*N*=27), Hong Kong (*N*=22), Liberia (*N*=20), Malta (*N*=13), Marshall Islands (*N*=12), Australia (*N*=11) and Bahamas (*N*=10).

Data Analysis and Reporting

Using the SPSS statistical analyses tool, the data were analysed at two distinct levels. First, an analysis was carried out at the individual level, taking into consideration the main differences and associations between responses offered by individual seafarers. The, data were analysed at the ship level by aggregating all individual responses from the same ship. Cross-level interactions were also investigated in order to identify the effects of broader (ship level) factors on individual outcomes. The results highlight the strengths and weaknesses of safety culture, as well as its possible antecedents and consequences within the sample.

Due to increased pressures and uncertainty in the industry and the possible increased relevance of priorities communicated by companies, a multi-level analysis was also performed to investigate more closely the way in which perceptions of company priorities and operational uncertainty at the command team level might explain safety and well-being outcomes for the rest of the crew onboard the ship. The main interest was on the interplay between priorities on safety

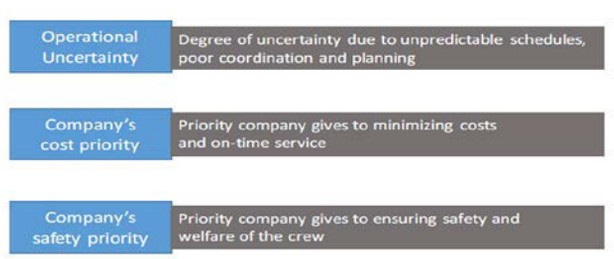


Figure 3: Overview of main predictors used in the multi-level analysis on priorities, operational uncertainty and their effects on safety and wellbeing

and costs, but operational uncertainty was also added to the model. An overview of the predictors used in this analysis is presented in Figure 3.

At the ship level of the multi-level model, priorities and operational uncertainty were included as perceived by members of the command team. The reasoning was twofold. First, company priorities are usually communicated to seafarers by the command team onboard the ship, which inform their decisions and management of the crew. Second, from a methodological perspective, using two different sources for the different data — the command team for priorities and operational uncertainty, and the rest of the crew for well-being and safety outcomes, ensures more robust results.

FINDINGS AND DISCUSSION

Safety Culture and its Antecedents

Figure 4 shows the results of how participants evaluated safety culture across ships. Aspects which were most positively evaluated were those related to seafarers' perceived personal responsibility towards safety: *responsibilities and motives*. Although the overall findings show that safety culture was evaluated positively, there were still a number of cases for which safety culture was reported within the reactive compliance-based spectrum such as the *Planning and Scheduling* dimension. In addition, although formal mandatory requirements such as the International Safety Management Code are expected to have a positive impact on the evaluation of perception of systems and processes, it is also important to understand how these formal systems have an impact on safety behaviour and well-being of seafarers.

Figure 5 presents an overview of how company priorities are perceived. Overall, seafarers perceive that companies place a great importance on preventing damage to the ship and cargo, as well as on the safety of the crew. However, about 20% of seafarers perceive that the company they work for places little or moderate importance on their welfare.

Work Demands

Participants reported working an average of 61.28 hours/week, with a standard deviation of 13.06 hours/week. The results indicate that a high proportion (almost 30%) of the participants are working long hours, exceeding 69 hours/week. Long working hours appear to be also coupled with increased work pressures and demands. More than 20% of participants reported that their working hours are unpredictable. Similarly, approximately 40% of participants reported working under time pressure, and about half of them reported experiencing high demands for vigilance at least sometimes in their work.

Work Difficulties

Descriptive data on the three types of shipboard conditions (*work difficulties*) which might affect safety culture and safety outcomes — *physical conditions*, *technology and resources*, and *operational uncertainty* were analysed. Two categories of *physical conditions* were measured — external (weather, visibility and ship motion) and internal conditions (see Figure 6). Approximately 40% of participants reported that bad weather often caused difficulties in performing their work. Additionally, more than 20% of participants reported that poor visibility and ship motions often created difficulties for them in performing their work. Results for internal physical working conditions were similar (Figure 6), with loud noise and cramped workspaces being reported as a source of frequent disturbance by a high proportion of participants.

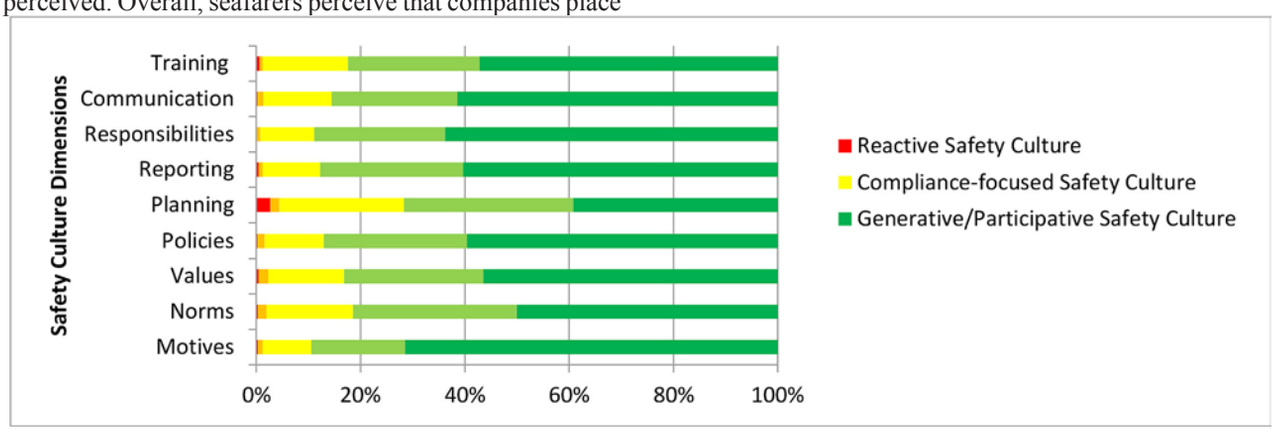


Figure 4: Breakdown of participants' responses on the SCDS dimensions

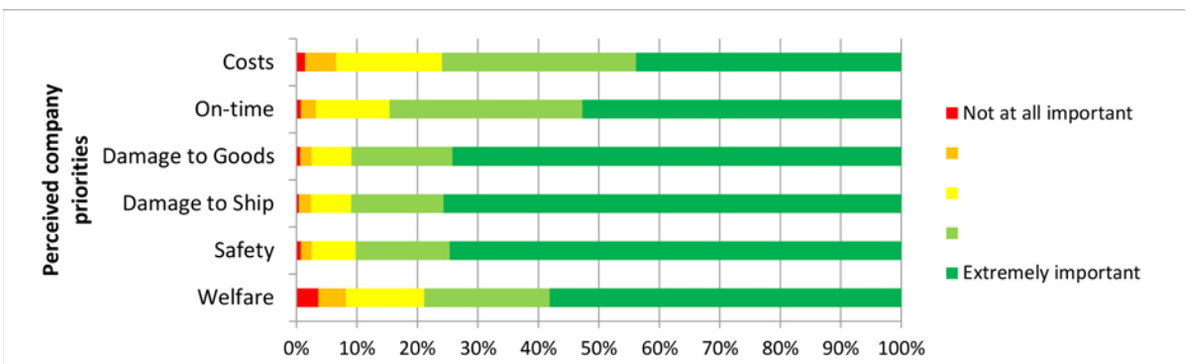


Figure 5: Breakdown of participants' responses on perceived company priorities items

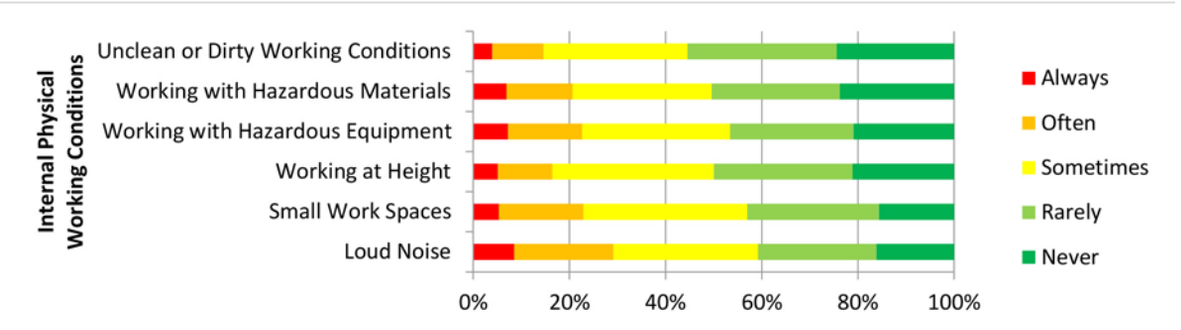


Figure 6: Breakdown of participants' responses evaluating how often internal physical conditions created difficulties for them in their work.

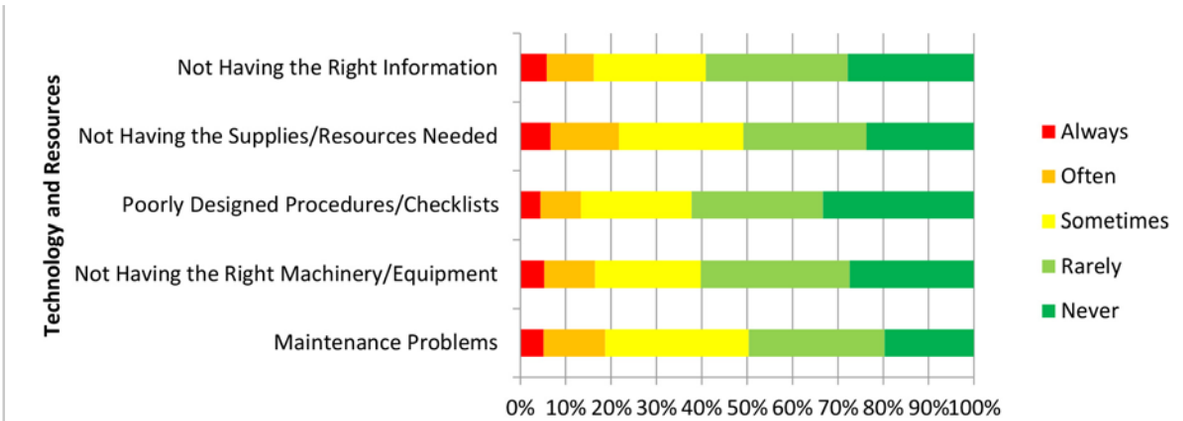


Figure 7: Breakdown of participants' responses evaluating how often conditions related to available technology and resources created difficulties for them in their work

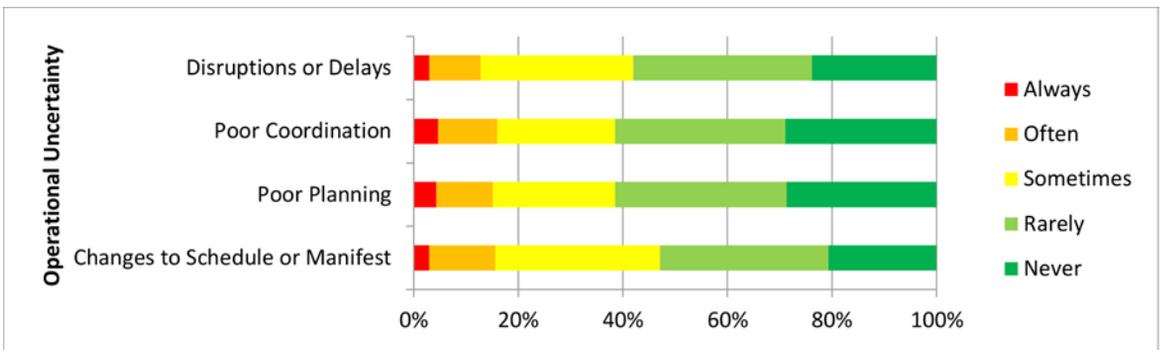


Figure 8: Breakdown of participants' responses evaluating how often conditions related to operational uncertainty created difficulties for them in their work

Scores for difficulties related to technology and resources were relatively homogenous. However, more participants (around 20%) reported that not having the needed supplies, and maintenance problems, often created difficulties in performing work (Figure 7).

Approximately 40% of the sample reported difficulties related to operational uncertainty at least sometimes in their work. Scores are relatively homogenous across the factors measured, but frequent changes to schedule and manifest as well as disruptions or delays appear to be more common forms of difficulties (Figure 8).

Safety Leadership

Four different aspects of safety leadership were measured: *leverage*, *energise*, *adapt* and *defend*. Overall, all aspects of safety leadership received positive evaluations, with over 80% of participants agreeing that their supervisors exhibit all four of the surveyed safety leadership behaviours. It is indicated that the way leaders reflect and communicate safety goals represents another type of work resource which plays an important role in health and safety outcomes.

Outcomes — Fatigue

Approximately 12% of the participants experienced sleep problems, while close to half of the participants reported no sleep-related difficulties. A similar pattern is observed in the participants' fatigue data (Figure 9). Approximately half of the participants reported experiencing low levels of fatigue, while close to 20% of the participants reported experiencing increased or high levels of fatigue, more notably chronic fatigue.

Outcomes — Mental Health and Wellbeing

Figure 10 presents an overview of mental health and wellbeing. Three aspects of wellbeing were measured: *hedonic*, *psychological* and *social* wellbeing. Almost 40% of the participating seafarers reported experiencing negative symptoms at least sometimes, and around 10% of them reported more frequent levels of mental ill health (frequent symptoms of mental ill health including depression and anxiety). In terms of overall well-being, responses were more positive. However, the lowest percentages of well-being were found for social well-being. Not surprisingly,

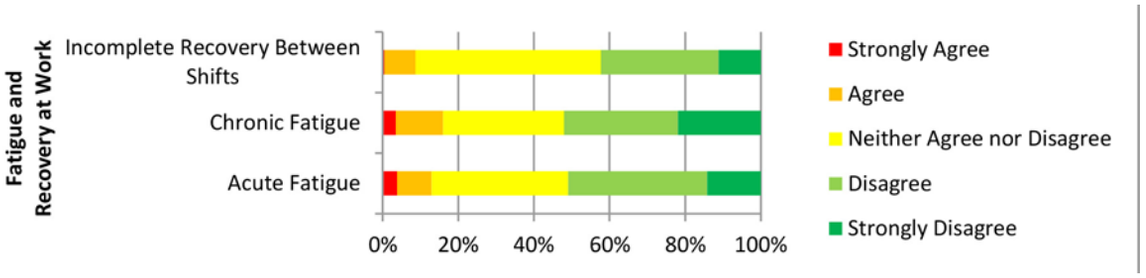


Figure 9: Breakdown of participants' responses regarding experienced levels of fatigue at work

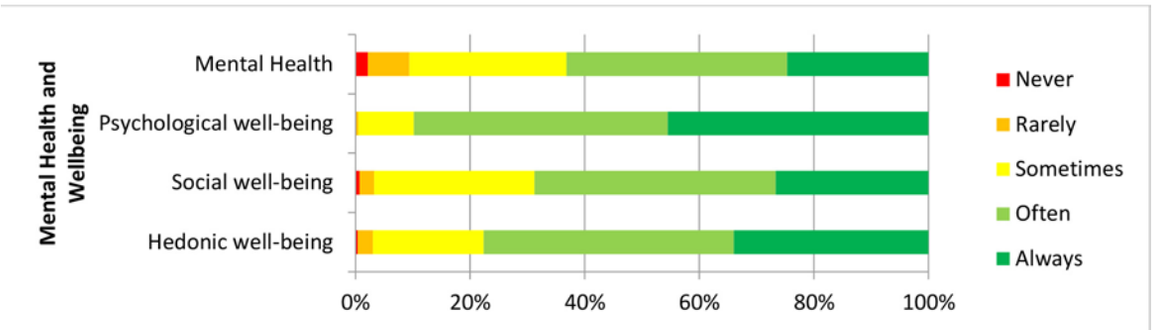


Figure 10: Breakdown of participants' responses regarding mental health and wellbeing

social well-being is the aspect of well-being which is more likely to be impacted by the working arrangements in the maritime industry which can be linked to social isolation which is supported by the literature (Iversen, 2012).

Outcomes — Overall Safety Behaviours

Overall *safety behaviours* were measured in terms of *safety task performance*, *safety participation* and *safety innovation*. High levels of these behaviours were reported, especially for safety task performance. The positive results for safety compliance do not necessarily reflect mature levels of participative/generative safety onboard the participating ships. Participative/generative safety cultures are usually associated with less emphasis on overall compliance (safety task performance) and more safety participation and innovation. While safety participation and innovation levels were relatively high in this sample, levels of safety task performance reported were even higher, indicating a strong emphasis on compliance.

Outcomes — Types of Safety Compliance

Figure 11 presents the results for positive compliance behaviours. The results suggest a high level of positive compliance. Most of the participants (approximately 80%) reported trying their best to apply the correct procedures to the task (deep compliance) and being adaptive, such as drawing on knowledge and experience to come up with a solution to complete the task safely when circumstances make existing procedures not appropriate (adaptive compliance).

However, when negative safety compliance behaviours are taken into account (Figure 12), the results indicate that non-compliance, and especially surface compliance, are also manifested by participants. Notably, more than 40% of participants reported that they sometimes just "tick the boxes" without paying too much attention to the actual procedures; and almost 20% reported some level of non-compliant behaviours (e.g. skip the procedures to get the work done). The results for positive and negative safety behaviours might appear contradictory at first glance. However, there are potential explanations for this pattern of findings. In particular, there are multiple procedures in place on any vessel, and seafarers might comply with some but not others. Even when overall compliance is positive, there might be situations of non-compliance or surface compliance that have the potential to put safety at risk.

Multi-level Analysis

Perceived Operational Uncertainty, Company Priorities, and Safety in relation to Well-being and Safety Compliance Outcomes.

The results (Figure 13) indicate that a priority on safety perceived at the command team level is not related to either well-being or safety compliance at the crew level. However, operational uncertainty and, especially, a company's priority

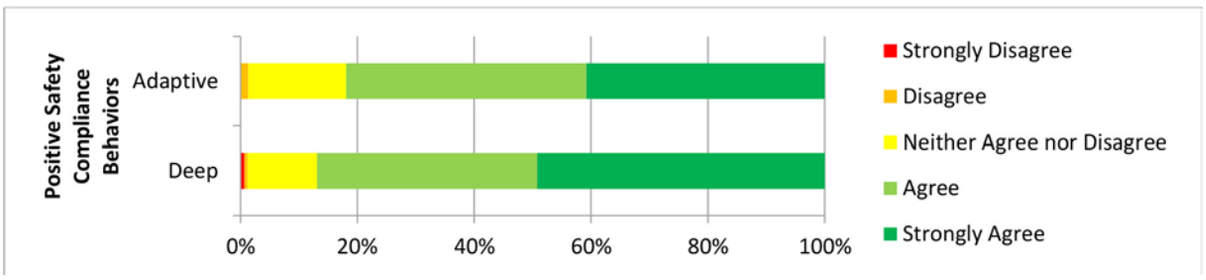


Figure 11: Breakdown of self-reported positive safety compliance behaviours

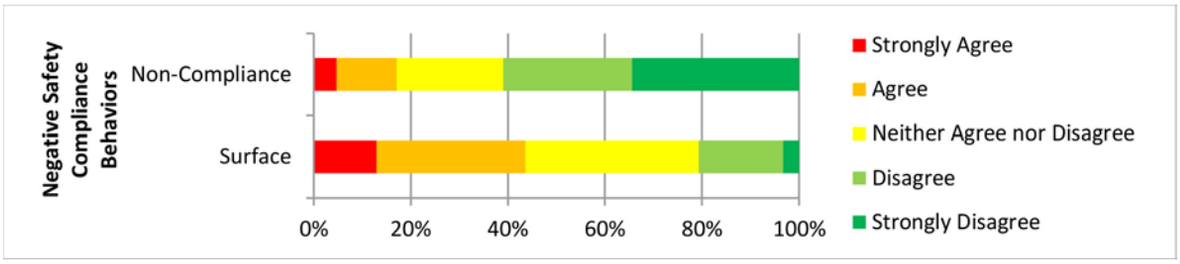


Figure 12: Breakdown of self-reported negative safety compliance behaviours

on costs translate into negative outcomes for seafarers' well-being and safety compliance. These results converge toward the conclusion that prioritising costs and increased operational uncertainty might damage both safety and well-being, and a sole focus on safety would not be sufficient to counteract these effects.

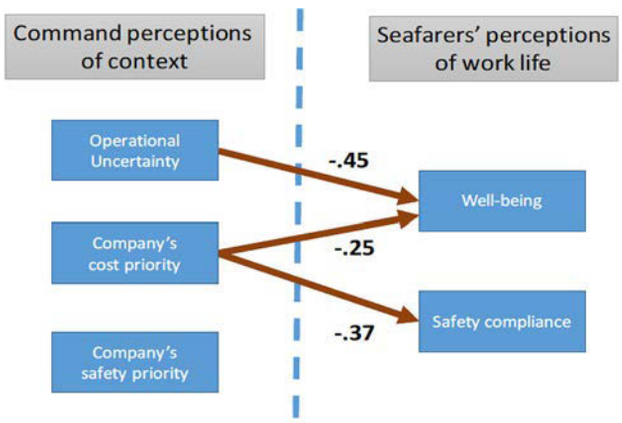


Figure 13: Overview of the multi-level analysis of the effects of perceptions of the overall context at the command team level on safety and wellbeing outcomes for the rest of the crew

CONCLUSIONS

Approximately 40% of this study's sample indicated that they experienced difficulties in performing their tasks due to factors related to technology and resources, such as "poorly-designed procedures/checklists" and "not having the right information". Similarly, conversations between seafarers and researchers during data collection revealed that a frequent complaint by seafarers was that there were too many procedures and many were too complicated for effective use. To encourage positive safety behaviours (e.g. deep compliance with safety rules and procedures), seafarers must have the necessary safety knowledge and motivation to perform their task safely, and this is determined, partly, by the degree of clarity and quality of the work procedures.

More than 20% of participants reported working more than 69 hours per week and that working hours were unpredictable. Approximately 12% of the participants reported experiencing sleep problems and 20% agreed that they experience some level of chronic fatigue and, similarly, 20% indicated experience acute fatigue. Further analyses revealed that chronic fatigue leads to reduced levels of psychological well-being which may impact on the overall functioning of employees.

RECOMMENDATIONS

A number of recommendations were developed based on information gathered from this study. The purpose is to propose research-based practices designed to manage the implications associated with this study's findings. This report focuses on two of these recommendations.

Work and Procedures

The important role of the quality of work procedures in predicting compliance is evidenced in studies which show that procedures perceived as vague, inappropriate, poorly written or difficult to access were more likely to result in poor compliance (Dahl, et al., 2014). Hence, a focus on developing and ensuring high-quality work rules and procedures which are easily understood and are perceived as valid by those to whom they are addressed is critical.

Fatigue Management

Organisations need to develop fatigue management interventions which continuously monitor and manage fatigue risks to prevent fatigue-related incidents or impaired psychological well-being. Managing the risk of fatigue requires a combination of intervention strategies with some being more effective than others. The International Maritime Organisation's (IMO) Maritime Safety Committee approved the revised *Guidelines on Fatigue* (MSC 1598) at its 100th session. Led by Australia, the revision resulted in a more useable guidance document. Central to these guidelines is the concept of a risk-based approach to fatigue management. This includes the approach that, since fatigue affects the safe operation of the vessel, fatigue management should logically be an integral part of safety management systems. The Australian Maritime Safety Authority has developed useable guidelines to support fatigue-risk management implementation in the maritime domain based on these guidelines.

REFERENCES

Casey T., Griffin M., Flateau Harrison H. and Neal, A. (2017), 'Safety Climate and Culture: Integrating Psychological and Systems Perspectives', *Journal of Occupational Health Psychology*,· February 2017

Dahl, O., Fenstad, J. and Kongsvik, T. (2014). 'Antecedents of Safety-compliant Behaviour on Offshore Service Vessels: A Multi-factorial Approach', *Maritime Policy & Management, 41*(1), 20-41.

Grech, M., Horberry, T. and Koester, T. (2008). *Human Factors in the Maritime Domain*. CRC Press.

Griffin, M. A. and Neal, A. (2000). 'Perceptions of Safety at Work: A Framework for linking Safety Climate to Safety Performance, Knowledge and Motivation', *Journal of Occupational Health Psychology, 5*, 347–358. doi:10.1037fl1076-8998.5.3.347

Griffin, M. A. and Hu, X. (2013). 'How Leaders Differentially Motivate Safety Compliance and Safety Participation: The Role of Monitoring, Inspiring, and Learning', *Safety Science*, *60*, 196-202.

Iverson, R. T. B. (2012). 'The Mental Health of Seafarers'. *International Maritime Health, 63(2):*78-89

Lawrie, M., Parker, D. and Hudson, P. (2006). 'Investigating Employee Perceptions of a Framework of Safety Culture Maturity', *Safety Science*, *44*(3), 259-276.

Lützhöft, M., Grech, M. R. and Porathe, T. (2011). 'Information Environment, Fatigue, and Culture in the Maritime Domain', *Reviews of Human Factors and Ergonomics*, *7*(1), 280-322.

Neal, A., Griffin, M. A. and Hart, P. M. (2000). 'The Impact of Organisational Climate on Safety Climate and Individual Behavior', *Safety Science*, *34*(1), 99-109.

Reason, J. (1997). *Managing the risks of Organisational Accidents.* Aldershot: Ashgate.

Roberts, S. E. and Marlow, P. B. (2005). 'Traumatic Work-related Mortality among Seafarers employed in British Merchant Shipping, 1976–2002', *Occupational and Environmental Medicine*, *62*(3), 172-180.

This paper was presented by Michelle Grech at the Pacific International Maritime Conference (IMC2019) at Darling Harbour, Sydney in October 2019 and received the inaugural Bob Campbell Award.

EDUCATION NEWS

Australian Maritime College

AMC and RINA Chart New Course for Maritime Engineers

All maritime engineering graduates of the Australian Maritime College have had their path to chartered status smoothed by a new agreement with the Royal Institution of Naval Architects Australian Division.

AMC Principal, Michael van Balen AO, and RINA's Australian Division President, Martin Renilson, signed the agreement at the Newnham campus on Monday 2 December.

"This sets our students off on the start of their career for certification as maritime engineers," Mr van Balen said.

Dr Renilson said that RINA was the international learned society for maritime engineers.

"This arrangement with AMC, which is the primary place for teaching maritime engineering in Australia, is a good move forward," he said.

"It makes it easier for AMC Maritime Engineering students to join RINA as student members and thus makes their path to Corporate Member and subsequent chartered status a lot easier.

The agreement comes at a time of growing demand for naval architecture and maritime engineering graduates thanks to the $90 billion National Naval Shipbuilding Enterprise.

Under the agreement, all AMC Bachelor of Engineering students can become student members of RINA free of charge.

"Graduation from AMC as a Bachelor of Engineering in any of the three specialties has been accepted as meeting the educational requirements for Corporate Membership of RINA," Dr Renilson said.

However, to achieve full Member grade a graduate must demonstrate professional competence through training and experience.

Dr Renilson said that it may take up to five years of experience to achieve Member grade and be eligible to be a Chartered Engineer.

"A person only becomes a fully-fledged maritime engineer when they achieve MRINA, CEng, or the equivalent Engineers Australia membership grade," Mr Renilson said.

"It is only when a person is at chartered status that they can truly work independently and call themselves an engineer."

He said that the requirement for a person to have chartered engineer status was increasing generally and especially with large companies.

Membership of RINA also provides members with up-to-date technical information and general news related to the maritime engineering industry.

"It also monitors continued professional development which is a requirement to maintain chartered status," he said.

AMC Principal, Michael van Balen AO (L), and RINA's Australian Division President, Martin Renilson, signing the AMC/RINA Agreement
(Photo courtesy AMC)

AMC and Navantia Team

Australian Maritime College students recently undertaking internships at Navantia Australia have lauded the team environment at the shipbuilder. The four Maritime Engineering students, two in Sydney and two in Melbourne, are being mentored by key Navantia Australia staff.

The students have been working on defence projects. In the Melbourne office Maitland Osborn said that he was part of a team working on a submarine project during his first week.

"Everyone was very welcoming and I felt like I was part of the team," he said.

"I've enjoyed being included in these sub projects that have given me the chance to contribute to Navantia Australia.

"My mentor, Matthew Harman, has been very good and helpful.

"I feel extremely privileged to have obtained a summer internship with a company like Navantia Australia."

AMC student ambassador Hadiqa Khan said the internship was ideal because working for defence had been her career plan "all along".

"Navantia has provided that platform by allowing me to be involved in the Royal Australian Navy's guided missile destroyer project," she said.

"Instead of being designated to a particular task, my team has been exposing me to various disciplines of the project, making sure that I acquire as many skills as I can throughout my time here by working with the most experienced and skillful individuals in the company.

"I believe that this stage is the most crucial part of the degree as this is where students take their first step as an engineering professional. We are able to implement the knowledge and skills acquired in the first three years at AMC and I am delighted that I've started my journey as a naval architect through Navantia Australia."

She said that the anxiety she had felt about transitioning from AMC to a renowned shipbuilding company had worn off quickly.

"The warm welcome and the constant support which I have received from my teammates and superiors is beyond my expectations," Hadiqa said.

Other students on internship with Navantia Australia are Johnson Joseph and Zachary Sutherland.

Navantia Australia Lead Engineer General Design, Matthew Harman, AMC student Maitland Osborn, AMC student Johnson Joseph, Navantia Australia Lead Engineer Equipment and Outfit, Simon Kelly
(Photo courtesy AMC)

UNSW Sydney

Undergraduate News

Thesis Projects

Among the interesting undergraduate thesis projects recently completed are the following:

The Design and Maintenance of Marine Engineering Systems onboard Royal Australian Navy Vessels

Isabella Yan investigated the design, acquisition and maintenance strategies of marine engineering (ME) systems of Royal Australian Navy (RAN) surface vessels. The scope of the project covered the guided-missile frigate (FFG), landing helicopter dock (LHD), and guided-missile destroyer (DDG) classes.

Interviews with RAN personnel of all ranks were conducted. Data regarding the planned and corrective maintenance conducted onboard RAN vessels was also conducted.

The interviews and data were analysed and a number of areas for improvement were noted. It was found that the RAN employs a time-based maintenance system. However, personnel supported the notion of using condition-based maintenance to alleviate issues such as over maintenance and maintenance-induced defects. The suitability of the designs of some engineering systems for Australia's operational requirements were brought into question by this project. Multiple issues in the logistics of the design and operation of marine engineering systems were uncovered. A number of cultural and organisational issues were found to be hindering the efficiency of the operation and maintenance of ME systems onboard vessels.

From these findings a list of broad recommendations for the RAN was developed.

Investigation of Small Scow-bowed Displacement Sailing Craft with Regard to Seakeeping

Scow-type sailing craft have full, blunt bows rather than slim, pointed ones. In addition to potential speed gains, scow-bowed craft have some advantages over slimmer, pointier hull forms, such as an increase in usable internal volume in the bow, and lower storage costs for a given displacement. One area of concern for this type of vessel has been their potential to produce unpleasant motions for those on board.

Max McCann conducted an investigation of the motion characteristics of three otherwise-similar hulls of varying bow-fullness in Maxsurf Motions. Results suggest that fuller-bowed craft produce motions of significantly lower magnitude across a wide variety of conditions.

Dynamically Supported Sailing Monohulls: An Investigation of the Stability of a Dynamically-supported America's Cup Monohull in the Absence of a Keel

The America's Cup is largely responsible for developments in sailing hydrofoils, and the next iteration of the Cup will be raced in 75 ft (22.86 m) long hydrofoiling sailing yachts, known as the AC75 class. These yachts are expected to exceed speeds of 50 kn (100 km/h), giving rise to concerns about safety and stability.

Mitchell Evans investigated the stability of the AC75 as a class. The class was found to be inherently stable due to considerable righting moments generated by the supporting foils. While some instabilities can arise from crew error, the overall stability cannot be overstated.

Analysis of the Flow around a Tug

The details of the water flow around tugs has not been well documented.

Nelson Tsang conducted an investigation of the water flow by analysing a 3-dimensional tug model using computational fluid dynamics (CFD) software. Initially, the background of the tug and the details of the CFD software for input, solver and post-processing of results were researched. The approach taken in the investigation was then to vary the yaw angles and speeds of the tug in order to visualise the water flow.

The pressure profiles were simulated and analysed successfully. Discrepancies between simulated results and the few that could be found in the literature were due to simulation application, different approaches and model

methods. Resistance results were also calculated using CFD and compared with those of van Oortmerssen's numerical method, and found to be lower by up to 12% at 12 kn.

Thesis Conference

The School has moved to having a Thesis Conference at the end of each Term, due to the change to three terms in lieu of two semesters annually, and theses being able to start in any term. At the inaugural undergraduate Thesis C (Research) Conference at the end of Term 3 in 2019, the following presentations by naval architecture students were made:

- Max McCann — *Investigation of Small Scow-bowed Displacement Sailing Craft with Regard to Seakeeping*
- Nelson Tsang — *Analysis of the Flow around a Tug*
- Isabella Yan — *The Design and Maintenance of Marine Engineering Systems onboard Royal Australian Navy Vessels*

Isabella's presentation was made separately from the conference, due to the confidential nature of the project.

RINA–DST Award

RINA and Defence Science and Technology jointly offered an award of $125 and a certificate for the best presentation at the Term 3 Thesis C (Research) Conference by a student member of RINA on a naval architectural project. Assessment was made on the basis of marks awarded by School staff. The award went to Max McCann for his presentation on *Investigation of Small Scow-bowed Displacement Sailing Craft with Regard to Seakeeping.*

Max's certificate and cheque are under way.

Phil Helmore

Post-graduate and Other News

Award for Innovative Marine Propeller Blade

Researchers at UNSW Sydney have taken out a JEC Asia Innovation Award for their research, testing and production of a "shape-adaptive marine propeller" which promises more efficient and longer-lasting propellers for marine applications. UNSW Engineering's Prof. Gangadhara Prusty accepted the marine category award at a ceremony in Seoul in mid-November on behalf of the Australian Research Council (ARC) Training Centre for Automated Manufacture of Advanced Composites (AMAC) and program partner the Australian Defence Science and Technology Group (DST).

Prof. Prusty is the Director of AMAC, based at UNSW's Kensington campus. He said "We've designed an intelligent propeller blade which can operate efficiently under changing conditions in the water. It's made of very lightweight composites which are strong, but flex and twist to change shape to achieve maximum propulsion efficiency."

Marine propellers are typically made with a nickel-aluminium-bronze compound metal, which is prone to erosion and, in comparison with carbon fibre, is much heavier, inflexible and expensive. Reduced noise generation

and the absence of a detectable "magnetic signature" from a composite propeller is also a desirable characteristic, especially for defence applications.

The manufacturing process of the winning propeller blade was also integral to UNSW's success at the awards, with its unique digital production and sensor technology. The research team manufactured the propeller blade using Automated Fibre Placement (AFP) technology, where prototypes are based on a "digital design" which can be optimised throughout the process and manufactured at an unprecedented rate, also minimising waste. The process also embeds fibre-optic sensors into the blade which provides strain measurements, useful for prototyping and manufacturing, as well as performance and maintenance across its entire life cycle.

Kerryn Caulfield, CEO of Composites Australia Inc., the peak industry body for the Australian composites sector, said "This shape-adaptive advanced-composite technology for marine vessels is an important step change for our nation."

Prof. Prusty said that he was honoured to receive the award on behalf of UNSW, AMAC and DST. "I am very proud that we have produced this significant breakthrough in demonstrating sensor-embedded, automated manufacture of adaptive structures using advanced composites. There are many opportunities for applying our technologies across the aerospace, civil, defence and automotive sectors, and I am looking forward to expanding our research for the next-generation propeller blade using digital technology in large-scale manufacturing solutions."

UNSW News, 21 November 2019

Franck Glowacz (JEC Group), Thomas Lepretre (JEC Group), Kerryn Caulfield (Composites Australia), Prof. Gangadhara Prusty (UNSW AMAC), Eric Pierrejean (JEC Group), Sung-o Cho (Austrade), Leona Reif (FDP Composites and Composites Australia) (Photo from UNSW website)

Vale Graham de Vahl Davis AM

It is with sadness that the School of Mechanical and Manufacturing Engineering records the death of Em/Prof. Graham de Vahl Davis AM on 24 December 2019, aged 88.

Elders of the tribe may remember Graham either as one of their lecturers in numerical methods (for which the textbook was his own *Numerical Methods in Engineering and Science*), fluid mechanics or thermodynamics, supervising thesis topics, or as Head of School, in which position he served for a time.

Graham's principal topics of interest at UNSW were computational fluid dynamics and heat transfer, and he grew to have an international reputation in both. He was involved in the introduction of CFD to Australia, and developed the largest and best-known CFD research group in the country. He worked to a large extent on problems in which the flow is wholly buoyancy-driven, or in which buoyancy causes a significant modification to a forced flow. Such problems occur over a wide spectrum of applications, and included research on gravity waves and microgravity with NASA. Graham was a leader of the Jewish community in Sydney, and served as President of the NSW Jewish Board of Deputies.

He is survived by his partner, Prof. Bettina Cass, one of his two daughters, five grandchildren and three great-grandchildren.

Phil Helmore

Em/Prof. Graham de Vahl Davis AM
(Photo from J-Wire website)

Western Australia

Model Experiments on the Swan River

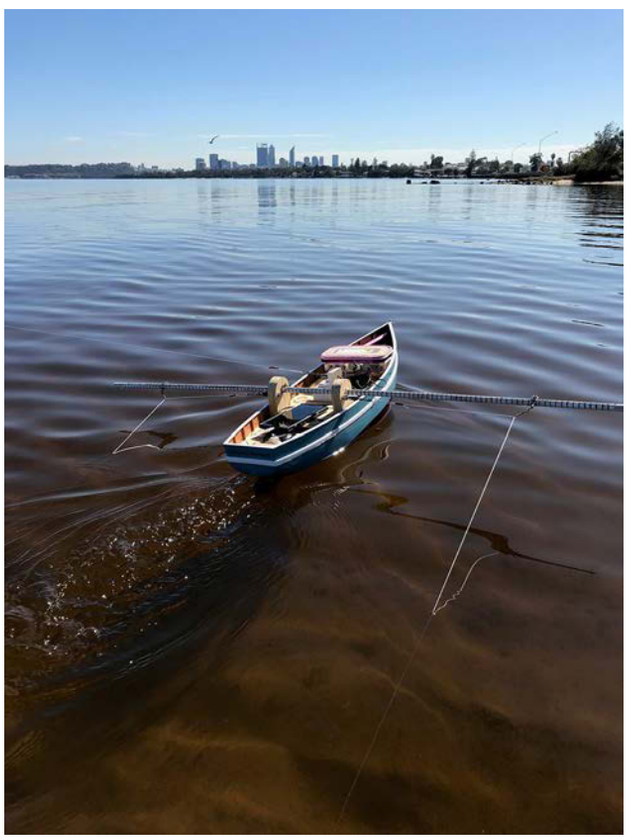
A Trawler-steering Mechanism based on Tow-point Adjustment for Efficient Mitigation of Side-wind Loads

Prawn trawlers operate trawling at about 3 knots and have an inefficient low aspect-ratio keel so, unlike yachts, they do not efficiently generate side forces (with application of the rudder) when there is a need to resist side-wind loading. Furthermore, the rudder force, which produces the turning moment for the necessary angle of yaw and desired keel side-force, is an undesirable side force as it acts in the direction of the wind.

A pilot study has been conducted jointly by Edith Cowan University (ECU) and the University of Western Australia (UWA) to assess the potential benefits of adjusting the location of the tow points during the side-wind loading situation. Specifically, experiments with a self-propelled trawler model were conducted on the Swan River, Perth.

The challenge was to measure leeway angle, side force, and tow-force reduction for a range of rudder and tow-point adjustment scenarios. Preliminary analysis suggests that the tow-point adjustment may have a substantial energy-saving benefit, but further experiment refinement, data collection, and analysis is required to conclusively test the hypothesis and to take the concept to the next phase of development. The project was undertaken by a final-year undergraduate student, Andrew Welsh, under the supervision of Dr Cheslav Balash (ECU) and A/Prof. Scott Draper (UWA), and practical industry guidance of Dr David Sterling (Sterling Trawl Gear Services, Qld). Support for the testing was provided by the RiverLab project, an initiative between Woodside and UWA to enable practical ocean engineering research in the Swan River.

Cheslav Balash



Model experiment underway on the Swan River
(Photo courtesy Cheslav Balash)

South Australia

Australia to build a Research Submarine

The fully reconfigurable Australian Research Experimental Submarine (ARES) will be used for hydrodynamic and crew-efficiency testing of future submarine designs. The project is a collaboration between the University of Adelaide, the University of South Australia, Flinders University, TAFE SA and the University of Tasmania's Australian Maritime College with Defence support from DST Group. The four industry partners for the project are SAAB, ASC, Dassault Systemes and MOOG Australia.

ARES has received $150 000 in Defence Innovation Partnership funding from the South Australian Government to boost a $350 000 in-kind contribution from participants to fund the project's first year. An estimated $3 million will be needed to complete the three-year project. Project lead and the University of Adelaide's Director of the Shipbuilding Hub for Integrated Engineering and Local Design (SHIELD), Eric Fusil, said that the project would deliver Australia's first reconfigurable research submarine.

He said the autonomous submarine would be used to test hydrodynamics — how a submarine behaves underwater — to aid in the design and safe operation of new submarines globally.

"Because you can't see on board a submarine and you don't really know where you are going, you need to know that, when you are pulling on the controls from inside the submarine, you are setting the control planes outside at a given angle. You need to know the effect of these angles for each given speed on the trajectory of the submarine — otherwise you are at risk of breaching the surface or diving too quickly.

"Despite all our best efforts worldwide, we're still at a point where we cannot use computers to predict all of that. You need to go to actual testing with small-scale submarines to be able to deliver a safe analysis of how present or future submarines are behaving underwater. These vehicles are often quite specific to a class of submarine, whereas our submarine will have the ability to be generic and to be adaptable to any kind of shape overall and also to any kind of location of contour plane."

Early designs show the submarine to be about 7 m long and up to 1.8 m high. Its 'golden wattle' yellow colour will allow it to be easily observed during underwater tests. Initial testing will likely be done in lakes at a depth of 30–40 m — deep enough to properly test the submarine's hydrodynamics, but shallow enough for it to be safely recovered by dive teams if it encounters problems.

While Australia has not previously had a research experimental submarine, several of its allies including the United States, the United Kingdom, The Netherlands and France, have used them extensively. Fusil said that the project would also help develop a skilled workforce which will go on to contribute to Australia's future submarine program.

"The project is quite unique because in Australia so far we have taken products off the shelf and we have customised and adapted them to our Australian environment," Eric Fusil said. "On this project we are starting pretty much from scratch, but we have access to a very good technical support network including the UK, The Netherlands and potentially the French, so we will be able to feed on the lessons learned from these countries and take the best from all of them to build a successful model."

The project will also enlist the help of several international 'grey-beards', experienced industry experts who will mentor and guide the project. The first year of the project will mainly involve design work before procurement, manufacture and testing phases in years two and three.

Fusil said that DST Group — the Australian government's Defence Science Technology agency and one of the project's major partners — would have the opportunity to use ARES to help develop the Attack Class submarine and also to validate other projects Australia is involved in with its allies.

SUMMER ON THE WATER

The beautiful 23 m S&S-designed aluminium yawl *Kioloa II* showing her power during the CYCA's Sydney-to-Hobart Classic Regatta on 8 December. *Kioloa II* took line honours in the 1971 race with an elapsed time of a little over three and a half days
(Photo John Jeremy)

Four starting lines were used for the 2019 Rolex Sydney to Hobart yacht race. This is the start on line four, the southernmost of the lines. Built in London in 1904, the 9.7 m ketch *Katwinchar* (sail number CYC 8) was the oldest boat in the race. She first competed in the event in 1951, arriving in Hobart on 3 January 1952 (retired) after having been missing for some time
(Photo John Jeremy)

HMAS *Canberra*, escorted by the fire tug *Shirley Smith* and hundreds of spectator craft, makes her way back to Fleet Base East after the Salute to Australia at midday on Australia Day
(Photo John Jeremy)

The start of Division 1 in the 184th Australia Day Regatta off Point Piper in Sydney on Australia Day. The Australia Day Regatta, previously know as the Anniversary Regatta, is the oldest continually-sailed regatta in the world, having been sailed every year since 1837
(Photo John Jeremy)

INDUSTRY NEWS

Attack-class Submarine Weapon Discharge System

Naval Group has signed a subcontract with Babcock International Group PLC for the design of the weapon discharge system for the Attack-class submarines.

Babcock is a proven in-service supporter for systems which have already been installed on the Collins-class submarines and Hobart-class guided-missile destroyers.

The subcontract with Babcock will support the operation and sustainment of the Attack class while maximising the involvement of Australian industry.

Babcock will transfer the necessary Intellectual Property to its Australian subsidiary Babcock Australia to act as the Engineering Design Authority. This includes training, maintenance and managing the supply chain, creating around 170 new jobs for the build and sustainment of this system.

Australian Suppliers for the Attack-class Submarine Program

Berendsen Fluid Power and H & H Machine Tools were selected in November as the first Australian partners for major equipment design contracts which will support the construction of the Attack-class submarine.

Seven Hills-based Berendsen Fluid Power and Melbourne's H & H Machine Tools will partner with Pinette Emidecau Industries and Starrag Group Holding AG to become the design authority and manage the local manufacture of medium-capacity presses and a large-capacity milling machine.

The value of the work for local companies is estimated at $20 million.

Austal can now Bid for US Navy Support Contracts

Austal's shipyards and service centres in Australia have been approved to bid for and provide support services, including ship repairs, maintenance and sustainment activity for US Navy and Military Sealift Command (MSC) ships.
The announcement comes after the Australian shipbuilder signed an agreement of boat repair (ABR) with the navy.

As explained, Austal's Australian operations may now bid to provide emergent repair services to deployed USN ships, including the Austal-designed and -constructed Independence-class littoral combat ships (LCS).

The ABR also allows Austal to bid for maintenance and repair of MSC ships deployed to the region, to include the Austal-designed and -constructed Spearhead-class expeditionary fast transport (EPF) vessels.

"With this approval, Austal can provide a range of vessel repairs, maintenance and in-service support to U.S. Navy and MSC ships operating throughout South East Asia," Austal's Chief Executive, David Singleton, said.

Specifically, the approval from the US Navy allows Austal to bid for work on US naval vessels which may visit Australia — including Cairns in Queensland, Darwin in the Northern Territory or Fremantle in Western Australia.

Fincantieri–Naval Group JV now Operational

Naviris, a joint venture (JV) between the Italian shipbuilder Fincantieri and the French company Naval Group, is now fully operational. The JV is said to pave the way to the consolidation of European naval defence in response to the increasing pressure of worldwide competitors.

With the head office located in Genoa, Italy, and a subsidiary in Ollioules, France, the Naviris team will focus on bi-national and export projects. Claude Centofanti, Chief Executive Officer, and Enrico Bonetti, Chief Operational Officer, will run the joint venture. Giuseppe Bono has been appointed Chairman and Hervé Guillou as a member of the Board.

Through Naviris, Fincantieri and Naval Group are pooling their strengths to develop a new strategic capability. As explained, Naviris' objective is to create value through common R&D projects, worldwide proposals, prime contractorship and design authority and procurement optimisation.

Naviris foresees export and common French-Italian opportunities, such as the first studies for the mid-life upgrade of the French and Italian Horizon-class destroyers, as well as European projects, such as the development of the European patrol corvette light frigates.

"We are grateful to have received the unconditional support of our governments for the creation of a new European leader for the strategic sector of naval defense," Giuseppe Bono and Hervé Guillou, the two CEOs of Fincantieri and Naval Group, commented.

"Together, we will accelerate our technological advance and maintain our key differentiators by combining our R&D capabilities, renovating the products for the benefit of our customers. Naviris opens the way to a real construction of European naval defence."

World-first Deployable 3D Printers for Defence

Cutting-edge 3D printing technology developed in Darwin will be deployed by the Royal Australian Navy in a world-first trial which will streamline the maintenance of patrol vessels.

The Commonwealth Government will invest $1.5 million in the two-year Supersonic Deposition 3D printer pilot, which will lead to a significant increase of parts availability compared to that which the regular supply chain can provide.

The Minister for Defence Industry, the Hon. Melissa Price MP, congratulated the Charles Darwin University's Advanced Manufacturing Alliance, along with industry partner SPEE3D, for producing the cutting-edge and uniquely-Australian capability.

"This high-tech machinery enables metal components to be produced quickly and efficiently, meaning that our ships can get back on the water without delay," Minister Price said.

"Benefiting both the Navy and industry, the knowledge transfer gained using this capability also positions the Advanced Manufacturing Alliance to pursue further opportunities.

"This capability is a prime example of Australian innovation at its best and supports the Government's unprecedented shipbuilding and sustainment plans."

Minister Price visited Charles Darwin University with Chancellor, the Hon. Paul Henderson AO, as part of a wider visit to Darwin to inspect work underway on the $1.1 billion defence infrastructure upgrades in the Top End.

Wärtsilä and Silverstream to Collaborate on Air-lubrication Technology

On 2 December, Wärtsilä, and Silverstream Technologies, the leading air-lubrication solution provider, announced the signing of a Licence and Co-operation Agreement for future sales and servicing of the Silverstream System. By offering the Silverstream System as an integral part of Wärtsilä's propulsion solution for new vessels, compliance with the Energy Efficiency Design Index (EEDI) will be further improved. Under the agreement, the Silverstream System will also be available through Wärtsilä's sales channels for retrofit installations on existing vessels where Wärtsilä is a primary solution provider. The integrated Silverstream System is expected to realise synergies in capital and operational savings across the propulsion chain by increasing fuel efficiency and optimising engine loading.

This new collaborative partnership will accelerate the deployment of air lubrication systems across all vessel classes, from small bulk vessels to the largest container ships. By combining Wärtsilä's propulsion expertise and Silverstream's innovative engineering knowledge, access to this clean technology will be facilitated across the market.

In the future, the collaboration agreement will enable current and future Silverstream customers to access Wärtsilä's global service network for the maintenance of their Silverstream System installations. Wärtsilä's network of service centres, workshops and service professionals is the most extensive in the maritime industry, with 4500 field service professionals located in 70 countries around the world.

The agreement means that more shipowners will have easy access to Silverstream's proven air-lubrication technology. The system has been proven to reduce fuel burn and associated emissions by 5 to 10%, depending on vessel type.

Noah Silberschmidt, CEO, Silverstream Technologies, added "Today's agreement with Wärtsilä reinforces our position as the shipping industry's leading clean technology manufacturer. In Wärtsilä we find a partner as committed as we are to achieving a cleaner, more efficient and sustainable maritime industry.

"With the global sulphur cap almost upon us and decarbonisation targets on the horizon, the commercial case for proven clean technology has never been stronger. Now is the time for ship owners to take action to reduce their operational costs and their impact on the environment, and today's agreement will help unlock the power of air-lubrication technology for more vessels across our sector."

The Silverstream System creates a carpet of microbubbles which coat the entire flat bottom of the vessel. This carpet reduces frictional resistance between the hull and the water, reducing fuel consumption and related emissions. The technology works in all maritime conditions, is not weather dependent, and does not constrain or negatively impact the normal operational profile of the vessel.

Austal Philippines Launches 109 m Catamaran Ferry

On 11 February Austal Philippines launched Hull 419, a 109 m high-speed catamaran ferry, from the company's recently-expanded Balamban shipyard in Cebu.

The vehicle-passenger ferry, to be known as *FSTR*, is the largest aluminium vessel ever launched in the Philippines — and the largest by volume ever constructed by Austal.

The vessel is now in the final stages of fitting out, prior to delivery to Fjord Line of Norway in the second quarter of this year.

Austal's Chief Executive Officer, David Singleton, said that the launch of the Auto Express 109 catamaran was a significant milestone for Austal Philippines, as the first ship to be wholly constructed from the Balamban shipyard's expanded production facilities, which were opened in July 2019.

"This impressive new ship for Fjord Line of Norway is the first of many large high-speed commercial ferries to be constructed at our newlyexpanded shipyard in the Philippines. After Hull 419, we have Hull 395, a 118 m trimaran under construction, which will be the longest high-speed ferry to be constructed in the Philippines.

"We also have a 115 m catamaran ferry scheduled for later this year — ensuring continuity of production at the Philippines shipyard well into the 2020s," Mr Singleton said.

Austal Philippines President, Wayne Murray, celebrated the launch of Hull 419 by thanking the local shipbuilding team and acknowledging the outstanding capability of the Balamban shipyard — which now includes a 120 m long assembly bay and multiple new fabrication bays.

"I am exceptionally proud of the entire Austal Philippines team. The launch of Hull 419 from our newly-expanded shipyard is a significant event which highlights our capability to deliver multiple projects concurrently – safely and cost effectively," Mr Murray said.

Fjord Line's *FSTR* is capable of transporting 1200 passengers at up to 40 kn and features Austal's largest-ever vehicle-carrying capacity constructed to date, with a beam of 30.5 m enabling 404 cars to be carried across two decks. The ship features several key design innovations which enhance operating performance and passenger comfort, including a new, optimised hullform which will minimise fuel consumption and wake wash when operating on the Skagerrak Sea between Hirtshals, Denmark and Kristiansand, Norway.

[*There is a video of the launching via the dock ship on YouTube at https://www.youtube.com/watch?v=xsmuPMfOmOU* — ED.]

The 109 m catamaran ferry transferred to a dock ship for launching at Austal's Philippines shipyard
(Photo courtesy Austal)

The new ferry safely afoat at Austal's shipyard in Cebu
(Photo courtesy Austal)

Dedicated Form for Alternate Survey Process Applications

Did you know that AMSA considers alternate survey process proposals?

These proposals may be made where the standard survey process is unreasonable. The power for AMSA to approve an "alternate survey process" is provided by Marine Order 503 and Part 2 of the Surveyor Accreditation Guidance Manual (SAGM).

Until now, these proposals have been submitted on the AMSA Miscellaneous Form, which has resulted in frequent requests for further information before being able to make a decision. To speed up the processing of these applications, and to provide more guidance to surveyors and industry about the information required to assess these applications, AMSA has published a new form (AMSA 1854—Alternate Survey Process application form). The form is available on the AMSA website and will be able to be submitted by email to dcvsurvey@amsa.gov.au.

New Electrical Standard now Approved

AMSA has completed a comprehensive review of NSCV Section C5B which has been in place since December 2005. The revised standard (Edition 3) has been approved by the Transport Infrastructure Council and came into effect on 1 January 2020. The amendments result in contemporary standards for electrical safety on vessels by aligning with the latest Australian Standard (AS/NZS 3004.2).

The principal change to the standard is the requirement for vessels to comply with state or territory electrical regulator's requirements. The revised standard also provides:

- Confirmation that protective devices (such as RCDs and RCBOs) are required to be fitted (AS/NZS3004.2) and tested regularly (AS/NZS3760). Obligations for existing vessels to fit and test circuit protection devices which are also considered to exist in both local WHS/OHS requirements and the National Law General Safety Duties.
- Relevant concurrent requirements of other regulators regarding electrical installations.
- A note stating that there are state and territory electrical licensing requirements which must be met by persons performing electrical work on low- and high-voltage electrical systems.

Survey Matters, December 2019

Transitional Vessel Stability Criteria for Boom Trawlers

Those with eagle eyes will have seen the article relating to this item in the December 2019 issue of *Survey Matters*.

The idea behind the transitional arrangements (in general) is to set the USL Code for general arrangement, engineering, construction and stability (especially for snagged net and cod-end lifting) as a baseline for older existing vessels to come into survey. This is particularly pertinent to the Queensland vessels which were commercially registered but did not require a Certificate of Survey when the National Law was brought in.

AMSA can't throw the full book of NSCV standards at these older vessels due to the potential costs arising from reassessing the designs along with drafting and approving new plans. Instead, AMSA requires the USL Code requirements as a minimum (as the chances are that it was used for the design of such vessels back in the day), provided that existing approved documentation is available. Areas such as navigation, communications and safety equipment must all be brought up to the current NSCV standards if a vessel triggers transitional arrangements. AMSA also requires fixed fire detection and extinguishing, and the fitting of RCDs if they aren't already fitted.

A vessel may trigger transitional arrangements due to a number of factors such as hull modifications, relocation to an area outside where it was operating pre-National Law, the addition of a class, or the addition of persons onboard. The full list of triggers can be found in Schedule 1 of Marine Order 503.

Phil Helmore

IMO 2020 brings Changes for Scrubber Operations in Australian Waters

The New Year brought in sweeping changes to the shipping industry with the aim of reducing the impacts of sulphur air emissions on the environment and human health.

1 January 2020 signalled the start of the International Maritime Organisation's amendments to air pollution regulations. The most significant change is a reduction in the global limit of sulphur content in ship fuel oil from 3.50% to 0.50%.

To comply with the low sulphur limit, ships can use compliant fuel oil with a sulphur content below 0.50%. Other options to comply include alternative fuels (such as LNG) or the fitting of an approved exhaust gas cleaning system (EGCS), colloquially referred to as a 'scrubber.'

Vessels are now subject to new reporting requirements if they are using an EGCS. The master, owner or operator of a vessel is to notify AMSA before first arrival at an Australian port to provide information on the EGCS installed. This includes (but is not limited to) the vessel name, arrival port and date, make and model of the EGCS, whether it is an EGCS Scheme A or Scheme B approval, whether it has open-loop, closed-loop or hybrid type system, and the results of wash-water testing. Notification is made by email to EGCS@amsa.gov.au

Ship's masters may be directed not to discharge wash-water from scrubbers in Australian waters if this data on the analysis of wash-water testing, or evidence that samples have been taken for analysis, cannot be provided to AMSA before arrival at the first Australian port.

EGCS are fitted with a range of sensors designed to indicate that the system is operating correctly. Where there is evidence of a malfunction, the crew are required to take action immediately. If, after an hour, the issue cannot be resolved, the vessel should be changed over to compliant fuel oil and a report made to the flag state and any relevant port or coastal state.

If the vessel does not have sufficient compliant fuel oil to reach the next port of destination, the vessel will need to make a report to the relevant authorities, including the vessel's flag state administration and the competent authority for the next port of destination. The report must outline the vessel's proposed course of action which might include bunkering compliant fuel oil at the next port or carrying out repair works.

From 1 March 2020 non-compliant fuel can only be carried on board, for use on the ship, where the vessel is fitted with an EGCS. In instances where compliant fuel cannot be obtained a Fuel Oil Non-Availability Report (FONAR) must be submitted to the flag State and the competent authority in the next port of call.

Any EGCS found to be not in compliance with IMO guidelines in any respect (including but not limited to the wash water discharge criteria) may be prohibited from use in Australian waters.

Vessels can be detained or banned from entry to an Australian port if found to be non-compliant with relevant conventions.

AMSA is undertaking further assessment of potential cumulative impacts of EGCS wash water discharges, which may result in further restrictions on their use in Australian waters in the future.

More information on the changes can be found here: https://www.amsa.gov.au/marine-environment/air-pollution/compliance-low-sulphur-2020.

Simon Anderson

Home of the Black Box Celebrates 80 Years

In November 2019, one of Australia's oldest Defence research facilities, the Defence Science and Technology research laboratory in Melbourne, celebrated 80 years at its Fishermans Bend location.

Chief Defence Scientist, Prof. Tanya Monro, congratulated the staff and alumni on the milestone and commended them for their contribution to Defence and Defence capability.

"Thanks to the research conducted out of Fishermans Bend, our soldiers are better equipped, our military platforms are better protected, and our aircraft and ships can be operated safely for longer," Prof. Monro said.

While the breadth of research conducted at Fishermans Bend now extends far beyond only aircraft, Prof. Monro noted the international reputation that the site had earned for its aeronautical research.

"This site commenced its operational life as an aeronautical research facility and which, to this day, the aerospace research that is conducted on this site is outstanding," Prof. Monro said.

"The structural fatigue testing of military aircraft alone has earned international recognition and saved Defence many millions of dollars."

Known as the birthplace of the Black Box flight recorder invented by David Warren in the 1950s, the Fishermans Bend site has produced innovations and scientific developments which are now known around the world.

In the 1940s and 1950s, scientists at Fishermans Bend developed *Jindivik*, a subsonic, uncrewed jet-propelled target plane designed to measure missile performance.

In the 1950s, Ron Cumming and Russ Baxter developed the Tee-Visual Approach Slope indicator system, or T-VASIS, an aid for pilots in the final stages of landing.

More recently, Defence scientists at Fishermans Bend have developed a technology known as MiTE (Microbolometer Thermoelastic) technology which makes it possible to image the stress in structures.

"DST has played, and continues to play, a pivotal role in the Defence industry sector, not only at Fishermans Bend but across the country," Prof. Monro said.

"Plans to transform the Fishermans Bend area into an innovation precinct would help to truly entrench the area as a Defence industry hub.

"Building on the legacy which DST has created at Fishermans Bend, this area will continue to grow as a globally-competitive and highly-skilled hub for defence industry that provides critical support to the Australian Defence Force and services global supply chains."

THE INTERNET

RINA Webcasts

RINA has set up a YouTube channel and all RINA webcasts can be viewed there. The RINA YouTube channel is at

https://www.youtube.com/channel/UChb1sfHbWfQmG-iwpp_QGJg/videos

Bookmark this website and keep your eye on it!

Video recordings of presentations should be sent to Jim-Ray Semanhiya <jsemanhyia@rina.org.uk> at RINA HQ for uploading.

To find a presentation made prior to the last three months, use the search function to the right of *About* in the menu bar, type the title of the presentation you are looking for (or at least the first few words thereof) and press Enter.

Victorian Section Webcasts

No Victorian Section webcasts have been recorded and uploaded within the last three months. Further recordings will be added as they occur.

Jesse Millar

NSW Section Webcasts

The NSW Section webcast recorded and uploaded within the last three months is:

Controlling Marine Engine Emissions, presented by Lachlan Colquhoun, Marine Engine Sales Manager Australia and New Zealand, MAN Energy Solutions, to a joint meeting with the IMarEST attended by 42 on 5 February in the Boardroom at Engineers Australia, Chatswood.

Further recordings will be added as they occur.

Phil Helmore

MEMBERSHIP

Australian Division Council

The Council of the Australian Division of RINA met on the afternoon of Tuesday 10 December 2019 by teleconference under the chairmanship of our President, Prof. Martin Renilson, in Launceston with phone links to Cairns, Gold Coast, Sydney, Canberra and Perth.

The meeting had a full agenda including a number of on-going items. Some of the more significant matters raised or discussed were:

Division Representative for 2020 AMC Accreditation

Council appointed the Division's representative to this accreditation, due to be undertaken in August 2020.

Updating of Web Information on Australian Courses

Council approved updated information which has subsequently been posted under "Academic Courses" on the Division's website.

Incoming President

Noting that Prof. Renilson will reach the end of his maximum permitted term at this year's Division Annual General Meeting, Council unanimously elected Mr Gordon MacDonald as President for the coming two years.

Victorian Engineers Registration Act 2019

Following the passage of this Act, Council noted that Victoria was considering the Institution's application to be made an accreditation body under that Act.

Senate Inquiry into the Sovereign Naval Shipbuilding Industry

Council noted a draft of the submission to be made to this inquiry, the final version of which would be lodged later in December.

Next Meeting of Division Council

The next meeting is scheduled for the afternoon of Tuesday 24 March 2020.

The draft minutes of the meeting are available to Council members on the Council forum and are available to other members by request to the Secretary.

Developments on these subjects subsequent to the Council meeting are covered elsewhere in this issue of *The ANA*.

Finally, and looking beyond Division Council, I have been advised that the later than usual date of this year's Annual Dinner in London has enabled the closing date for entries for the Lloyds Register Maritime Safety Award to be set at 29 February 2020. I would encourage all those involved in projects to improve maritime safety to submit entries by that date.

Rob Gehling
Secretary

Free Papers for Members

Members should be aware that they are entitled to four free copies of RINA papers each year. This includes papers from previous transactions, conferences, etc., and is especially useful if you are interested in just one or two papers from a particular conference as you don't then need to buy a copy of the entire proceedings.

Papers published by RINA are searchable on the RINA website www.rina.org.uk; click on

Publications>Search Publications and Order.

The procedure for obtaining a free copy is to email your request to publications@rina.org.uk, with the subject line "Member's Free Paper", and specify the author(s) and year, the title of the paper, where the paper appeared (transaction year/volume, conference name and year, etc.) and, finally, your name and RINA membership number.

Free Places for Student Members at RINA Conferences

RINA also makes available two free places for Student Members of RINA at conferences organised by the Institution, including the Pacific International Maritime Conferences in Sydney.

The procedure for obtaining a free student place is to email your request to the Chief Executive, Trevor Blakeley, at tblakeley@rina.org.uk, and specify the conference, your name and membership number.

Changed contact Details?

Have you changed your contact details within the last three months? If so, then now would be a good time to advise RINA of the change, so that you don't miss out on any of the Head Office publications, *The Australian Naval Architect*, or Section notices.

Please advise RINA London, *and* the Australian Division, *and* your local section:

RINA London		hq@rina.org.uk
Australian Div.		rinaaustraliandivision@gmail.com
Section	ACT	rinaact@gmail.com
	NSW	rinansw@gmail.com
	Qld	hamish@oceanicdesign.com.au
	SA/NT	rinasantdiv@gmail.com
	Tas	brian.winship@utas.edu.au
	Vic	owen.tregenza@dst.defence.gov.au
	WA	rina.westaus@gmail.com

Phil Helmore

THE AUSTRALIAN NAVAL ARCHITECT

Contributions from RINA members for *The Australian Naval Architect* are most welcome

Material can be sent by email or hard copy. Contributions sent by email can be in any common word-processor format, but please use a minimum of formatting — it all has to be removed or simplified before layout.

Photographs and figures should be sent as separate files (not embedded) with a minimum resolution of 200 dpi. A resolution of 300 dpi is preferred.

RINA AUSTRALIAN DIVISION

NOTICE OF ANNUAL GENERAL MEETING

TUESDAY 31 MARCH 2020

Notice is hereby given that the Annual General Meeting of the Australian Division of the Royal Institution of Naval Architects will be held at Smartship Australia offices, 6–12 Boronia Road, Brisbane Airport, at 5:30 pm for 6.00 pm.

The meeting will be followed immediately by a technical meeting of the Queensland Section featuring a number of practitioners' presentations on *Design Highlights of 2019 in South East Queensland — Recent Naval Architecture Accomplishments*.

Apologies should be received by the Secretary no later than 29 March 2020.

AGENDA

1. Opening
2. Apologies
3. To confirm the Minutes of the AGM held in Sydney on Wednesday, 3 April 2019[1]
4. To receive the President's Report
5. To receive, consider, and adopt the Financial Statements and Auditor's Report for the year ending 31 December 2019
6. Announcement of appointments to the Australian Division Council
7. Other Business

R. C. Gehling
Secretary
Email:rinaaustraliandivision@gmail.com or ausdiv@rina.org.uk; Phone: 0403 221 631/

[1] available at www.rina.org.uk/res/Minutesof2019AGM.pdf

The Tall Ships Race, a regular feature of the Australia Day celebrations on Sydney Harbour
(Photo John Jeremy)

NAVAL ARCHITECTS ON THE MOVE

The recent moves of which we are aware are as follows:

Tom Bromhead has moved on from Toll Shipping, and has taken up the position of Second Officer on board *Maersk Master,* a Maersk Supply Service Starfish-class DP2 deepwater anchor-handling tug/supply vessel, currently operating out of Dampier, WA.

Lauchlan Clarke has been awarded his PhD by the University of Tasmania and has moved on from Incat Tasmania to take up a position as a naval architect in the Naval Technical Bureau in Canberra.

Kate Devereaux, a recent graduate of the University of Southampton, has taken up a position as a naval architect with One2three Naval Architects in Sydney.

Clive Evans has moved on from Spiral Marine Design and has taken up the position of Maritime Systems Lead—Research Supply Icebreaker Project with the Australian Antarctic Division in Hobart.

Elettra Ganoulis, a recent graduate of the University of Southampton, has taken up a position as a naval architect with One2three Naval Architects in Sydney.

Bing Zheng Ho has moved on within the Royal Singapore Navy, and is now the Operations Officer on one of the Formidable-class frigates.

Danielle Hodge has moved on within Collins Submarine Engineering of the Capability Acquisitions and Sustainment Group, Department of Defence, and has taken up the position of Engineering Manager in Adelaide.

Michael Hodgkinson has moved on from Norman Disney and Young and has taken up a position as a naval architect with One2three Naval Architects in Sydney.

Joel Ireland has moved on within Ocean Installer and has taken up the position of Vice President — Asia Pacific and Oceania in Perth.

Peter Ivanac moved on from Veem Engineering in 2016 and, after some time at Castech Solutions, Austal and Pressure Dynamics International, has taken up the position of Business Development Manager with Watmarine Engineering Services in Perth.

Rick Ives moved on from a long career with Nestlé in 2016 and is now consulting in project management and food and industrial-services engineering in Brisbane.

Martin Jaggs has moved on within Transport Safety Victoria and has taken up the position of Manager Technical Services in Melbourne.

Colin Johnson has moved on from BAE Systems and, after some time at Seaspan, has taken up the position of Program Chief Technical Officer with Naval Group Australia in Adelaide.

Gavin Jones has returned from Singapore with Lloyd's Register, and continues as Hull Principal Specialist in Sydney.

Scott Jutson continues as CEO and Chief Designer with Jutson Marine Design in Vancouver, Canada.

Irek Karaskiewicz has moved on from Remontowa Shipyard and has taken up the position of Director with Związek Pracodawców Forum Okrętowe in Gdansk, Poland.

Tegan Kay has moved on from Technip Oceania and, after some time at McDermott International Inc., has taken up the position of Bar Manager at the Oxford Hotel in Perth.

Simon Kelly has moved on from Jacobs and has taken up the position of Lead Outfit Engineer with Navantia Australia in Melbourne.

Gerard Kenny has moved on from the Virgin Islands Shipping Registry and has taken up the position of Technical Manager with the Liberian International Ship and Corporate Registry in London.

Mervyn Lepper has moved on within the University of the South Pacific and has taken up the position of Director Estates and Infrastructure in Suva, Fiji.

Lance Marshall has moved on from Jacobs SKM and has taken up the position of Senior Technical Consultant with Rubicon Associates in Melbourne.

Todd Maybury moved on from Serco in 2017 and has taken up the position of Engineering Manager—LHD Transition and Remediation Program with KBR Inc. in Sydney.

Gino Parisella has taken up the position of Senior Mooring Engineer with InterMoor in Perth, and is also pursuing the completion his PhD on wave-energy converters at Curtin University.

James Phillips has moved on from Incat Crowther and has taken up the position of Naval Architect in the Asset Management Services Program with Thales in Newcastle, currently working on the ACPB and MHC platforms.

Dov Sobel has moved on from consulting and is currently diving Florida springs and reefs while evaluating opportunities.

Mark Williamson continues as Managing Director with Southport Custom Yachts in Ashmore, Qld.

Gabriel Wong has moved on from Wärtsilä Ship Design and, in addition to his role as Inspection Coordinator with Region Diversified (S), has taken up the position of Naval Architect with Offshore Technology Development in Singapore.

This column is intended to keep everyone (and, in particular, the friends you only see occasionally) updated on where you have moved to. It consequently relies on input from everyone. Please advise the editors when you up-anchor and move on to bigger, better or brighter things, or if you know of a move anyone else has made in the last three months. It would also help if you would advise Robin Gehling when your mailing address changes to reduce the number of copies of *The Australian Naval Architect* emulating boomerangs.

Phil Helmore

FROM THE ARCHIVES

THE CAPTAIN COOK GRAVING DOCK

John Jeremy

On 24 March 2020 it will be 75 years since the largest graving dock in Australia was officially opened by the Governor General of Australia, HRH The Duke of Gloucester, when the RAN frigate HMAS *Lachlan* entered the flooded dock and cut a ribbon stretched across the entrance.

Conceived in the late 1930s, the dock was intended to meet the need for a capital ship dock in Australia to avoid reliance on the existing dock in Singapore. Moreover, the dock was to be designed to be able to dock the largest ships in the world at the time, the Cunard liners *Queen Mary* and *Queen Elizabeth*. The site was selected after detailed consideration of other locations in Australia and in Sydney Harbour. Construction of the dock was approved on 1 May 1940.

The project involved the reclamation of about 12.1 hectares between Potts Point and Garden Island and the construction within massive cofferdams of a graving dock 347.29 m long and 45 m wide with a depth of 12.6 m over the sill at low water, together with supporting infrastructure, cranes and services. The dock was designed by Sir Alexander Gibb and Partners under the supervision of the firm's Principal, Sir Leopold Saville. Management of the construction of the dock was entrusted to Maurice Mchaffey, the Assistant Commonwealth Director-General of Allied Works.

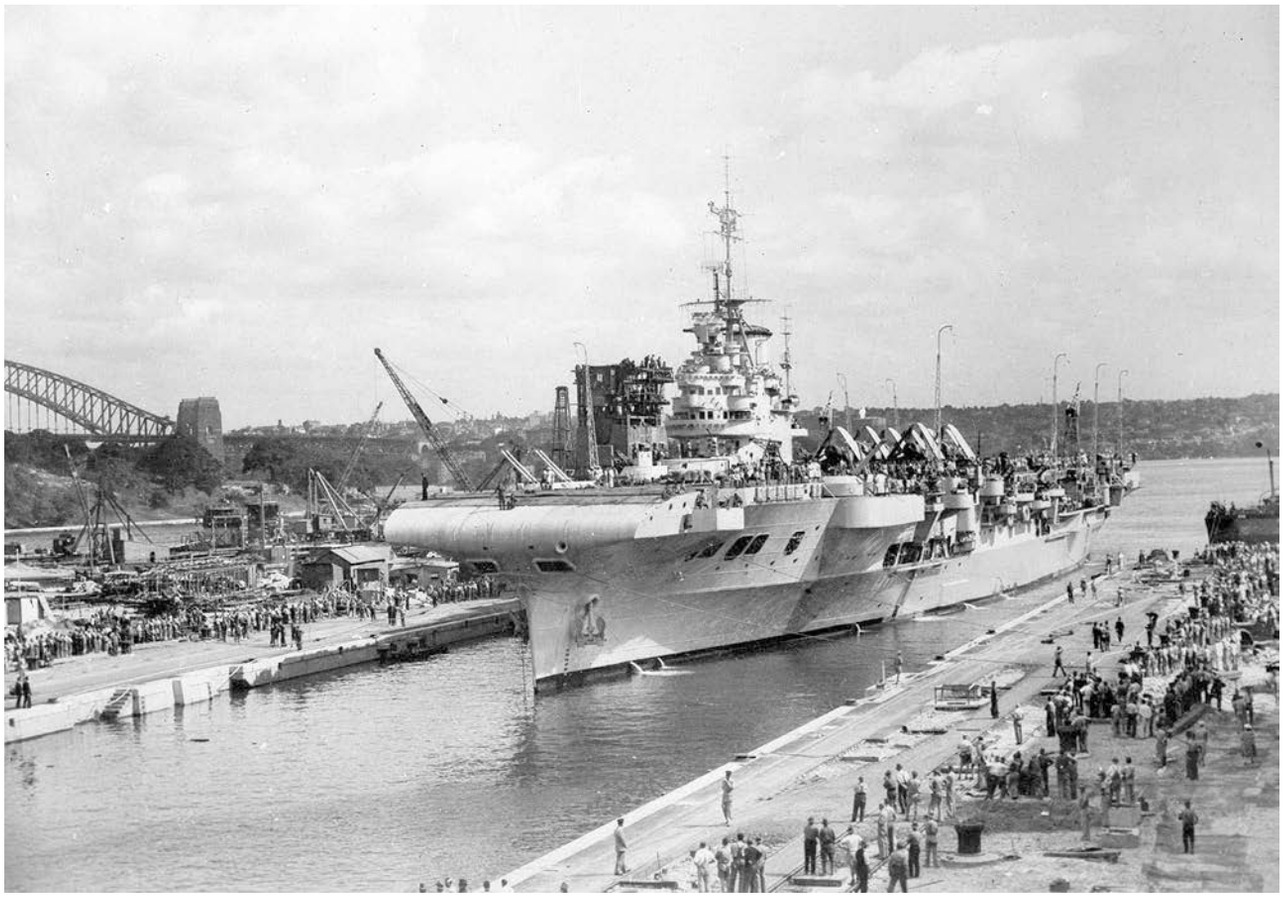
Construction of the cofferdam began in January 1941 and the site was dewatered by February 1942. Excavation of the site began in April 1942, and the first concrete was poured in October.

The construction of the dock was one of the greatest engineering works undertaken in Australia at the time. By the time it was completed in March 1945, 240 076 m^3 of concrete had been used, 658 172 m^3 of material removed by dredging or excavation, and 1 016 755 m^3 of rock, clay and other back-fill material consumed. At the peak of construction activity in mid-1943 4125 men were employed at the site.

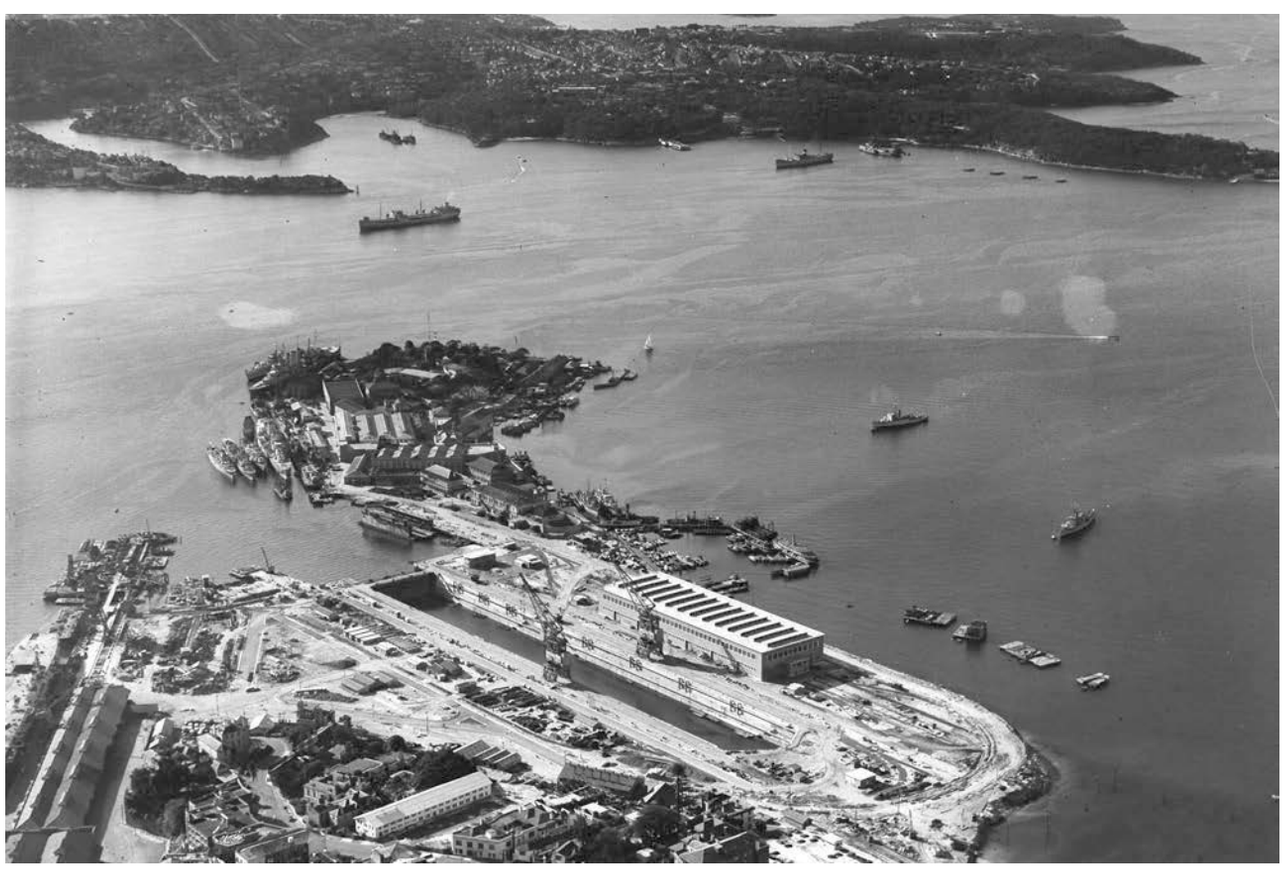
After March 1945 the dock was soon busy in the role for which it was intended. Final construction work, which included the construction of the Fitting Out Wharf and the erection of a 250 ton (254 t) hammerhead crane was completed by June 1950 at a total cost for the project of £10 558 349 ($760.9 million in today's dollars).

Since 1945 over 2000 dockings have been completed in the Captain Cook Graving Dock and, with the closure of other large docks on Australia's east coast in recent decades, it remains a major national strategic asset.

Progress on the construction of the graving dock in August 1943, showing the massive construction of the dock's concrete walls. Work continued around the clock, at night under bright lights, some visible in the foreground
(Sydney Water Collection)



The first ship to use the new graving dock was the Royal Navy aircraft carrier HMS *Illustrious* which required urgent repairs. She entered the dock on 1 March 1945 and was docked down the following day
(Naval Historical Society of Australia)



The Captain Cook Graving Dock in 1946. The construction of the fitting out wharf (on the left) is incomplete and the erection of the 250 ton (254 t) hammerhead crane has not yet begun. Today the dock remains the only one in Australia which can dock all the ships of the RAN and many visiting commercial vessels
(RAN Historical Collection)

James Craig aglow with light against a smoky sky on the evening of SMIX Bash 2019 (Photo John Jeremy)