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THE NAVY

THE MAGAZINE OF THE NAVY LEAGUE OF AUSTRALIA

A CORVETTE BY ANY OTHER NAME

RETENTION IN THE ADF

SURFACE FLEETS: FLEXIBLE RESCALING

MARITIME TRADE OPERATIONS TEAM 1

HMS FIJI AGAINST THE LUFTWAFFE

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Volume 82 No.1

THE NAVY

THE MAGAZINE OF THE NAVY LEAGUE OF AUSTRALIA

Front cover:
HMAS SIRIUS (AO 266) conducts RAS with KD LEKIU (F30) and KD KELANTAN (F175) from HMAS STUART (F153) Exercise MASTEX 19 East Asia Deployment (LSIS Tara Byrme).

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HMS ANTELOPE (F170) Explodes 24 May 1982 - We Will Remember.

2020 – A HINGE YEAR

This first issue of *The NAVY* in 2020 begins with an important paper by John Jeremy AM on Corvettes; their historical development, and potential application today with specific regard to the Commonwealth Navies. Picking up, in some regard, from where David Hobbs completed his two-part series on 'Rebuilding the Commonwealth Navies' (*The NAVY*, Issue 81, No. 3 and 4, Jul-Sep and Oct-Dec 2019). The second paper is by Mark Linden (Second Prize, Essay Competition, Professional Section), regarding the development of Maritime Trade Operations (MTO) as 'a contemporary capability specifically designed [by Navy] to engage with maritime industry, coordinate operations involving maritime commercial interests and protect merchant shipping'. This is an important strategic development by Navy, in which significant interest is being expressed by Allied Navies, including the USN, RN, and JMSDF. In some respects, it is a return to what Navies used to do during the Cold War – and when there was a recognised need to preserve skill sets necessary to sustain maritime trade and retain shared awareness between navies and merchant marines.

Maintaining the theme, the paper by Jim Hutton OBE considers retention in the ADF – applying different generational theory approaches from a Defence and Maritime perspective. The paper concludes, that the second 'most common reason people [leave] …were found to be a lack of motivation, job satisfaction and poor leadership'. The changes envisioned by the first three papers require to be led effectively, if they are to deliver – be it retention, new ship designs, or maritime trade operation capabilities. If we cannot retain the skills we have lost through poor retention – any amount of recruiting will not fill the knowledge gaps.

The final paper is by Peter Cannon (First Prize, Essay Competition, Professional Section), and considers HMS FIJI's valiant fight and ultimate loss against the Luftwaffe. Peter's paper is significant, in reminding us that losses will be taken in peer-on-peer conflict, and that navies will need to be tough enough to keep on fighting, even after ship's have been lost. This takes a level of mental toughness beyond resilience – essential if we are to sustain effective fleets at times of war.

Unusually, in Flash Traffic, consideration is given to re-scaling Surface Fleets, through a Enterprise Limited Liability Partnering arrangement proposed (for the UK – but equally relevant to Australia) by the ANSON Team. This provides for a commercial relationship with Admiralty/ Navy and a commercially disciplined "point-to-multi-point" Fleet procurement arrangement, including: installation of exchangeable and flexible modules; a constant upgrade programme; and new, new-build and further technical changes "plumbed in" to a bigger system. The proposed Enterprise Fleet, operating under a new Red Ensign investment rate regime – is designed to provide further incentives for the institutional investment in the Merchant Fleet available for commercial charter. Further profit-sharing arrangement would allow Admiralty to average down or ameliorate the costs of its own use of the vessel pool from its share of the revenues generated from the normal trading of the vessel. The Enterprise approach is designed to capture the benefits of the current industrialised trend to modularise and to deliver equipment and technology to meet desired capability.

The consideration of 2020 being a hinge year is based upon a number of factors, including recent public statements by both Chief of Defence Force (General Angus Campbell AO DSC) and Chief of Navy (Vice Admiral Michael Noonan AO RAN) identifying 2025 as being fundamental to ADF Preparedness. There is a temptation in some quarters to think of 2020 as being 1933 all over again, and there is six years before a major conflict. In 1932, HM Treasury's "10 Year Rule" had only just been invoked. Planners were thinking of 1942 (not 1939), and much planning was based upon a knowledge base honed during WW1, 'the war to end all wars', which ended only 15 years beforehand. A grimmer year to consider might be 1909, after years of relative peace and prolonged Grey Zone type operations; including the Boer War, in the Middle East and on the Khyber Pass.

Kaiser Shipbuildign Yard - Building Liberty in 1943.

Construction begins on the new smart city of Clark City (on the former US Clark Base) in the Philippines.

The knowledge base between 1914 and 1918 had to be reconstructed to enable people to think at the scale and numbers necessary to fight a global war, against a powerful continental power – with a significant, modern Navy.

If a health of the nation audit was undertaken today, the Australian record sheet would not look good. Commissioner Hayne of the Banking Royal Commission found:

> There can be no doubt that the primary responsibility for misconduct in the financial services industry lies with the entities concerned and those who managed and controlled those entities: their boards and senior management.

Much of industry lies dormant; there is increasing instability in the building sector – exacerbated by delays; cost blow-outs; poor quality and swings in housing demand. CSIRO has been underfunded in recent years – and the Defence Science & Technology Organisation has become a "group", under a Chief Defence Scientist seemingly remoted from the Chiefs, the science, and group. In education, Australia has slipped down the PISA scales to rate below developing nations, and poorly amongst other English-speaking/regional/ Indo-Pacific nations such as Canada, South Korea and China. The ranking of Australia's top universities lies low on international ratings – Australia's top 5 universities ranking, on average, in the top 60, below top 5 Japanese, Chinese, European, UK, and U.S. universities. Meanwhile, three separate Parliamentary inquiries are examining different aspects of operations by the big four consulting firms, including:

- quality of corporate audits;
- relationships between the auditing and consulting arms;
- competition in the audit market;
- roles in detecting fraud and misconduct;
- use of outsourcing providers, contractors and consultants;
- hiring of former ministers.

The PM's shake up of ministries and the hiring and firing of some senior public servants may go some of the way – but there is a sense of deck-chairs being shuffled on the deck of the Titanic, rather than designing a different ship and navigating it to a better place. The gap between those happy to assume authority and those willing to accept responsibility for taking decisions, appears wider than ever. Paraphrasing UK Prime Minister Stanley Baldwin in 1931:

> Authority without responsibility – the prerogative of the harlot throughout the ages.

The NAVY has argued for many years, that there are skill sets and capabilities within Australia, including amongst Gen Zed, that can be harnessed and brought to effect over the next 15 years. This will require the retention of the knowledge of those about to retire – due largely to the way the Western World (applying the consulting models provided by the big four (plus 1)) has stripped knowledge and asset from the public commons including Defence, research, industry, Government, schools and Higher Education – and the bootstrapping of middle management into more senior positions. It can be done, and has been done before – for example U.S. shipbuilding during WW2. This will require leadership and, as argued in the previous editorial, thinking what we would do at war, and doing it today. Waiting 15 years is not an answer.

In many regards, China's / Chinese Communist Party (CCP) thinking is years ahead of the Global West. China is experimenting, for example: creating/ nurturing new smart cyber-cities and their associated political economic entities (up to 20 a year); commissioning 1.3 nuclear and 5 coal power stations a year; developing new weapons/ applications; and pioneering future ICT/ Quantum technologies. When was the last new city the Global West built – how would/ could the democracies compete on such a scale? For compete the West must, if it is to mobilise to deter and prevent war – rather than having to fight through lack of choice.

This returns to 2020 as a hinge year. If Australia is to mobilise its people, knowledge, capability and industry at the scale required before 2025, for 2025, it is going to have to:

1. Think / lead differently, today – applying best programme management/engineering build designs practices; and
2. Take grand/national strategic level decisions in 2020.

2020 is a hinge year for the Global West – probably more like 1909 than 1933. *The NAVY* has long advocated an increased size of Navy complement. It is likely to be more like 25,000 plus Reserves (not 20,000) by 2030 – for which both recruitment and retention will be key. The sooner this is recognised, the sooner detailed planning can begin. The clock is not yet started. ■

STATEMENT OF POLICY

For the maintenance of the Maritime wellbeing of the nation.

CURRENT AS AT 1 JANUARY 2020

The Navy League is intent upon keeping before the Australian people the fact that we are a maritime nation and that a strong Navy and capable maritime industry are elements of our national wellbeing and vital to the freedom of Australia. The League seeks to promote Defence self-reliance by actively supporting defence manufacturing, research, cyberspace, shipping, transport and other relevant industries.

Through geographical necessity Australia's prosperity, strength, and safety depend to a great extent upon the security of the surrounding seas and island areas, and on unrestricted seaborne trade.

The strategic background to Australia's security is changing and in many respects has become much less certain following increasing tensions, particularly in East Asia involving major powers, and in Europe and the Middle East. The League believes that Australia should rapidly increase the capability to defend itself, paying particular attention to maritime defence.

The Navy League:

- Believes Australia can be defended against attack by other than a major maritime power and that the prime requirement of our defence is an evident ability to control the sea and air space around us and to contribute to defending essential lines of sea and air communication with our allies.
- Supports a continuing strong alliance with the US.
- Supports close relationships with all nations in our general area particularly New Zealand, PNG and the South Pacific island States.
- Advocates the acquisition of the most capable modern armaments, surveillance systems and sensors to ensure technological advantage over forces in our general area.
- Advocates a strong deterrent element in the ADF enabling powerful retaliation at significant distances from our shores.
- Believes the ADF must be capable of protecting commercial shipping both within Australian waters and beyond, in conjunction with allies.
- Endorses the development of the capability for the patrol and surveillance of all of Australia's ocean areas, its island territories and the Southern Ocean.
- Advocates Government initiatives for rebuilding an Australian commercial fleet capable of supporting the ADF and the carriage of essential cargoes to and from Australia in times of conflict.
- Notes the Government intention to increase maritime preparedness and gradually increase defence expenditure to 2% of GDP, while recommending that this target should be increased to 3%.
- Urges the strength and capabilities of the Army (including particularly the Army Reserve) and Air Force be enhanced, and the weaponry, intelligence, surveillance, reconnaissance, cyberspace and electronic capabilites of the ADF be increased, including an expansion in its UAV capability.

As to the RAN, the League, while noting vital national peacetime tasks conducted by Navy, including border protection, flag showing/ diplomacy, disaster relief, maritime rescue, hydrography and aid to the civil power:

- Supports the maintenance of a Navy capable of effective action in hostilities and advocates a build-up of the fleet and its afloat support elements to ensure that, in conjunction with the RAAF, this can be sustained against any force which could be deployed in our area of strategic interest.
- Considers that the level of both the offensive and defensive capabilities of the RAN should be strengthened, in particular with a further increase in the number of new proposed replacement frigates and offshore patrol vessels, noting the need to ensure essential fuel and other supplies, and the many other essential maritime tasks.
- Recommends bringing forward the start date of the replacement frigate program to both strengthen the RAN and mitigate the local industry capability gap.
- Recommends the timely replacement and increase in numbers of the current mine-countermeasure force.
- Strongly supports the early acquisition of large, long range and endurance, fast submarines and notes the deterrent value, reliability and huge operational advantages of nuclear powered submarines and their value in training anti-submarine forces.
- The League is concerned at the very long time before the projected 12 new conventional submarines can enter operational service, noting very serious tensions in the NW Pacific involving major maritime powers.
- Recommends very early action to provide a submarine base on the Eastern seaboard.
- Notes the potential combat effectiveness and flexibility of the STOVL version of the Joint Strike Fighter (F35 Lightning II) and supports further examination of its application within the ADF.
- Supports the development of Australia's defence industry, including strong research and design organisations capable of the construction and maintenance of all warships, submarines and support vessels in the Navy's order of battle, and welcomes the Government decision to provide a stable and continuous shipbuilding program.
- Advocates the retention in maintained reserve of operationally capable ships that are required to be paid off for resource or other economic reasons.
- Supports a strong and identifiable Naval Reserve and Australian Navy Cadets organisation.
- Advocates urgent Government research and action to remedy the reported serious naval recruiting and retention problem.

The League:

- Calls for a bipartisan political approach to national defence with a commitment to a steady long-term build-up in Australia's defence capability including the required industrial infrastructure.
- Believes that, given leadership by successive governments, Australia can defend itself in the longer term, within acceptable financial, economic and manpower parameters.

THE NAVY LEAGUE ANNUAL CONFERENCE

On 25 and 26 October 2019 the Navy League met in Canberra for our Annual General Meeting and a meeting of the Federal Council of the League.

The programme was well attended by our members and Navy. The Chief of Navy was represented at the meeting by the Director of the Sea Power Centre, Captain Sean Andrews RAN, who gave a broad ranging and engaging presentation on governance invested in Navy capability and current issues affecting the Navy. If time had not been an issue I've no doubt the Q&A session could have extended well into the afternoon and we thank CN and Captain Andrews for supporting the Navy League in this way.

The Maritime Commander was also represented at the Federal Council meeting, noting he was unavailable due to other commitments interstate. Commodore Matt Buckley CSC RAN, the Director General Maritime Operations, was able to draw on his broad experience including as a submariner in the Oberon and Collins classes, with the Royal Canadian Navy's submarine force, as Commanding Officer of HMAS COLLINS and Commander of the RAN Submarine Force. His presentation focussed on his role as DGMAROPS, the provision of 'the right forces at the right time, capable of fighting and winning at sea', an overview of major exercises and operations locally and internationally, and a very enthusiastic acceptance of questions and candid answers which drew much appreciation from the meeting. Thankyou Commodore Buckley.

The submarine theme continued with a presentation from Christopher J Skinner, our esteemed guest, retired RAN Captain and long serving naval engineer. Captain Skinner assisted the advancement of our discussion from last AGM (one that has been going on for over a decade in the League) on the theme of nuclear propulsion. His latest paper on the issue was published in The Navy last year and I encourage you all to revisit it. Thanks Chris for a great presentation and for all your work advancing this most important issue. Well done.

THE NAVY LEAGUE OF AUSTRALIA ANNUAL MARITIME AFFAIRS ESSAY COMPETITION

Also discussed at the Navy League annual conference were the Annual Maritime Affairs essay competition entries. The winners were announced to the meeting and the winning papers will be published in The Navy in this and over the next few editions. As you read the essay competition winning entries you will no doubt be reminded of the depth of talent in our membership, readership and the broader Defence community.

Congratulations go out to all of those who entered the competition. As in previous years the field of entrants has been an international one and awards have been made both to local and overseas entrants. As you would be aware there are two prize categories, the professional category, which covers journalists, Defence officials, academics, Navy personal and previous contributors to The Navy and the Non-Professional category. Special congratulations go out to our prizewinners.

First Prize in the Professional category was awarded to Peter Cannon for his essay HMS FIJI against the Luftwaffe: Crete, 22 May 1941 which is a fascinating read that I commend to you all. Second Prize in the Professional category was awarded to Mark Linden for his essay Maritime Trade Operations another very deserving entry. Third Prize in the Professional category went to Geoff Crowhurst for his essay Command Decisions during the Battle of the River Plate which is indicative of the quality of entries received.

In the Non-Professional category First Prize this year was awarded to Jonathan Wilson for his essay The Spectre of Autonomy. Well done Jonathan and keep up the good work. Second Prize in the Non-Professional category was awarded to our friend from across the ditch Murray Dear, for his essay First Away.

PROFESSIONAL CATEGORY

Title	Author	Place
HMS Fiji against the Luftwaffe: Crete, 22 May 1941	Peter Cannon	1ST PLACE
Maritime Trade Operations	Mark Linden	2ND PLACE
Command Decisions during the Battle of the River Plate	Geoff Crowhurst	3RD PLACE

NON-PROFESSIONAL CATEGORY

Title	Author	Place
The Spectre of Autonomy	Jonathan Wilson	1ST PLACE
First Away	Murray Dear	2ND PLACE

As well as providing fascinating reading and an insight into some events that are likely not known to many, I hope reading these essays will encourage many of you to begin research for and writing of your entry for the 2020 essay competition. The deadline, usually in late August, will be upon us before you know it – so get started now and be in the running for a great prize and the potential for your essay to be published in a future edition of The Navy Magazine.

We look forward to your feedback on the essays as they are published.

THE NAVY LEAGUE OF AUSTRALIA PERPETUAL TROPHY – COMMUNITY AWARD

The Navy League of Australia Perpetual Trophy – Community Award is an annual award made to the ship or establishment that has, in the opinion of the Federal Council of the Navy League made the best contribution to its community. The award was established in 1981, and for the last two years was in Western Australia having been won in consecutive years by HMAS STIRLING.

In 2019 many ships and establishments were nominated for the award and the hard work of each of them is worthy of commendation. The Federal Council's task of deciding on which ship or establishment should win was assisted by the Fleet Commander, who reduced those nominated to a shortlist. From that list, each of whom were also well-deserving of recognition, the Federal Council unanimously

chose HMAS CAIRNS as the Community Award winner.

HMAS CAIRNS has made an exceptional ongoing contribution to the Cairns and greater Far North Queensland region, particularly in the last year. The most impressive of the CAIRNS contributions to the region (which include activities across a geographical area between the Torres Strait and Rockhampton) being its support of Legacy, for which the Commanding Officer was appointed Honorary Patron of Cairns Legacy, and for being Australian Red Cross No. 1 Donor Organisation for the Cairns Region for the second year in a row. BZ CAIRNS.

Three RAN *Attack-class* Submarines in Formation (Image Naval Group).

LIFE MEMBERSHIP – MASON HAYMAN

The Federal Council took pleasure in awarding Mason Hayman Life Membership of the Navy League at its meeting in October. The Western Australian Division reminded us of Mason's tireless efforts and longstanding commitment to the League. Mason joined the League in 1987 and, as many of you will know, is a former President of the WA Division, has provided outstanding service to the Navy League of Australia and the WA Division during his membership of over thirty years and continues to be an active member of the Executive of the WA Division. We thank Mason, and acknowledge the support he (and the Division) received from his wife Margaret in the role. Well done Mason.

IN THIS ISSUE

In this issue we have a great read from our Senior Vice President John Jeremy AM On Corvettes which should be compulsory reading for all Australians. In addition, we have the first and second prize winners from the professional section of our annual essay competition which you should all enjoy. There is also plenty of other wonderful reading to stimulate your mind as well as our Statement of Policy which I encourage you all to revisit.

I trust you will enjoy reading these articles and, as always, encourage your feedback.

Happy reading. ■

THE 20TH ANNUAL

CRESWELL ORATION

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A CORVETTE BY ANY OTHER NAME

By John Jeremy AM

This Paper asks the question "What is a corvette?", with the view to shaping future navies. Admiral W H Smyth in his Sailor's Word Book of 1867, helpfully defines 'corvette' as: "Flush-decked ships, equipped with one tier of guns: fine vessels for warm climates, from admitting a free circulation of air." The Oxford English Dictionary agrees, noting the term's use since 1636, adding "now, a small naval escort vessel."

The term 'corvette' was quite widely used during the 19th century. It described a ship which roughly fitted between a sloop and a frigate. Royal Navy ships on the Australia Station were commonly corvettes, like the 60 m long screw corvette HMS PEARL, which was Flagship of the Australia Station from 1873 to 1875.

HMS PEARL, Flagship of the Australia Station, 1873 to 1875.

INTRODUCTION

A well-known Royal Navy Corvette to visit Australian waters in the 19th Century was HMS BACCHANTE. Completed in 1876, BACCHANTE was a 4,000 ton 85 m long screw-propelled ironclad which became famous for being the ship in which two grandsons of Queen Victoria both served as a midshipman. Princes George and Albert spent three years in the ship between 1879 and 1882 patrolling the British Empire.

HMS CALLIOPE, survivor of the 1889 storm at Apia in Samoa, was another famous "corvette", or third class cruiser as many became known. The classification "corvette" went out of use around the turn of the century until it was revived during the Second World War.

For many people of a certain age, the term "corvette' may today conjure up an image of HMS COMPASS ROSE battling the Cruel Sea. In his novel published in 1951, Nicholas Monsarrat graphically describes life on the North Atlantic during World War II in a small warship, designed and built in a hurry to meet an urgent need, a *Flower class* corvette.

NEEDS MUST

Based on World War I experience, there was a perceived need for anti-submarine ships capable of coastal escort and minesweeping. The conversion of whale-catchers was considered, but among the alternatives was a proposed new design based on the whale-catcher *Southern Pride,* built by Smith's Dock. This design became the *Flower-class* patrol vessel – whaler type, which was later classified as corvette. Many of these simple ships, which were built to commercial standards, were completed — 145 in the United Kingdom and 93 in Canada. Some of these ships also served in the US Navy.

These small ships, originally intended as coastal escorts, were soon fighting the Battle of the Atlantic in seas for which they were really too short. Habitability was dreadful and the crews suffered greatly from fatigue and seasickness. The later twin-screw corvette design, which became the *River class* frigate, was much more suited to North Atlantic conditions and the developments of this design, the Loch and Bay classes, designed for prefabricated construction, were even better and more effective anti-submarine ships. A larger corvette based on the *Flower-class* but more suited to ocean service, was proposed by Smith's Dock in 1942. Initially turned down by the Admiralty, a modified design was approved in May 1943. These 76 m long ships of the Castle class were a vast improvement on the Flower class and 39 ships were completed.

The influence of size on the effectiveness of warships is often overlooked in efforts to have more hulls for the available money and resources. The *Flower-class* corvettes, for example, were quite safe at sea but pitch and heave motions were too high for their crews to work satisfactorily. Modern seakeeping theory has been used to estimate the percentage of lost operational time due to motions in bad weather. For the Flower-class corvette the figure is 28%, for the Castle class 21%, for the *River* and *Loch-class* frigates the figure is 15%. For comparison, the lost time for the post-war Type 12 design is 9% [Brown, D K (1996)]. These comparisons are as valid today as they were at the end of World War II.

The United States built a very large number of coastal and ocean escort ships during the Second World War — nearly one thousand ships of the patrol craft, patrol frigate (based on the RN *River class*) and destroyer escort types. The first was the patrol craft (PC), of which 286 were completed. Whilst intended for a similar coastal role, these ships were quite different in design concept from the British corvettes. Smaller in length and beam (52.7 m by 7 m) they also proved to be of limited value for ocean work and were most useful for coastal patrol and escort work. The later, slightly larger PCE was a much more efficient vessel despite a tendency to roll.

HMS CANDYTUFT as USS TENACITY.

MARITIME PROTECTION AND PREVENTION

In Australia today we are very conscious of the need to protect our maritime approaches against unwanted incursion and illegal activities. This need is not new. In the late 1930s two vessels were built for the Commonwealth to protect our northern approaches. One was a 45 foot high-speed motor launch, *Larrakia*, which, armed with a Vickers machine gun, was intended to serve as an air-sea rescue launch as well as a patrol vessel to combat illegal fishing. The other was the patrol vessel *Vigilant*. *Vigilant* was designed for the Department of Trade and Customs by the well-known naval architect Cecil Boden and built at Cockatoo Island in Sydney. She had the distinction of having been the first Australian-built ship to use aluminium as a structural material – it was used for all superstructure forward of the funnel. *Vigilant* was 31 m long, had a maximum speed of 14.5 knots and was armed with a 3-pounder gun. She was roughly the same size as the *Attack-class* patrol boats of the 1960s. During the coming war she was commissioned in the RAN as HMAS VIGILANT, then SLEUTH and finally HAWK and was based in Darwin.

Cockatoo Dockyard in Sydney was designated as the lead yard for the *Bathurst-class* LDVs and ultimately sixty of these useful little ships were built for the Royal Navy, the Royal Australian Navy and the Royal Indian Navy. All except the Indian ships were manned by the RAN and commissioned as Australian ships. The program was also instrumental in reviving the Australian shipbuilding industry.

Interestingly, the classification of the ships as Local Defence Vessels was said to cause confusion in Britain and the ships were reclassified in 1940 as Australian Minesweepers (AMS) *Bathurst class*. Unofficially, however, they were called 'corvettes', although never classified as such.

The *Bathurst-class* ships were rather small. At 56.4 m in length they were smaller than the *Flower-class* corvettes and notoriously uncomfortable at sea. Like most of the war-built corvettes and small minesweepers most had very short operational lives. Some were kept in commission after the war as training ships, some were transferred to depleted allied navies but most were ultimately scrapped. A couple survive today to remind us of these small hard-worked ships.

POST WAR RE-CONCEPTUALISATION

In the years following the war, major western navies concentrated on the design of new or converted anti-submarine ships capable of matching the high-speed submarine which had rendered most of the frigates and destroyer escorts built during the war obsolete. The perceived need was for ocean escorts built to designs suitable for a re-run of the Battle of the Atlantic. Some outstanding designs were developed, like the British first-rate anti-submarine frigate (FSA), the Type 12 frigate and, somewhat later, the US Patrol Frigate, which was reclassified as guided-missile frigate (FFG). Over 140 ships of both designs were ultimately built.

The new ships were expensive to build, and Britain also developed a small dedicated anti-submarine frigate intended as a convoy escort which could be built in large numbers. This was the second-rate anti-submarine frigate (FSB), or Type 14 Utility Frigate. Whilst a good anti-submarine vessel, at 1,320 tons full-load displacement with a length of 95 m they proved, once more, to be rather small for ocean work. Habitability was poor and the ships were structurally weak. In later years they were employed in fisheries protection duties for which they were not suited earning the unofficial classification of Type 14 Futility Frigates.

For Britain, the drivers for change were the Cod Wars, a series of confrontations with Iceland over fishing rights in the North Atlantic between 1958 and 1976. The clashes resulting from British attempts to protect trawlers fishing in areas claimed as exclusive territory by Iceland were expensive for the Royal Navy which deployed frigates on the task. Despite substantially outnumbering the Icelandic patrol vessels, some serious clashes ensued which demonstrated how unsuited Type 12 and Type 14 frigates were for close quarters encounters with small robust patrol vessels.

With lessons of the Cod Wars and the adoption of 200 mile exclusive economic zones, the Royal Navy acquired a number of *Island-class* patrol vessels to form a Fishery Protection Squadron to patrol Atlantic fishing grounds and the oil and gas fields of the North Sea. These single-screw, 59 m long, 1,280 ton vessels had a speed of 16 knots and a complement of 35. Cheap and simple, they served the navy well for three decades and most survive today, mainly in the navy of Bangladesh.

ISLAND RETHINKING

The *Island class* ships were very similar to the Flower-class corvettes and suffered from similar vices. In 1976, the RN began the design of a class of offshore patrol vessels to succeed the *Island class* ships. Driving factors in the design were improved seakeeping, a bit more speed, and the desire to be able to land a large helicopter like the Sea King for rescue purposes. Provision of a hangar to enable the ship to embark an organic Lynx helicopter was considered but rejected because the landing deck would then be too small for the larger aircraft and the Lynx would, in any case, likely cost more than the ship!

A length of 80 m was initially selected, but later studies suggested that 75 m would be sufficient to limit the amplitude and frequency of the ship's motions to an acceptable level outside the range most

A Bathurst-class survivor - HMAS CASTLEMAINE (J244).

RAN Ton-class minesweepers - HMAS TEAL (M1152) nearest ship.

likely to cause seasickness. The bridge and accommodation were also located as close to amidships as possible.

Originally six ships were planned but only two were built – *Leeds Castle* and *Dumbarton Castle*. They were built as far as possible to commercial standards. At 75 m long with a beam of 11.5 m and draught of 3.4 m they were almost exactly the same size as the *Castle-class* corvettes of World War II. They were twin screw ships powered by diesels for a speed of about 20 knots and a remarkably long range of 10,000 n miles at 12 knots. They became very effective Falkland Islands guard ships and survive today as corvettes in the navy of Bangladesh.

The *Island-class* offshore patrol vessels were replaced early this century by three *River-class* OPVs which were leased from Vosper Thornycroft, their designer and builder, although subsequently purchased outright. They are 79.5 m long twin-screw ships with a speed of 20 knots and a range of 5,500 n miles. Their complement is 30 persons but, like most modern OPVs, they have additional accommodation for embarked forces or other personnel. A fourth ship was chartered from VT in 2005 to replace the two *Castle-class* ships in the South Atlantic. HMS CLYDE has a slightly longer hull to accommodate a flight deck capable of handling a Merlin helicopter.

In 2013 the UK Government signed an agreement with BAE Systems to design and build three new OPVs to replace the earlier ships. These ships are intended to be capable of counter-terrorism, counter-piracy and anti-smuggling operations worldwide. They are fundamentally different from the earlier *River-class*. They are 90.5 m long, have a large flight deck, a top speed of 25 knots and displace around 2,000 tons. HM Ships FORTH, MEDWAY and *Trent* will be joined in due course by two more, TAMAR and SPEY. Whilst these ships were planned to replace the earlier *River-class* OPVs, it is now intended to keep them in service to meet fishery protection demands post-Brexit.

The need for a smaller, flexible warship was brought home to the Royal Australian Navy during the Malaysia–Indonesia confrontation in the early 1960s. Australia committed destroyers, frigates and the recently-purchased *Ton-class* minesweepers to the Far East Strategic Reserve which became engaged in anti-insurgency patrols. These patrols were demanding and tedious with HMAS TEAL, for example, spending only 46 of 245 days in harbour during her 1964–65 deployment.

The *Ton-class* ships were not designed for the type of work thrust upon them and they were expensive to maintain. This experience resulted in the re-introduction of small patrol vessels to the RAN, the *Attack-class*, and plans for the development of an Australian light destroyer (DDL) which could be built some numbers and in variants for different roles. The DDL was initially planned to be a fast, simply armed ship smaller than the normal destroyer, at around 1,500 tons displacement, to back up patrol craft in anti-infiltration and patrol duties. Twenty ships were proposed.

FUNCTION CREEP AND FEATURISM

During 1967 and 1968 the size of the ship grew and the DDL was seen as a replacement for the existing destroyers rather than an addition to the naval force. An embarked helicopter was also seen as being desirable. By the time the design was revealed to the intended builders, Cockatoo Dockyard and HMA Naval Dockyard Williamstown, in 1968, the ship had grown to around 2,100 tons displacement with six ships to be built, three in each yard. Discussions were held with the RN to explore the possibility of joint development of the design but there were too few common requirements and the RAN proceeded independently. By the time the DDL project was cancelled in 1973, the ship had grown into a highly-capable general-purpose ship of 4,200 tons displacement with a length of 128.8 m, fitted with a 5-inch gun, the US Tartar (later Standard) missile and two helicopters. The DDL had become anything but a light destroyer, or corvette as it would possibly have been classified today.

Throughout the world, the small affordable warship presented market opportunities to well-established naval shipbuilders. Some very capable ships were built during the 1960s and 1970s, the Vosper Thornycroft Mk 5 frigate is a good example and very similar to the light destroyer as originally conceived for the RAN. Built for pre-revolutionary Iran, the ships had a displacement of 1,372 tons and a length of 94.5 m. With CODOG propulsion they could achieve a speed well over 30 knots.

Fremantle-class patrol boat HMAS CESSNOCK (P210).

Another private-venture design of the early 1970s was the Vickers Vedette. When this ship was conceived, in 1968, the rising cost of warships was demanding a new approach — to design smaller yet capable ships which were also adaptable to different navy's needs. The target displacement was about 1,000 tons. It was also important that the ship have a genuine ocean-going capability. The design as completed was for a small warship with a displacement of around 1,275 tons full load, length of 77 m, beam 10 m and draught up to 3.5 m. The ship could be propelled by diesels only for a maximum speed of 26 knots or with CODOG propulsion (two diesels and one gas turbine) for a maximum speed of 33 knots. The range was up to 6,000 n miles and the complement a maximum of 81.

In the early 1970s the Vedette was offered to Indonesia by a consortium comprising Vickers UK, Vickers Cockatoo Dockyard Pty Ltd in Sydney, and Brooke Marine in England. The ships were to be built by Brooke Marine and Vickers in the UK, with support from Australia, where construction proved to be too expensive. The competition was Vosper Thornycroft and a Dutch yard. Unfortunately support to the British bids from the UK Government was less imaginative than that of the Netherlands Government, and the Dutch yard won the contract.

Arafura-class Offshore Patrol Vessel.

When the DDL was cancelled, the RAN conducted a review of all available options for alternative designs, although it was clear that the main contenders capable of meeting the RAN's requirements were either a heavily-modified British Type 42 destroyer or the US patrol frigate. Nevertheless, Vickers offered the Vedette to the RAN noting how similar it was to the original concept of the DDL. The Vedette designs as developed in the UK had little commonality with existing or planned Australian weapons and equipment, so two new versions of the Vedette were designed in Australia, one without a helicopter but with the US 5-inch Mk 45 gun and US electronics, the other with an organic helicopter which took advantage of a novel hangar design.

UNDER THE RADAR

Meanwhile, the RAN had built 20 *Attack-class* patrol boats which were unsupported by the large patrol combatant original conceived. Whilst the Attack-class patrol boats, designed in Australia, were fine vessels, they were asked to do much more than they were originally designed for. In the mid-1970s the RAN set out to acquire a larger and more capable patrol vessel to replace them. Two companies were invited to carry out a project definition study — Brooke Marine of the UK with their 42 m patrol boat and Lürssen of Germany with their 45 m FPB 45 design. In 1978 the Brooke Marine design was selected and the lead ship, HMAS FREMANTLE, was built in Lowestoft and completed in 1980. The remaining 14 were built by NQEA in Cairns.

The *Fremantle-class* patrol boats had steel hulls and aluminium superstructures, were 42 m long, displaced 250 tons and were powered by diesels for a maximum speed of 24 knots and range 2,360 n miles at 12 knots. The complement was 24.

Whilst HMAS FREMANTLE and her sister ships were a considerable improvement on the *Attack class*, they were still small ships for their wide-ranging role of fisheries protection, immigration, customs and drug law-enforcement operations. Plans to replace the ships were being developed in the mid-1990s when a Malaysian requirement for a patrol vessel of similar capability arose. The Australian Government agreed to support a joint acquisition with Malaysia and to provide $12 million for initial design work for Transfield Shipbuilding (Williamstown) which was among the shipbuilders in discussions with Malaysia. A common design was subsequently agreed for an 80 m long, 1,250 ton vessel which had helicopter capability. Whilst there were suggestions that Australia would spend too much on ships which were bigger than needed if the project went ahead, the Government continued to support the Joint Patrol Vessel right up to the Malaysian decision in October 1997 to select an 1,850 ton ship offered by Blohm + Voss based on their MEKO 100 design.

Australia had nearly had a true Offshore Patrol Vessel. The design by Transfield (which became Tenix in 1997) had a length of 81.5 m, beam of 12.05 m and displacement 1,395 tons. Built entirely of steel to commercial standards, the ship was to be powered by diesels with twin screws for a maximum speed of 24 knots and a range of 3,500 n miles. Slow speed loitering was to be enabled by electric motors connected to each gear box. The complement was 84. Overall it was a fine small warship and remarkably similar to the Vickers Vedette which had been designed 20 years earlier.

21ST CENTURY REDESIGNS

Tenix subsequently built two similar ships for the Royal New Zealand Navy at Williamstown in Victoria as part of Project Protector, the RNZN's fleet renewal program in the early years of this century. HMNZ Ships OTAGO and WELLINGTON were built to a design by Vard Marine, which is now part of the Fincantieri group. Ordered in July 2004, delivery of the two ships was delayed by a dispute over excess weight, finally settled in 2009. Both ships were accepted in 2010 from BAE Systems which had acquired Tenix in 2008.

OTAGO and WELLINGTON are 85 m long with a beam of 14 m and displace 1,400 tons. Twin screws are driven by diesels for a speed of 22 knots and a range of 6,000 n miles. The complement is 35, or 45 with an embarked helicopter. There is also accommodation for 30 additional personnel.

Following the collapse of the joint project with Malaysia, a new project was begun in 1999 to replace the Fremantle-class vessels. After a competitive selection process, the bid by Austal and Defence Maritime Services for twelve vessels based on an enlarged version of Austal's Bay-class patrol boat was accepted in December 2003. The designs offered by industry were based on a performance specification leaving the tenderers to propose the number of vessels to meet the Commonwealth's requirements. Support and maintenance for the ships was to be provided for fifteen years after completion. Two additional vessels were ordered in 2005. The first ship, HMAS ARMIDALE, was completed in June 2005 and the last, HMAS GLENELG, was completed in October 2007.

The *Armidale-class* patrol boats have an overall length of 56.8 m and a beam of 9.7 m — coincidentally almost exactly the overall dimensions of the *Bathurst-class* minesweepers of World War II. The *Armidales* are, however, entirely constructed of aluminium and displace only 300 tons. They are propelled by two diesel engines for a maximum speed of 25 knots and a range of 3,000 n miles. The complement is 29 but there is also austere accommodation for additional persons. Overall they have improved seakeeping capability over the *Fremantle-class*, naturally, being larger and are designed to survive conditions up to sea state 9.

One of the class, BUNDABERG, was lost by fire during refit. The boats have been worked hard and have been deployed as far away as the Philippines on counter-terrorism patrols. Maintenance of the vessels has proved challenging and there have been structural

Keel laying of Arafura by Chief Navy Vice Admiral Michael Noonan RAN at ASC Shipbuilding Adelaide.

problems arising from fatigue. The class are being strengthened during major refits.

The 2009 White Paper proposed replacing the *Armidale-class* patrol boats and the mine warfare and hydrographic vessels with a single multi-role class of offshore combatant vessels of about 2,000 t displacement. The ships would use modular unmanned underwater systems for both mine countermeasures and hydrographic tasks. These systems were to be containerised and portable modules capable of being used in any port or loaded onto any of the offshore combatant vessels. The ships were to be able to undertake offshore and littoral warfighting roles, border protection tasks, long-range counter-terrorism and counter-piracy operations, support to Special Forces, and missions in support of security and stability in the immediate region. Embarked helicopters or UAVs were also to be considered.

By the time the 2013 Defence White paper was released, the modular multi-role offshore combatant had become a long-term objective and the *Armidale-class* were to be replaced by a vessel of proven design as an interim measure.

Meanwhile, Austal has continued to develop their patrol vessel designs, providing the (now) Australian Border Force with eight *Cape-class* patrol boats, slightly larger than the *Armidale-class*. To supplement the *Armidale-class* patrol boats while waiting for their future replacement, the RAN has chartered two additional *Cape-class* patrol boats from the National Australia Bank. *Cape Fourcroy* and *Cape Inscription* were initially chartered for three years, but this has since been extended to five years. The ships are operated by the RAN but designated Australian Defence Vessels (ADV). Austal has also been successful with an export order for two ships for Trinidad and Tobago for delivery towards the end of 2020.

Austal participated in the competition for Australia's new Offshore Patrol Vessel in association with the German shipbuilder Fassmer. The others in the competition were Damen of the Netherlands and Lürssen of Germany.

COMPROMISE BY DESIGN?

On 24 November 2017 the Government announced that the Lürssen design had been selected. The selected design, based on the Lürssen OPV80, is very similar to the *Darussalam-class* OPV of the Royal Brunei Navy, one of which visited Sydney for the International Fleet Review in 2013.

The new Australian ships will have a length of 80 m, a beam of 13 m and draught of 4 m. With a displacement of 1,840 t they will be propelled by diesel engines driving two shafts for a maximum speed of about 20 knots and a range of 4,000 n miles. The complement will be 40, although accommodation will be provided for up to 60 persons. They will be armed with a 40 mm gun and two .50 calibre machine guns and will have an Australian-developed Saab tactical combat management system with a Saab electro-optical fire control director.

The ships will have three boats — two side-launched 8.5 m sea boats and one 10.5 m stern-launched-and-recovered sea boat. They will also have a helicopter deck, but no hangar. Whilst it may be possible to deploy a manned aircraft for short periods, perhaps a maximum of three days, it is planned that the ships will in due course support a maritime unmanned tactical aerial system, perhaps like the US MQ-8B Fire Scout unmanned aerial vehicle or the US Navy's unique vertical take-off and landing UAV currently under development.

True small warships, the roles of the RAN's OPVs will include maritime border patrol, maritime constabulary duties including interdiction, fisheries patrol, humanitarian and disaster relief, mine hunting and hydrographic survey. Given that only twelve vessels are currently planned, to replace the *Armidale-class* patrol boats, they are likely to be very busy ships indeed. Twenty four ships would seem to be a more appropriate number. Shortly before the last election the Prime Minister announced that three mine-hunting and/or survey vessels would be built in Western Australia. Whether they turn out to be additional OPVs remains to be seen.

The new ships will be mainly built in Western Australia by Lürssen Australia in partnership with Civmec. However, in order to partly fill the gap between the end of the *Hobart-class* guided missile destroyer program and the start of construction of the *Hunter-class* frigates, the first two OPVs are being built in Adelaide by ASC Shipbuilding, now a subsidiary company of BAE Systems Australia.

Construction of the ships began in November 2018 and a ceremonial keel-laying of the first ship, the future HMAS ARAFURA, was held in Adelaide on 10 May 2019.

When completed, the RAN will have in service a type of small warship which is becoming very common throughout the navies of the world. Generally ranging in size between 60 and 100 m in length, these ships are usually classed as offshore patrol vessels or corvettes.

With the ever-escalating cost of modern frigates and destroyers, we are likely to see many of these small warships take their place in the navies of the world to undertake duties like those planned for the RAN ships. Whilst often described as offshore patrol vessels, the classification of corvette is becoming more common. Surely, it would be reasonable to describe our *Arafura-class* ships as modern corvettes, worthy successors to the small ships which proved so valuable three quarters of a century ago. ■

About the Author: John Jeremy AM is Editor in Chief *The Australian Naval Architect*, Journal of the Australian Division of the Royal Institution of Naval Architects. He is a past President of the Australian Division of RINA and was the last Chief Executive Officer of Cockatoo Dockyard (1981-91). He spent most of his working life on the island, beginning in 1960 as an apprentice ship's draughtsman and then qualifying as a naval architect at the University of NSW. He is Senior Vice President of the Navy League of Australia and Vice President of the Naval Historical Society of Australia.

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2ND PLACE

MARITIME TRADE OPERATIONS TEAM 1
A CONTEMPORARY CAPABILITY

By Mark W Linden

"Seaborne commerce & naval power are meshed together: merchant vessels provide the business of the sea, and naval vessels provide the security of the seas. For that reason…navies are…a key and inevitable component of trade security"

Vice Admiral Tim Barrett. *The Navy and the Nation (2017)*

Singapore Strait connecting with the Malacca Strait A critical SLOC.

INTRODUCTION

Australia is a maritime nation reliant on trade. Sea Lines of Communication (SLOC) directly affect our economy, our resources and our concomitant ability to field and sustain a credible maritime deterrent. The traditional definition of SLOC is defined by merchant shipping transiting along established trade routes, however a new line of thought is that SLOC also reflects 'sea lines of commerce' including not only merchant ships, but submarine cables laid across the seas that are also fundamental to our national security and economic prosperity. One of the Navy's fundamental roles is to ensure Freedom of Navigation (FoN) along Australia's SLOC. As presently demonstrated in the Straits of Hormuz, if an antagonist disrupts commercial shipping, the Navy is called upon to minimise the strategic impact by deploying a presence in the form of a deterrent or a form of sea denial. However, the size of our Navy likely precludes sea control due to our vast maritime geography.

In terms of trade, 99 per cent of our international trade is transported by ship whilst Australian ports manage 10 per cent of the world's sea trade. 56 per cent of the word's iron ore and 30 per cent of the world's coal was exported from Australian ports in 2018. In other commodities, 25 million 20-foot Equivalent Unit (TEU) containers transited the Europe-Asia-Europe trade routes through the South China Sea. [1] These trade routes intersect with Australia's SLOC or pass through Australia's strategic areas of interest. The task of protecting the shipping plying these waters, whether they be Australian flagged vessels or not, is a core function of the Navy. [2] Maritime Trade Operations (MTO) is a contemporary capability specifically designed to engage with maritime industry, coordinate operations involving maritime commercial interests and protect merchant shipping.

POLITICAL RISK

Politically driven changes in our strategic environment creates instability. The South China Sea, a key commercial shipping route connecting Asia with Europe and Africa, is now a source of tension between nation states; in particular the US and China. China is also in dispute with a number of Asian countries claiming sovereignty over different areas of the South China Sea. Maritime industry is not immune to political risk playing out in cyber space. Belligerent nation states look to target critical infrastructure, including ports, maritime logistics and shipping. For example, the 2017 'NotPetya' contagious malware outbreak, attributed by the US to Russia, crippled information technology systems at Maersk, disrupting its port terminals and container operations. Twenty vessels were also impacted by a GPS spoofing [3] attack in the Black Sea during tensions in the Crimea, whilst ships in the Middle East have reported similar incidents.

Political rivalries and conflicts are being played out on the seas. [4] With the territorial boundaries of nations closely adjacent to choke points such as in the Straits of Hormuz, or in high-density SLOC transiting archipelagic choke points such as the Malacca Straits, GPS spoofing could cause catastrophic navigational and political

Blockade of Kerch Strait, Crimea, Nov 2018.

outcomes. Based on the current events in the South China Sea and the extended nature of our SLOC throughout South East Asia, the Middle East and the Indian Ocean, it is reasonable to accept that Australia will face a range of maritime security risks driven by political risk in the future.

MARITIME TRADE OPERATIONS TEAM 1

Over the last 25 years the Navy has conducted operations from low-level humanitarian assistance and disaster relief (HA/DR) and maritime interdiction operations e.g. counter-piracy, narcotics and human trafficking, to high-end joint warfare in the Persian Gulf. These operations have all intersected Australia's SLOCs, which convey Australia's oil, consumer goods and food imports, and our exports such as iron ore, coal and cattle. One of the critical imports to Australia is phosphates. Imports of phosphate fertiliser have increasing at around 14 per cent per year to 1 million tonnes, almost entirely as ammonium phosphates. [5] If we drill down a little further, without the free movement of merchant shipping along our established SLOCs the ADF cannot effectively sustain its own operations. An obvious example of this is the potential impact on, and vulnerability of, Australia's strategic fuel reserves. In this context, the reliance on externally refined fuel resources and the global nature of Australia's sea trade generates a priority military requirement to protect Australia's SLOCs.

Whether our Navy is involved in benign operations or we deploy task groups in kinetic environments, nearly every operation will interact with, or affect merchant shipping. Maritime Trade Operations Team 1 (MTOT1) is the Navy's primary Civil-Military (CIVMIL) specialist in this environment and it provides an organic link to maritime industry and merchant shipping. MTOT1 understands, and can move seamlessly, within this environment. It is a wholly Naval Reserve capability whose primary purpose is to coordinate naval operations with maritime industry and merchant shipping, in order to support military operations.

A CONTEMPORARY CAPABILITY

The Navy Warfighting Strategy 2018 states the 'Navy will generate and deploy self-supported and sustainable task groups, supported by specialist teams, capable of achieving the full spectrum of maritime tasks.' MTOT1 is a specialist team that can deliver a particular effect to support a key maritime task; maritime trade protection:

> *MTO's mission is to provide effective support to the ADF and maritime industry through civilian-military liaison, cooperation, coordination, guidance, advice, assistance and, where necessary, positive naval supervision of ports and shipping, to support maritime military operations.*

MTO effects are scalable. MTOT1 has the ability to deliver a series of graduated actions in response to an escalating or evolving threat. At the 'left of arc' is the low-level contingency environment

MV CSLC Globe Arriving at the UK Primary Container Port in Felixstowe UK, Jan 2015.

NotPetya Ransome Attacks on Maesrk cost an estimated $300M.

where MTOT1's Port Liaison Officers (PLOs) leverage relationships with maritime industry locally to facilitate military operations. Moving along this arc to broader national or international tasking, MTOT1 provides specialists to the Maritime Component Command Element (MCCE), Combined Forces Maritime Component Command (CFMCC), or deploys the MTO Element (MTOE) as a Task Element and force multiplier. At the extreme 'right of arc' is a national response to an existential threat. In these circumstances, MTOT1 is a critical enabler to the success of maritime mobilisation. Mobilisation requires timely and coordinated decisions across the Whole of Government geo-political-economic-security spectrum. In the maritime domain, MTO supports the movement of industrial goods and energy, requisitioning, crewing and chartering and most importantly, the protection of merchant shipping and surety of supply.

BETTER MILITARY DECISION MAKING

In the joint environment, operational commanders are required to take into account factors other than those purely military in character when planning and conducting operations. One of the most significant of these factors is the presence of merchant ships. [6] MTO enables the military commander to shorten the decision making-taking time in planning and executing operations for the protection of shipping. MTO is therefore a critical factor in coordinating and deconflicting merchant shipping with naval operations, or taking positive control of the commercial maritime environment in, or adjacent to the area of operations.

Merchant ships use economical routing techniques (allowing for transit route, speed of advance, cabotage, insurance, port costs, flag registration, crew sustainment and wages and entitlements) to move commodities along SLOC. The requirement for a merchant ship to divert from an established voyage plan increases the cost of the voyage in proportion to the profit margin on the commodity carried. Diversion can make a voyage unviable. MTOT1 provides rapid advice to commercial operators and ship's masters on threat areas or navigational hazards during maritime operations. Such advice allows shipping companies to plan early and confidently to minimise the potential economic impact of a diversion. MTOT1's engagement ensures maritime industry can make their own risk assessments on routing based on releasable and up-to-date military information and their own economic and other risk drivers.

During recent Exercises KAKADU and OCEAN EXPLORER, MTOT1 was able to imbed with local VTS and port operators and work with

Royal Australian Navy replenishment ship, HMAS SIRIUS (AO266), in formation with other multinational ships during Exercise Kakadu 2018 (image POIS James Whittle).

maritime industry to deconflict military and commercial operations. Integrating with civilian authorities minimised diversions, potential embarrassment and delays to exercise serials. Recent experience in multinational operations and exercises also demonstrates MTOT1 can provide a suite of operational and tactical level effects in support of a joint campaign. Such effects include:

a. acting as a central point for merchant shipping coordination.

b. establishing MTO areas to manage the maritime environment adjacent to operations or along SLOC.

c. maintaining maritime domain situation awareness and understanding by compiling the daily merchant shipping picture and advising commanders.

d. monitoring and reporting the flow of shipping into key ports and through key choke points or managing a focused neighbourhood watch or coast watching organisation.

e. briefing merchant masters and working with industry to deconflict or route merchant shipping away from risks.

f. tracking adversary flagged merchant vessels to assist in determining if these vessels are engaged in belligerent acts or supporting hostile forces.

g. managing the entry of non-government agency shipping and other-government agency shipping into ports for civilian relief and humanitarian assistance.

h. conducting Rapid Port Assessments on the status of ports and harbours and providing naval harbour masters to work with civilian infrastructure to restore services.

AN EXPERIENCED CAPABILITY

Today's MTO officer has a complex and specialised role to play in 'a thinking Navy, a fighting Navy, an Australian Navy.' [7] MTO supports military commanders to set the conditions for success in a broad spectrum of maritime operations from maintenance of FoN, to task force oriented operations, to recovery and stabilisation. MTO officers have deployed on OPs WARDEN (East Timor), BELISI II (Bougainville) and CATALYST (Iraq). From 2009 onwards, MTO has deployed in support of combined operations with UKMTO in OPs SLIPPER and MANITOU. During OP APEC ASSIST, MTO officers deployed as part of Fleet Battle Staff. The deployment brought a tangible network and a comprehensive knowledge of maritime industry to planning and operations providing a way to champion military priorities in the ports and harbours under PNG (national) control. Thus, the MTO capability has developed its doctrine and personnel to be able to directly support joint and combined operations. Consequently, as of October 2019, Australian MTO officers are imbedded in the UK Maritime Component Command (MCC) of the International Maritime Security Construct (IMSC) executing shipping protection operations in the Straits of Hormuz.

CONCLUSION

A critical foundation of a maritime strategy is a deep understanding of maritime economics. Australia's maritime economy, now more than ever, is crucial to our national prosperity and security. Most, if not all, maritime military operations will affect maritime industry and merchant shipping in some way. As an island nation, this interaction is inevitable.

MTOT1 is a contemporary capability, an experienced capability and an enduring capability to support the war fighter. Given its CIVMIL role, MTOT1 presents a unique enabler by providing the Navy with a means to engage maritime industry, provide better decision making and to deliver effects at all levels of maritime operations. Keeping MTO foremost in the deliberate planning process and in the mind of the planner as a warfare enabler is fundamental to executing better maritime operations. Utilising MTOT1's capability fully during maritime operations means the Navy positioned to ensure FoN and merchant ships are effectively protected, therefore assuring the integrity of Australian SLOC and thus Australia's security and economic prosperity. ■

About the Author: Commander Mark Linden, CSM joined the RAN in 1979, and is a MTO officer and MWO. His sea postings include *HMA Ships Melbourne, Vampire, Curlew, Rushcutter* including command and OPs BELISI II (2000), CATALYST (2006-7) and MANITOU (2014-15). He holds an Executive Masters of Business from QUT.

Able Seaman Keeylan Hume mans the distance line on HMAS MELBOURNE (FFG05) during a RAS with .Royal Fleet Auxiliary *Fort Victoria* (A387), while on OP SLIPPER (Image ABIS Jayson Tuffrey).

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SURFACE FLEETS: FLEXIBLE RESCALING

By ANSON Team

CAPITAL BY DESIGN

As 2020 dawns, the UK's Royal Navy Fleet, remarkably, now includes two Capital Ships (HMS QUEEN ELIZABETH and HMS PRINCE OF WALES) reputed to be the largest, most powerful and most modern vessels ever constructed for the Royal Navy. These vessels have set their bows to the sea for the first time – a full 77 years after the last class of Strike Carriers (HMS EAGLE and HMS ARK ROYAL) were ordered. [1] Most commentary focuses only on the immediate tactical deployment (and associated capex and opex costs) of the new Capital Ships.

The availability and structure of investment capital remains the critical driver to the composition, scale, replenishment and deployment of the RN's Surface Fleet. This financial context, defining the optimal configuration of the RN's Fleet, has long been the most pressing feature of life for the UK's Royal Navy; Nelson's own HMS VICTORY being completed, launched and then promptly accepted into the 'ordinary' (the reserve) some thirteen years before his Vice Admiral's Flag was hoisted aloft.

RECENT ATTACKS ON THE ADMIRALTY [2]

The extraordinary capabilities, the embedded and connected technologies, of these modern Capital Ships, with the Warships, Boats and essential RFA Fleet Support vessels that surround them, greatly exceed the capabilities of their illustrious predecessors. It is nevertheless tempting, as many Defence commentators do, to assert that capability (compounded by the financial impact of globally experienced defence cost inflation) has finally trumped quantity.

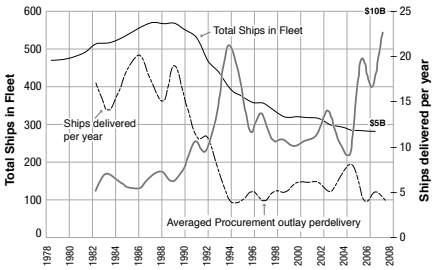
See Figure 1

Surface Fleet numbers (**see Figure 2**) have undoubtedly substantially declined from the time of HMS EAGLE and HMS ARK ROYAL (387 vessels in 1950 (12 Carriers, 29 Cruisers, 280 Destroyers and Frigates, 66 Submarines)) to today's Surface Fleet of approximately 19. However, it is simply too easy to assert an absolute correlation to a lack of strategy, or worse still, to the inevitable consequences of financial and political decline – this allows for no context. The last 50 years of tumultuous political events – a firestorm in Global Financial markets and the huge leaps in technology.

The independent work of the ANSON team

Figure 1: US Navy Shipbuilding Trends

Source: CRS report for Congress, Navy Force Structure Plan, 2008



[3], challenges these casual assertions, acknowledges the strategic direction, identified and now addressed by Admiralty and places the future decisions about the composition of the Royal Navy's Surface Fleet within this context. ANSON identifies and acknowledges the pivotal role that Admiralty has played in shaping this new and invigorated Strategy. This Strategy has profound – and positive implications – for the UK, for Defence, for Industry and for the City. It is no longer about scale but scalability – in City parlance – rapid rightsizing. This Strategy is now visible in these Capital Ships and it presents a challenge.

The ultimate success of this Strategy now lies with those to whom its fulfilment falls. For the strategy of Nelson's HMS VICTORY to carry the day it had to be faultlessly executed – at speed, scale and scope – procured and sustained in the copper-bottomed guarantee of Collingwood's magnificent HMS ROYAL SOVEREIGN. Admiralty, Industry and the City - a powerful combination.

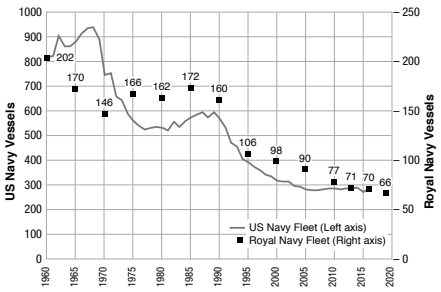
INDUSTRY

> "Some went out on the sea in ships; they were merchants on the mighty waters". [4]

Industry responded quickly to the challenge of Admiralty, calling upon the deep industrial insight of Sir John Parker. Sir John's Independent Report [5] into naval shipbuilding (accepted in its entirety in 2016) created the platform for the most far-reaching transformation of the United Kingdom's commercial shipbuilding and naval procurement industry. This was primarily aimed at boosting the prosperity of shipyards and supply chains across the country. Sir John's defined terms of reference included input from Government,

Figure 2: US Navy and Royal Navy Vessel Fleet Size Since 1960

Source: US Naval History & Heritage Command, UK Defence Statistics, Note: UK vessels include submarines, carriers, assault ships, surface combatants, mine countermeasure, and patrol vessels, and excludes specialist survey and ice patrol vessels



Industry, and Trades Unions. This has produced an effective, accountable, maritime construction governance regime; a new strategic platform from which a national shipbuilding industry might revive and thrive. This laid the foundations for a modern, efficient, and competitive naval construction platform designed around modularity - better suited to the country's defence and security needs.

Key areas of recommendation for Government and Industry intersect completely with the investment focus of global financial investors; in marine (fixed and floating infrastructure), in digital engineering, in industrial innovation, in competitiveness, in exports and in regionalisation. As Sir John reported "Should Government, Industry and the Trade Unions rise to the challenges I have set, I believe we can establish a new era of collaboration and success across the 'Whole Flexible Enterprise'. The impact of this report is already evident. The ANSON team recognises the potential for the power of this platform to be released with the introduction of fresh capital.

GOVERNMENT

Government has gripped the Strategic challenge of Admiralty – supported and enhanced by Industry. Recent Ministerial announcements include provisions for a revised Merchant Marine tax regime (historically an essential component of growing and sustaining the Red Ensign Fleet) and with enhanced consular support and the protection of the Royal Navy. [6]

Additional initiatives are planned that "Maximise our strength in maritime professional services, retaining and enhancing our UK competitive advantage in the provision of maritime law, finance, insurance, management and brokering, and developing our green finance offer. That will further promote a liberalised trading regime that delivers maximum benefit for our maritime sector." [7]

Government has also pledged its support for the continued multi-billion-pound commercial investment in maritime infrastructure that makes the UK a globally attractive destination for all maritime business and infrastructure investors.

THE "CITY"

To truly respond to the Strategic challenge laid down by Admiralty, enhanced by Industry and supported by Government – one more key step is required - to reconnect with "City".

The years that separate the commissioning of the Capital Ships of the *Audacious Class* from the Capital Ships of the *Queen Elizabeth Class* have seen the safe passage of the UK, through sometimes mountainous global Political seas and tumultuous financial storms. The engine of the Global Capital Markets was once expressed powerfully through the "City" of London and it is still strongly centred there – and as "Seapower identity still matters even though it has become a collective Western possession rather than the sole preserve of individual states" [8] so the global financial hub that is the "City of London" still matters to support and express these collective values and objectives, through the Royal Navy. [9]

ON STRATEGY

Professor Lawrence Freedman [10] notes that "Strategy is often expected to start with a description of a desired end state, but in practice is rarely an orderly movement to goals set in advance. Instead, the process evolves through a series of states, each one not quite what was anticipated or hoped for, requiring a reappraisal and modification of the original strategy, including ultimate objectives."

Sir Julian Stafford Corbett – the towering intellect of his time, close associate of the Royal Navy's great reforming First Sea Lord, Admiral Fisher applied his own unique intellect to the strategic position of Britain at sea. In a series of incisive and insightful addresses to Admiralty – this lawyer/banker – highlighted the function of British Naval Strategy as an illustration of how much can be achieved from limited resources and focused tactical engagement." Corbett emphasised that naval strategy needs to be consciously related to policy; maritime strategy should serve the interests of the State and in war and peace the type of strategy a Navy adopted should reflect national objectives" [11]. As Professor Andrew Lambert illustrates "Corbett broke the mould of strategic writing by insisting on the primacy of national strategy which must be soundly based in theory and integrate all aspects of national power under civilian direction. Navy, Army, Communications. Merchant Shipping, Economics, Law and Culture."

Figure 3: 10 Year Government Bond Yields Since 1990s

Source: Thomson Reuters

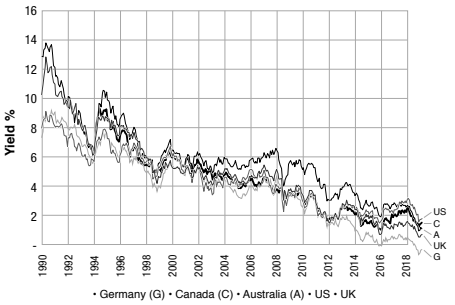
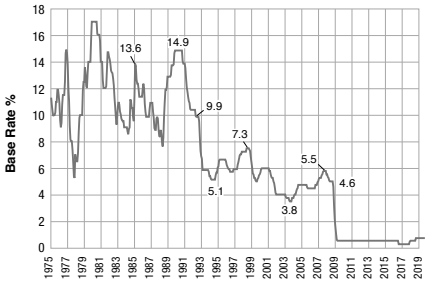


Figure 4: Bank of England Base Rate Since 1975

Source: Bank of England



ON GOVERNMENT, UK DEFENCE SPENDING AND GLOBAL FINANCE [12]

With a World population rising from 3.6bn [13] (1970) to 7.6bn (2020 proj.) [14], all the accompanying potential for conflict as settled and unsettled systems compete for resources, influence; for their culture and very identity, the relentless pace of Political and Technological change continues to accelerate. Through HMS EAGLE to HMS QUEEN ELIZABETH, ten UK Governments have presided over the UK's economy and security (including conducting 11 UK referendums [15] (reflecting more internally devolved Government) with the last (June 2016), most notably, when the UK voted to leave the European Union.

Throughout this same period, UK armed forces have conducted (at least) 14 major, extensive and intensive military campaigns (fought with allies or substantially alone) and have deployed from the mountainous seas of the South Atlantic to the searing heat of the Helmand River valleys.

At least 12 Financial Market crises have created, supported, fuelled, dominated. shaped and sometimes engulfed all of these world events: Energy Crisis (1970s), Latin American Debt (1980s), Japanese Banking (1986 -1992), the US S&L failures, Nordic Banking (1990s), the Dot-Com crash (2000-2002), the US Sub-Prime mortgage crash (2007-2010), the European Sovereign Debt crisis, (Greece, Portugal) (2009-2019) – and latterly also including the "Great Recession" (2008 -2009)). Through all of which the UK has (possibly remarkably) encountered only 20 quarters [16] (of a possible 200) of technical economic recession; although it did feel at times that it was indeed...

> "the nearest run thing you ever saw in your life..." [17]

See Figure 3

However, the economic and financial reality is that today (see Fig 3), for the US and for many of the major Western European Sovereign liberal democracies (UK, Germany, Canada, Australia), it has never been a better time to raise Sovereign Capital.

The prevailing economic climate comprises historically, low interest rates (in an extended period of historically low interest rates.

See Figure 4

the global institutional investor's "flight-to-quality", global financial regulators' and central banker's financial regime changes, greater resilience to credit shocks and downgrades, the greater prevalence of financial market "circuit breakers" – all have been effective. Better still is the vigilance that comes from the experience of the tumult of 2008/9, the echoes of which still resonates through Banking Board Rooms and Global Investor Commitment Committees.

See Figure 5

By way of illustration - a generally used yardstick of the perceived credit risk in the largest economy in the world – the U.S. economy - is the "TED Spread". This is 3 Month LIBOR / 3 Month Treasury Bill). The London Interbank Offered Rate ("LIBOR") measures the inter-bank lending rate, As the spread between LIBOR and the T-bill rate increases it is seen as an indicator of the accelerating lack of trust between Banks and thus a corresponding tightening of credit for all other counterparties.

The value of the TED spread at October 2008 stood at 4.58%. The current value of the TED spread [18] as at November 20, 2019 is 0.36%.

Figure 5: TED Spread

Source: Current TED Spread Quote from StockCharts.com

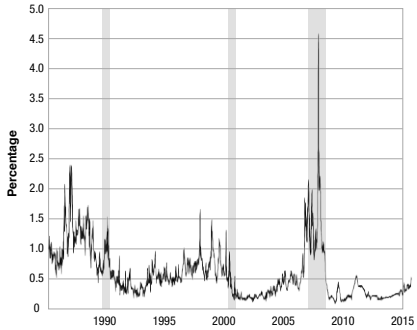


Figure 6: UK Defence Spending Since 1900: £, billion

Source: www.ukpublicspending.co.uk

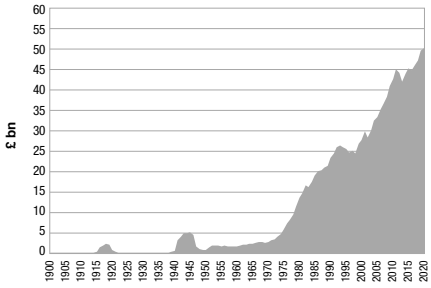
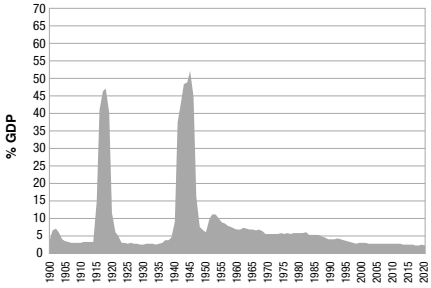


Figure 6b: UK Defence Spending Since 1900: % GDP

Source: www.ukpublicspending.co.uk



ON PUBLIC CAPITAL (CREDIT) MARKETS

Although Brexit is regularly cited as the core, even asserted as the only factor driving a view of the UK's economic future the leading rationale e.g. cited when Moody's, one of the major global credit ratings agencies, downgraded the UK to an Aa2 rating from Aa1– September 2017 was that Government had "yielded to pressure and raised spending in several areas" including health and social care. The other major agencies, Fitch and S&P, had already changed their ratings in 2016, with S&P cutting it two notches from AAA to AA, and Fitch lowering it from AA+ to AA.

If the responsible Investment Banker's advice to is to invest prudently – it must also be to borrow wisely – and that generally means in circumstances when force majeure is not a factor. Thus, despite all the Global political turmoil and the Brexit "noise" – the market reality is that now has never been better time for Sovereign Capital raising. The current change that is very evident in the political and social stance to more borrowing - clearly informs the global markets stance to Sovereign capital raising. [19]

However, never have the demographics – the rise of differing political and social demands – created a greater clamour for the proceeds of Sovereign Capital raising. Competing interests mean that the needs of security and defence now sit with the increasing call for Government to support an increasing population with greater health and longevity expectations, refreshing an aging physical, terrestrial, transport infrastructure (a 1st mover disadvantage), delivering a new 22nd Century connectivity network and managing a changing environment.

ON PRIVATE CAPITAL MARKETS

The liquidity that Governments created as a response to these numerous financial crises and that markets then delivered in the aftermath of these crises also drove the current rebound in public and private markets, allowing the private equity markets to recover, gain momentum and even begin to compete with public equity market investor options.

In the Private Capital Markets – most notably the Private Equity and Infrastructure investment market - the flow of capital remains unabated. Global Investors have more money to invest than ever before. Financial engineering and technology advances within regulated markets have created deep, diverse pools of financial assets through the last 50 years which have transformed the practices and behaviour of both the private equity and private debt capital markets. It is estimated that global financial capital increased 53% from 2000 to 2010 alone, reaching some $600 trillion, or 10 times real global GDP. [20] Industry commentators project this to reach approximately $900 trillion by the end of 2020. Equity Investors – as with credit investors - are hunting for yield and have flocked to private equity and to infrastructure, enticed by superior returns and secured investments respectively, relative to other asset classes. In the years following the global financial crisis it is estimated that investors have allocated $5.8 trillion [21] globally to private equity, and the private debt markets have equally been eager to finance transactions. Over the past 20 years, private-market capital has grown at more than double the rate of public capital globally with only a very slight slow-down in demand yet evident. Private Equity funds raised $417bn in the first three quarters in 2019, up from $345bn over the same period in 2018, even through this apparently uncertain current environment.

ON DEFENCE SPENDING

Notwithstanding the increased demands of a growing state, by most measures the United Kingdom still ranks 7th by absolute global defence spend, after the United States, China, Saudi Arabia, India, France and Russia, but slightly more than Germany. If looked at as a percentage of Gross Domestic Product, the beginning of the 20th Century saw the UK increase defence spending to 7% of GDP in the Boer War, increasing though World War I to 47% of GDP in 1918. World War II subsequently exceeded this when defence spending peaked at over 52% GDP in 1945. Following the Korean War UK defence spending rapidly declined to 5% of GDP in 1986 – by the end of the Cold War. In the 2010s, defence spending remains broadly stable at about 2.4% GDP. In terms of military spending as a share of GDP, the UK ranks eighth with notably Saudi Arabia spending 8.8% of its GDP on defence.

See Figure 6 and 6b

ON PFI/PPP/PF2 INVESTMENT STRUCTURES

> "What surety of the world, what hope, what stay, when this was now a king and now is clay?" [21]

In addition to direct Sovereign funding, Public Finance Initiative (PFI) structures were developed and heavily promoted in the UK primarily to achieve at least two explicit objectives namely; the use of third party, "off-balance sheet", funding and the management of completion risks for large complex State or para-state infrastructure projects by commercial counterparties to commercial standards. The third, generally unstated objective, being the potential to migrate the provision of certain Government services (often attached to or co-mingled with the asset financed) to an efficient, often lower cost (when fully costed headcount is included) business structure and operational practice of the commercial world. The cost of this indebtedness was incurred through a period of rapidly increasing interest rates, via these PFIs/Public Private Partnerships (PPPs – a major borrowing vehicle in both military and civilian environments) and has now, become fully visible.

Originally PFI's grew from Build-Own-Operate ("BOO") and Build-Own-Operate-Transfer ("BOOT") project finance structures which were relatively simple financing constructs, matching long

term assets (bridges, toll-roads, power stations etc) with long term financing provided by institutional investors. These were effectively backed by Government supported cash flows. These were often intermediated and funded by the Bank market and not the long-term institutional investor market. This arose, in part, because of the low capital levels then required for Banks engaging in this type of lending; a feature of the then international banking and financial regulatory system.

Against a background of rising general interest rates, the low returns but increasing complexity of the structures, as more was expected of (completion/system acceptance risk) or was contracted with these financing vehicles also drove out the long-term institutional investor and they became more and more dependent on the Banks. PFI's, thus, grew to be a common vehicle for many forms of Sovereign State financing. But, bridges do not (generally) move location (tectonic forces aside), toll-roads do not need to be adjusted to reflect Urgent Operational Requirements, Power Stations – Airports even - are unlikely to require as many changes as, say, the implementation of a nationwide medical database – yet this became the essentially unmanned "vehicle" of choice for many.

In the defence sector a further complication has been the inflexibility of the PFI/PPP type structure. "In the mystery of the sea craft there is something that sailors call "seamanship" an intangible but necessary equipment which they know it is extremely difficult for civilians to acquire. In its broader sense it is impossible to define or even to explain; but we know that it is something to be mastered by long service afloat, and that it so completely permeates the whole subject of naval warfare that no civilian writers can hope to avoid grave error without the assistance of naval officers. Those of us who have at least dared to walk upon the waters know well the need of their helping hand." [22]

Flexibility and agility has been long striven for and is now designed into the operational structures of the Royal Navy developed over the last 30 years. This flexibility can be impaired by the rigidity of the investment capital structure of entities which may be required to support and equip the projection of force and protect sovereign interests. The adoption of complex and bespoke technology – glued to hulls, carried aloft or strapped to the Infantryman – rapidly compounded this problem.

See Figure 7

Although interest rates are now at an historic low – and the clamour for Sovereign Capital borrowing has never been greater - it is primarily the operational and practical disadvantages of these structures – rather than simply the adverse economics that have caused this structure to become widely discredited. This form of Sovereign Capital raising has now been abandoned.

A different model for the procurement of capital investment for a Sovereign enterprise is required, For Governments, for Defence Ministries, and specifically for the Royal Navy – to deliver, support and answer the Strategic challenge now laid down by Admiralty and Industry – it is now critical to connect – through the City - with the pool of available investment capital as directly and as efficiently possible.

There is much at stake and much future capability will depend upon the pace and enthusiasm with which this transition can be embraced.

ON FLEET CLASSIFICATION (INVESTMENT STRUCTURES FOR PROCURING SCALABILITY)

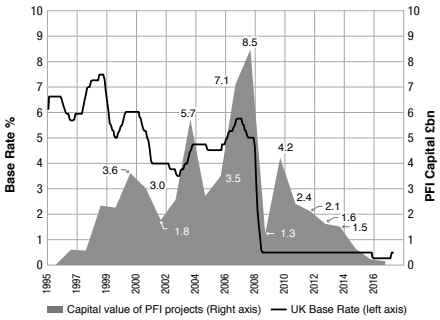
As Professor Lambert [23] illustrates so clearly "a sea power was a state that consciously chose to create and sustain a fundamental engagement between nation and ocean, from political inclusion to the rule of law, across the entire spectrum of national life. It was a cultural choice not a question of naval power."

It is the ANSON team's contention that the Admiralty have made this choice. That despite many political, financial and economic challenges, they have anticipated and understood the global forces that shape our Island and have held close to a Strategy that has served the UK well; allowing it to benefit from a range of Military, Industrial and Financial options that are still relevant to a nation at the centre of world affairs.

We can now clearly identify this Strategy in the context of the Queen *Elizabeth-class* squadron and the consequential supporting programme that we believe will have profound – and positive - economic, political, military commercial and financial consequences not only for the Royal Navy but for the UK maritime industry, its associated global partners, its treaty signatories and for our future national defence and wellbeing.

CONNECTING SHIPS CAPITAL TO CAPITAL SHIPS - THE "FLEXIBLE ENTERPRISE"

The Surface Fleet is a significant source of large Government capital expenditure programmes - because of the breadth and effectiveness of vessel capabilities that are demanded. Determining the optimal size, specification, design and procurement of Naval Fleets involves managing some of the most complex financial, procurement, project management and completion risks.



See Figure 7: Capital Value of UK PFI Contracts Signed Each Year Compared To UK Base Rate

Source: National Audit Office report for HM Treasury, dated January 2018, Bank of England.

ANSON's independent work, has developed financing options and solutions that respond to this challenge.

Given the current availability of capital, and that capital reasonably demands a commercial return for an enterprise undertaken, a further feature of the future development of Fleet Investment programmes will be the transparency of the risk transferred and the pricing of the risk.

As is true when dealing with so many of the current challenges, moving from the working titles of the past; from "partnerships" to real commercial (i.e. not simply contractual) relationships with real and accountable entities that are of real economic substance will be essential. Getting customer, management and investor interests properly aligned in this new model is key. Getting this model right will drive the most efficient provision of assets and services critical to making the connection from the Capital Ship to Ships Capital.

THE ANSON APPROACH – CONNECTING THE CITY TO ADMIRALTY AND INDUSTRY

> "When a thing's done, it's done, and if it's not done right, do it differently next time". [24]

About PFI – monitor but time to move on.

For the UK, and particularly the MOD unwinding many PFI projects, or PFI look-a-likes, may have some unwelcome and potentially higher cost consequences. These consequences may be visited on the UK more generally and must be balanced against the potential benefits of any unwind. Whilst there is undoubtedly merit in pursuing redress for projects where there is poor or non-performance under current contracts, the real objective in doing so needs to be clear. The focus should be primarily on developing the new model for the structure of future contracts. This new structure has the potential to creates

or, more accurately re-create, a Surface Support Fleet – in being.

Currently, only the very largest defence companies or consortia can sustain the heavy investment cost required over long, long Defence planning and procurement time frames. New–build programme delivery timelines have now become so extended that intervening, political, economic, budgetary and financial cycles dramatically impact the final costs and scale of capability delivered. This is much the same effect as the UK experienced when the vigorous and multiple (27) aircraft manufacturers of post-war UK were forced to consolidate into 1 (Airbus) - as civilian and then military (airborne) platforms became increasingly expensive to develop and build. Thus, product and systems become more costly and pricing power is ceded to the, now very few, incumbent manufacturers.

A willingness to combine adoption, adaption and "new-build" will be important. In the Naval theatre, particularly for blue water support, littoral support and sea-lift capability, greater use of existing and widely available modules and commercial platforms would considerably shorten the time taken for capability to reach front-line operations. Speed, Scope and Scale.

Over time more frequent, more numerous – and equally capable - products and services will be commissioned or made available from a multitude of potential suppliers and these will be "assembled" and "composed" differently and may not be immediately identifiable in quite the forms we see today. The ability to source from multiple suppliers is the most effective way that competitive design, manufacturing and production is sustained. This is the optimal way by which Admiralty might drive costs down and greatly improve the transparency and efficiency of the purchasing process. In the maritime investment environment, the absence of pure hull construction risk could materially reduce costs and enhance the ability to externally finance such ventures further freeing constrained budgets. This effect could then be captured to secure funds to further enhance the procurement of capability and allow for the purchase of larger volumes of the critical "smart" UK marine industrial materiel to deliver this.

THE ANSON APPROACH – THE FLEXIBLE MARINE ENTERPRISE OR "REAL CO":

For Admiralty and with special reference to the development and expansion of the scale and capabilities of the Surface Fleet, the following solutions are considered:

New build: allowing ships to be designed and constructed to naval class rules and to incorporate a multitude of high value/ high capability naval requirements (e.g. watertight sub-divisions, enhanced stability, Helidecks and military communications fit etc).

HMS IRON DUKE leads elements of the Grand Fleet in 1914 at the onset of the Great War.

Whilst this option is attractive for meeting specific naval requirements it is highly costly in time, financial and human capital.

Chartering Commercial Ships: The "just-in-time" chartering of existing UK flagged tonnage could be undertaken under the STUFT regime – the US has a similar concept – the Voluntary Inter-modal Sealift Agreement (VISA). This option is, however, problematic in that there are now many fewer UK flagged ships (RO-ROs in particular) currently in service. Operational experience in the 1990s (Gulf War, Bosnia) demonstrated to the UK MOD the difficulties in chartering suitable ships to move military equipment in relatively short timescales. The chartering of foreign flagged shipping is also problematic as other countries may be looking for the same tonnage in the case of unilateral and/or multinational urgent operational needs. Short notice chartering means that vessel capabilities are necessarily limited by the purely civilian role that they hitherto undertook.

The Versatile Modular Fleet: The ANSON team has developed an alternative solution that is better aligned to Admiralty's strategy - based upon deep strategic and operational Naval experience, expert Naval Architecture advice, Investment Banking and Global Capital Markets expertise. This solution is consistent with the UK's Shipbuilding Strategy, fully compliant with its Governance regimes – founded upon the marine engineering success of the modularity so evident in the new Capital Ships - and with the "grip" identified as the essential requirement for success in the Parker Report. This solution is an investor shaped approach - that facilitates the introduction of external investment capital and allows procurement teams to focus on the delivery of systems and capabilities rather than on the lengthy Sovereign Capital driven process of creating traditional, bespoke forms.

This - **British Maritime Enterprise** (the "Enterprise") - which will be UK registered, structured as a UK Company, a UK LLP or incorporated by special charter - would be focussed on the provision of current capability requirements and because the Enterprise is the charterer - is not trying to immediately amortise the cost of new-build (cost-overruns etc) over a typical 25-30 year life – a PFI style contract approach – which would in any event be undesirable - is unnecessary.

Fast, sophisticated, hulls could be procured and commissioned by the Enterprise - currently these are cheap and readily available. This Versatile Modular Fleet ("VMF") owned and operated by the Enterprise will be UK Flagged and primarily, modern, fast and efficient commercial marine vessels will be used. This new approach to procurement and usage also allows for fully modular conversion and with the application of containerised technology. This provides for the installation of exchangeable and flexible component units to configure high quality merchant platforms to meet all the required Fleet Support capabilities. This latter component taps into the UK's vibrant and highly regarded Marine Technology manufacturing and service sector. A constant upgrade programme will be developed (aided by the rotation of larger vessel numbers) and new, new-build

Royal Navy halts order for support ships as bidders could not meet the budget. RFA Fort Rosalie (A385) RASing with HMS ALBION (L14) and HMS OCEAN (L12).

and further technical changes can then be "plumbed in" to a bigger system. In a sense, for Admiralty, tactical command then becomes the challenge – not technology and project management.

The Enterprise Fleet - registered as UK merchant ships – operating under the new Red Ensign investment rate regime – which will be providing further incentives for the institutional investment in the UK Fleet would be available for commercial charter when not required for the transportation of MOD cargo or the provision of RN capability. A further profit-sharing arrangement would allow Admiralty to average down or ameliorate the costs of its own use of the vessel pool from its share of the revenues generated from the normal trading of the vessel – in this sense the contract becomes partly self-financing. The Enterprise approach further captures the benefits of the current industrialised trend to modularise and thus can deliver equipment and technology that meet any desired capability. The Enterprise has a real commercial relationship with Admiralty and becomes a commercially disciplined "point-to-multi-point" Fleet procurement specialist.

SPEED, SCOPE AND SCALE

> "The Admiralty had demanded six ships; the economists offered four; and we finally compromised on eight." [25]

This Marine Enterprise will draw from the entire UK maritime defence industrial base (employment, export, technology and research) - to develop, procure, construct, convert and deliver the capabilities of the VM Fleet. Additional services will include the design of connecting systems, the assembly and storage of the relevant modules. Anticipated volumes may be high - every yard from Belfast to Devonport, from the Tees, the Wear, the Tyne and the Clyde – might be expected to participate in this work. The IP – within any security limitations - will be globally exportable. The modularised approach evident in the new Capital Ships secured, with impressive foresight, through the vision and Strategy of Admiralty demands a creative and supportive response from the City. Putting "Bounce" back into the Fleet's plans! ■

The ANSON Team comprises:

Andrew Swinburne – MA Law, (Cantab) Founder Partner Anthem Corporate Finance.

Professor Robert C. Blake PhD (Cantab) - FIET CEng, Principal Investigator, Chief Systems Designer and Chief Engineer.

Dr Richard Golding (Oxon) – Fellow of the Institute of Physics, a Fellow of the Securities Institute, a member of the Institute of Mathematics. Founder Partner Anthem Corporate Finance;

Professor David Aldwinckle - Vice Chairman of the Safety Committee at the Royal Institution of Naval Architects, B.Sc. (Hons), Ph.D., CEng., FRINA, former Vice President of The Royal Institution of Naval Architects. Member of Lloyd's Register's Technical Committee and retired Senior Principal Surveyor and Manager at Lloyd's Register.

Simon Hudson – Physics (BSc) . Vice President Anthem Corporate Finance

Martin Romilly - OBE (Colonel Rtd.) formely Senior Research Fellow, Military and Technical Systems and Policy Adviser, R&AB, Advanced Research and Assessment Group (ARAG), UK MoD Shrivenham.

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[2] Sir Julian Stafford Corbett (12 November 1854 – 21 September 1922) eminent British naval historian and geostrategist of the late 19th and early 20th centuries.

[3] *ANSON* (Alliance of Naval Support Operations' Network) is an international team drawing upon global Naval, Maritime, Naval Architecture, Military, Defence Technology, Government Procurement and Global Capital Markets experience.

[4] the Royal Navy Hymn with its evocative lyrics "For Those in Peril on the Sea" this hymn has a long tradition in civilian maritime contexts as well. Regularly invoked by ship's chaplains and sung during services on ocean crossings the original 1860 hymn of William Whiting, is generally thought to have been inspired by Psalm 107 (23-26) ".

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[18] the TED spread is calculated as the difference between interest rates on 3-month T-bills and 3-month LIBOR (London Interbank Offered Rate).

[19] Goldman Sachs eyes multi-year Boris boom - but warns on gilts risk The Daily Telegraph Ambrose Evans-Pritchard 1 December 2019

[20] Bain and Company's Macro Trends Group (2019)

[21] Sources: International Monetary Fund, World Economic Outlook: Slowing Growth, Rising Risks, September 2011; Organisation for Economic Co-operation and Development; national statistics; Bain Macro Trends Group analysis

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Captain Josephine (Jo) Clark Marine Pilot Port Kembla.

CAPTAIN JOSEPHINE (JO) CLARK – PORT KEMBLA

Captain Josephine (Jo) Clark works as a marine pilot at Port Kembla, NSW. She has held this position for 7 years and was previously Harbour Master / Marine Pilot at the Port of Eden, NSW.

Prior to commencing her pilotage career, Jo served for 16 years in a variety of merchant ships, including bulk carriers, chemical tankers and general cargo ships in all deck officer capacities including Master. She has commercial shipping experience coupled with postgraduate shipping business qualifications.

Her responsibilities at the Port Kembla are the day to day delivery of safe and efficient vessel pilotage services.

Jo has recently been elected to the board of directors of the Australian Marine Pilots Institute.

Capt. Clark grew up in WA and after completing school in 1988 decided that she wanted to go to sea . She considered joining the RAN, but at the time women were not able to serve in a combat role and decided on a career in the Merchant Marine. She commenced her shipping career with BHP Transport as a Cadet and spent 12 years with the Company, including a 2 year secondment to the Chartering Department, where she learned a great amount about Charter Parties and Shipping Law and Commercial contracts.

Returning to sea she spent 4 years with Incoships as Chief Offer and Master. In 2005 she came ashore to a position of Harbour Master and Pilot at Eden, where she spent 7 years. Eden is an idyllic location, however she had a desire to broaden her pilotage experience and so in 2012, moved to Port Kembla where she remains.

In 2012, Clark moved to PK as a Pilot where she currently remains. In 1988 IMO's Women in the Maritime Sector initiative sought to achieve gender equality for women and girls in the maritime industry. In Australia it has become known simply as Women in Maritime however excluding passenger ships where there is a slightly higher concentration, women represent only 2% of the world seagoing maritime industry.

Early in 2019, Capt. Clark was sponsored by AMPI, the Nautical Institute SE Branch and Port Authority of NSW, to attend a conference in Houston called the Women Offshore Unite Conference, the term Offshore being a US generic term for being at sea.

DESTROYERS FOUND

(Baird Maritime, 4 Nov 2019)

A group of researchers has confirmed that an American warship recently found at the bottom of Leyte Gulf in the Eastern Philippines is the deepest sunken shipwreck ever discovered. Found at a depth of 6,220 metres is what the crew of the research vessel *Petrel* have identified as a US Navy destroyer that was lost to enemy action in October 1944 at the Battle of Leyte Gulf, a massive naval engagement involving over 300 American and Japanese surface ships and submarines.

The announcement of the discovery was made in the days following the 75th anniversary of the opening phase of the four-day battle, which took place during the final year of World War II.

Petrel's crew said the wreck is of a US Navy Fletcher-class destroyer but could not state for certain whether it is USS JOHNSTON (557, pictured) or USS HOEL (533), both of which were sunk off Samar province on the third day of the battle on October 25, 1944.

Researchers on *Petrel* remarked that the wreck is "completely decimated" with no hull numbers clearly visible, making it difficult to positively identify.

Both JOHNSTON and HOEL had formed part of "Taffy 3," a small US Navy task force of six escort aircraft carriers, three destroyers, and four destroyer escorts that had fought against the numerically superior Imperial Japanese Navy Center Force consisting of four battleships including the celebrated Yamato, six heavy cruisers, two light cruisers, and 11 destroyers in a battle off Samar on October 25, 1944.

BLACK BOOK OF THE ADMIRALTY

(Ted Wilson, noting Wikipedia)

The *Black Book of the Admiralty* is a compilation of English admiralty law created over the course of several English monarchs' reigns, including the most important decisions of the High Court of Admiralty. Its starting point is the Rolls of Oléron, which were promulgated in c. 1160 by Eleanor of Aquitaine, although the Black Book is undoubtedly later. The book itself states that the High Court of Admiralty was established during the reign of Edward I (1272–1307), although more recent scholarship places the establishment at c. 1360, during the reign of Edward III.

Apart from the Rolls of Oléron, the earliest statute referred to is the Liber memorandorum (1338), of which a separate manuscript copy is available in the archives of the City of London. The book is written in Old French and its authors change handwriting and tone various times. The earliest surviving manuscript copy dates from c. 1450, and is held in the National Archives.

By Editor: In the 18th and 19th Century, the *Black Book of Admiralty* became the Naval Register, used to keep the British Royal Navy in Class. From the mid-19th Century through to the end of the 1990s, and the transfer of the Black Book (of Class) to Lloyds Register, this was run through the Naval Architects and Constructors based in Bath, England. Colloquially, known as the *Black Spider* – the Chief Constructor had responsibility and authority (now lost) both for maintaining the tempo of ship building, and keeping the Fleet in Class. ■

The US Navy *Fletcher-class* destroyer USS JOHNSTON in 1943 (Image - US Naval History and Heritage Command).

RETENTION IN THE ADF
CAN GENERATIONAL THEORY HELP?

By Jim Hutton OBE

I hypothesise in this paper that an understanding of generational theory will assist ADF to address retention. While the ADF will naturally lose people as they ascend through the ranks, it must aim to keep those it needs through good leadership founded on keeping people motivated and satisfied with their work. I examined reasons why people leave the ADF to see if this could be matched to generational theory and help understand why people leave, so that mitigations can be put in place. Research shows that there is a degree of predictability on how people age and stage through life such that leaders and Career Managers might better guide Defence members through their time in the Services in order that the people the ADF wish to retain, stay longer.

INTRODUCTION

The genesis of this research came from my experience as Commander Joint Task Group 661 in 2018. I was responsible, as a senior officer in my late 50's, for delivering command philosophy to deployed force elements comprising defence members aged 18 to 60+ from all three services embarked in four ships. As their lead, I had to find a way to relate to all of them, regardless of age, gender, background or generation.

Early in 2019, the Chief of Army (CA), in a talk to the Defence Strategic Studies Course asked the rhetorical question,

> "How do I lead a diverse multi-generational workforce?"

CA was referring to what he identified as "the challenges facing leaders at every level of leading and managing a workforce that now comprised four generations of people; each having its own motivations, characteristics and values based on their upbringing and life experience". It could be concluded that ADF leaders may need to pay attention to generational theory, in order to see what might be learned.

In tandem, the ADF is on a journey to grow its people capability to crew the platforms and equipment it is procuring for future warfare against a national demographic that sees the pool of recruits shrinking (Statistics, 2016, Karen Harris, 2018). This places increased importance on the need to retain the people you invest time and resources in training (Branson, 2014). Whilst ADF retention figures have fluctuated with the wealth of the nation, they are currently in a state where the numbers are leaning towards being above acceptable annual norms and perilous in some categories of employment. Some platforms simply cannot be crewed due to lack of skilled personnel (DGNP, 2018).

Given this context, it is necessary for the ADF to understand why people leave. (Reed, 2018), amongst others, has argued that quality of leadership is a key component for retention and that "people leave their bosses not their jobs".

Based on a review of the literature (see for example (Jorgensen, 2003), (Greig, 2001), (General, 2014) etc there appeared growing evidence to merit researching generational theory with regard to ADF and informing Defence leadership about its potential application to retention.

RESEARCH

From the review of the problem space, it was possible to derive the ordinate research question to be:

> "How will an understanding of generational theory support ADF leaders address retention concerns?".

In addressing these questions, this study applied an understanding of generational theory gained through the literature to the context of the ADF and collected statistics and other details about the nature of the ADF workforce in order to test the following hypothesis, "that an understanding of generational theory will assist ADF leadership in addressing retention concerns".

RETENTION ANALYSIS

There are many different approaches to generational difference in the literature, but they largely fit into three categories. The first is based upon a cohort of generational theory literature (Grubb, 2017, Zemke R, 2013, Jorgensen, 2003, Cogin, 2012, Wiedmer, 2015, Tulgan, 2016, S. Reay Atkinson, 2018). The general hypothesis developed in the literature posits "that people are born into a generation that is distinguished by the environment and time into which they are born". There is much popular generational literature that defines age cohorts by birth date with such terms as Baby Boomer, Generation X, Y and Z in common usage. Much of the popular literature is confusing and sometimes lacks grounding. For example, different standards and generation start and endpoints are often applied to make the point the author wishes to establish.

Next, there is a body of literature that subscribes to the theory espoused by Erik Erikson on the aging of man (Erikson, 1959, Learning, 2017, Mohr, 1960, Headquarters, 2017). Erikson describes eight (later nine) life stages, each containing a crucial problematic issue that needs to be resolved to progress healthily through life. The stages are ego-centric and address the balance between self and world. They are described through characteristics of commitment and virtues of caring and trust.

Thirdly, Daniel Levinson, makes use of Erikson's work but shifts the focus (Daniel J. Levinson with Charlotte N. Darrow, 1979). He sees the concept of life structure as centred "more directly on the boundary between self and world" giving equal consideration to both. Levinson describes a larger number of development periods.

Whilst there are areas of divergence, Levinson's work builds on

that of Erikson and sees a defence member who works from 17 to 65, transition through nine developmental periods. Together with the popular literature and a back-cast to William Shakespeare's Seven Ages of Man in "As You Like It" (Shakespeare, 1599), they make for a rich commentary on the aging of man and provide a platform from which to look at people at different ages and stages of life to determine clues on how best to manage and lead them, if you are to retain them. Having explored these different theories, I believe there is value in applying the principles of the three main approaches to the problem. My goal in the research was not to identify the 'best' generational theory, but to instead highlight the main lessons from the overall literature that could be applied to the ADF.

The next step was to research ADF as a whole and by Service (Army, Navy Air Force) to determine:

- the current structure and make-up of the generations within the Services and;
- examine the evidence to determine any patterns or trends impacting retention.

This was a lengthy process requiring examination of significant amounts of data and questioning the workforce planners approaches to managing people capability from all three Services (CMDR K.R., 2019a, Robinson, 2019, Group, 2019, Hindmarsh, 2004, General, 2014).

Following this examination, it was necessary to determine the reasons that people leave the ADF. This was challenging. The ADF conducts exit surveys of members as they leave the ADF, but they are not compulsory. Exit Interviews are administered through multiple choice question response forms. The questions change over time and there is no compulsion to complete the survey, so any analysis has to be caveated against the fact that only a proportion of leavers answered the surveys and against the set of question asked at the time (K.R., 2019).

It was possible to access data from 2001 to 2017 and to gain a reasonably good understanding of the reasons people gave for leaving and how that changed over time. In general, due to lack of rigour there is limited value in what can be discovered from Exit Survey answers. There was sufficient evidence available for an exploratory study like this, but a more detailed follow-up study would need to address this lack of data (maybe by collecting its own primary evidence).

FINDINGS

Research allowed for a solid understanding of generational theory and the differences and similarities between the various hypotheses was established. There are proponents, such as Snow and Harber (Maureen Snow Andrade, 2018, Harber, 2011) and critics, such as Jorgensen (Jorgensen, 2003), of generational cohort theory. Much of the popular literature appears alarmist and designed to sell a product or policy. Making a generalised, oft repeated point, "that something must be done about the newest generation to enter the workforce, because they simply are not up to it" (Jaksch, 2018, Holman, 2019, Cunningham, 2014, Ferri-Reed, 2016)! This has occurred most recently and dynamically with the Gen Y or Millennial generation, where popular headlines suggests "that they have a low attention span, keep jumping ship, have no loyalty and constantly challenge authority" (Jorgensen, 2003, Zemke R, 2013).

The author recalls entering the workforce at 17 (as a Baby Boomer) and being told that as a:

> 'youth of today', "you just don't get it! Your work ethic is wrong. You are rebellious, undisciplined, punching above your weight and failing constantly to understand your place in society (on the bottom rung of a long ladder)".

Though this is headline grabbing and allows for the "5 tips and 10 reasons type culture" (Reuteman, 2015, Ganapathy, 2016), popular literature offers only generalised views on how and why people behave the way they do in the workplace. By contrast, Levinson and Erikson tell more about the way populations age and the experiences they share as people mature through life (Sheehy, 1976). Do career managers in the ADF ask defence members how they are getting on with finding a partner or, were they coping through the mid-life crisis? These are both life experiences and findings from Levinson and Erikson's academic work that people face that significantly influence them in their 20's and 40's.

According to the 2018 Department of Defence statistics (Defence, 2018), the ADF employs people from age 16 – 70+ (Generation Z to Baby Boomer inclusive). The Strategic Leaders are Baby Boomers and Generation X and fall into the category of Levinson's Middle Adulthood. ADF new joiners are predominantly Generation Z and in the Levinson's period of Early Adult Transition. Taking a snapshot of the ADF Workforce as of 1 May 19 it is possible to view it through the age lens against theoretical models as shown in Table 1.

Table 1 is a model developed as an instrument against which generational theory may be applied and assessed with respect to the ADF. It is designed to assemble the component age groups of the ADF workforce, showing how many there are in each age group, what percentage they form of the overall workforce with their ranks and associated skill progression. This data is then aligned to what the literature tells us about generational theory, offering insights, according to the proponents, on what a particular age group may be experiencing at that time of their life.

An interpretation of Table 1 reveals that 75% of the workforce are under 40, and largely comprise Generation Y and Z. The ADF is generally a young workforce with a median age of 31.2 years (CMDR K.R., 2019b). Although there are leaders throughout the organisation at every rank, the majority of leaders are in this under-40-years cohort, and a third of them are in Levinson's Age 30 Transition and Settling Down period where they are building and investing in the life they have chosen for themselves, while dealing with Erikson's Intimacy vs Isolation stage, which focuses on their life choice to share and accept love through establishing a family.

See Table 1 on page 25.

ADF Senior Leaders are mostly Gen X with some Baby Boomers. Gen X were generally not known for their people skills (Wooten, 2010) and much of the attempts to improve the culture of the ADF within the three services has been to bring in 360 degree reporting that allows leaders to get a view from their subordinates, peers and superiors on how constructive or defensive they are as leaders. Through follow-up coaching, leaders can change for the better.

With an understanding of age-related theory around how defence members might behave differently depending on age, what motivates them and what they value, ADF leaders should be enabled to get the most from their people through their working lives. Good use of Emotional Quotient (EQ) skills (Council, 2018) allows leaders to address Herzberg's motivation and hygiene factors (Herzberg, 1964), compare and contrast the reasons given for leaving the ADF with the Job Satisfaction and Job Dissatisfaction criteria of Defence members and thus improve the chances of retaining them in the workforce:

See Table 2 on page 26.

The Most Important Factor - Lest We Forget, 2019 Remembrance Day Melbourne (image Jay Cronan).

It is important that ADF leaders consider both the Satisfaction and Dissatisfaction criteria if they are to successfully retain members in the ADF.

CONCLUSION

Research revealed that there are distinguishable age groups within Defence that pose identifiable retention challenges. Many who never had a desire for a career, seemingly leave at the 4-6-year point. The most jobs exist amongst the lower ranks and we cannot promote or advance everyone. The challenge is to try to keep the good ones. The next big departure point is around 8-10 years of service. ADF has always needed people to leave at these points to sustain the hierarch based on front end recruitment (as teenagers). An analysis of the 2001-2017 ADF *YourSay Exit Survey* results (provided by the Directorate of People Intelligence and Research) revealed that the most common reason cited by Navy members for wanting to leave in the early years is to begin a new career; an expected rationale for departing. The next most common reasons, however, were found to be a lack of motivation, job satisfaction and poor leadership. This finding is a concern and should be given prominence, as it suggests that "people leave their bosses not their jobs"(Reed, 2018). These points can all be addressed through improved leadership of our people and one way to achieve that is to better understand how we age and generational theory, it appears, can support that knowledge.

Discussion with the workforce planners of the three services reveals that the RAN are aggressively addressing retention concerns through a number of measures that support the newly introduced Total Workforce Model, a scheme that addresses Jorgensen's previously discussed concerns (Jorgensen, 2003, p.48). Amongst those were the introduction of the Navy Retention Incentive, a series of financial payments aimed at inducing members to stay an extra year in service. A focused Retention Working Group are working through 500 ideas from the front line on what will keep people in service and Project Verto is looking at the structure of the Career Management Agency and creating change to include the professionalisation of the Career Managers which will see them imbued with training in the basic HR tools, HR soft skills such as EQ, decision-making and bias training and an opportunity to further specialise as a Strategic Maritime HR Officer. A recommendation from this study is to include a class and study of generational theory into the training of Career Managers to support their knowledge of Navy members and better enable them to guide their careers.

Navy might remind themselves of the findings of the ANAO Report of 2014 (Office, 2014), which urged Navy to:

> "evaluate the impact of retention bonus schemes on the Navy workforce and determine the future role of retention bonus schemes with its overall workforce strategy".

Having measures of success in place to monitor the introduction of the Incentive payment and the changes in how careers are managed will help identify the true nature of the difference that these changes are making. Elsewhere, Army and Airforce are in the early stages of focusing on retention having in Army's case just completed extensive evaluation of recruiting. It is recommended that Army and Airforce are mindful of the findings of this research into generational theory and look to where they might include the conclusions in the further education of their leaders. ■

About the Author: Captain Jim Hutton OBE RAN served in the British Royal Navy (as Midshipman) and the Royal Marines (as Colonel and Acting Brigadier) before moving with Sally to Australia in 2012. This paper represents research undertaken for Captain Hutton's Master's Thesis in Defence and Strategic Studies at Deakin University.

Age	Number in ADF Permanent Force as of 1 May 19	%age of Workforce	Year of Service (YoS) if joined at 17	Enlisted Rank	Enlisted Skill progression	Officer Rank	Officer Skill Progression	Shakespeare Age "As You Like It" Seven Ages of Man, 1599	Generation Cohort (Grubb, (2017)	Levinson's Life Stages Daniel J. Levinson with Charlotte N, (1979)	Erikson's Stages of Psychosocial Development Erikson (1959)
Younger than 20	2367	4.02	1 to 3	E1	Trainee	01	Trainee	Then a soldier, Full of strange oaths and bearded like the pard, jealous in honour, sudden and quick in quarrel, Seeking the bubble reputation, Even in the canon's mouth.	**Gen Z** Tech savvy, diverse and inclusive, job stability, shorter attention span, independent thinkers, collaborative	Early Adult Transition (17-22) **QUESTIONING**	Adolescence Identity vs Role confusion (13-21) **FIDELITY**
20-24	11591	19.67	4 to 8	E1/2/3	Proficiency	01/2	Trainee & Primary Qualified		**Gen Z, Gen Y**	Entering Adult World (22-28) **TESTING CHOICES AND EXPLORING POSSIBILITIES**	Young Adulthood Intimacy vs Isolation (21-39) **LOVE**
25-29	12639	21.45	9 to 13	E2/3/4	Specialist	02/3	Primary Qualified & Specialist		**Gen Y** Tech proficient, flexible, teamwork, diversity, corporate citizens, communal, optimistic, instant feedback, multi-taskers, need supervision and structure	Entering Adult World (22-28) & Age 30 Transition (28-33) **BUILDING LIFE STRUCTURE**	
30-34	9920	16.84	14 to 18	E4/5/6	Supervisior	03/4	Specialist & Charge	And then the justice, In fair round belly with good capon lined, With eyes severe and beard of formal cut, Full of wise saws and modern instances; And so he plays his part.		Age 30 Transition (28-33) & Settling Down (33-40) **INVESTING IN LIFE STRUCTURE**	
35-39	7280	12.36	19 to 23	E5/6/7	Manager / Regulator	04/5	Charge & Command		**Gen Y, Gen X**	Settling Down (33-40) **INVESTING IN LIFE STRUCTURE**	
40-44	5078	8.62	24 to 28	E7/8/9	Mentor	05	Command & Staff		**Gen X** Realists, independent, resourceful, creative, adaptable, entrepreneurs, work/ life balance, impatient, poor people skills	Mid-Life Transition (40-45) **– WHAT DO I TRULY WANT?**	Adulthood Generativity vs Stagnation (40-65) **CARE**
45-49	4893	8.31	29 to 33	E8/9	Staff	05/6	Staff			Mid-Life Transition (40-45) & Entering Middle Adulthood (45-50) **FORM A NEW LIFE STRUCTURE**	
50-54	3214	5.46	34 to 38	E8/9	Staff	06/7	Staff		**Gen X, Baby Boomers**	Age 50 Transition (50-55) – **TEST AND ADJUST NEW LIFE STRUCTURE**	
55-59	1707	2.9	39 to 43	E4 - 9	Staff	07/08/9	Staff	The sixth age shifts Into the lean and slipper'd pantaloon, With spectacles on nose and pouch on side, His youthful hose, well saved, a world too wide For his shrunk shank; and his big manly voice, Turning again toward childish treble, pipes and whistles in his sound.	**Baby Boomers** Driven, competitive, individualistic, dedicated, keep working, separate work and family	Age 50 Transition (50-55) & Culmination of Middle Adulthood (55-60) **FULFILLMENT**	
60-64	195	0.33	44 to 48	E4 - 9	Staff	08/9/10	Staff			Culmination of Middle Adulthood (55-60) & Late Adulthood Transition (60-65) **PREPARING FOR THE ERA TO COME**	
65-69	29	0.05	49 to 53	E4 - 9	Staff	04 - 9	Staff			Late Adulthood Transition (60-65) **PREPARING FOR THE ERA TO COME**	Old Age Integrity vs Despair (65+) **WISDOM**
70-74	2	0	54 to 58	E4 - 9	Staff	04 - 9	Staff		**Baby Boomers (Traditionalist)**	Late Adulthood **A NEW SEASON**	

Table 1: Generational Theory Model – A Comparison of the Numbers of ADF Workforce by Age, Rank, Length of Service with Generational Theory.
Sourced from Shakespeare, (1599), Erikson, (1959), Daniel J. Levinson with Charlotte N. Darrow, (1979), Wooten, (2010), Grubb, (2017), compiled by author.

Reasons for leaving the ADF	Herzberg's Factors for Satisfaction	Herzberg's Factors for Dissatisfaction	Reasons for leaving the ADF
	Achievement	Company Policies	General dissatisfaction with service life
	Recognition	Supervision	Poor leadership from immediate supervisor
Low job satisfaction	The work itself	Relationship with supervisor and peers	Issues with day to day management of personal matters
	Responsibility	Work conditions	Low morale in work environment, Impact of job demands on family/personal life, Desire for less separation from family
Better careers in civilian life. Limited opportunities in present Category/ Corps / Mustering /Specialisation /Primary qualification	Advancement	Salary	
Limited opportunities in present Category/ Corps / Mustering /Specialisation /Primary qualification	Growth	Status	
		Security	Change while still young enough

Table 2: Herzberg's Motivation-Hygiene Theory with Top Reasons cited by ADF Members as 'very important' or 'extremely important' reasons for leaving over period 2013-2017 grouped against the criteria.

Source (Herzberg, 1964) and K.R, 2019) compiled by author.

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1ST PLACE

HMS FIJI AGAINST THE LUFTWAFFE:
CRETE, 22 MAY 1941

By Peter Cannon

22 May 1941. 1615. Three of the Royal Navy's most modern warships, the light cruiser HMS FIJI flanked by HM destroyers Kandahar and Kingston, were retiring from the Kithera Channel, course 170°, speed 27 knots. Astern, off the northwest tip of Crete, the burning wreck of HMS GLOUCESTER remained visible on the horizon, her final position marked by towering clouds of black smoke against an overcast sky. The stricken cruiser's crew, either making their way over the side or already struggling in the water, had cheered FIJI as her men launched 11 of their precious Carley floats and six Floatanets whilst circling their erstwhile consort for the final time.

HMS FIJI (58) Crown Colony Light Class Cruiser.

INTRODUCTION

By mid-1941, the threat posed to warships by well-trained and highly motivated *Luftwaffe* bomber units was well appreciated by British and Australian forces fighting in the Mediterranean. [1] However, the weight of aerial attack brought to bear upon Admiral Andrew Cunningham's Mediterranean Fleet during the Battle of Crete was both unprecedented and breathtaking in scale. Neither side believed it possible to take the island with airborne troops alone; the key to victory or defeat would lie with seaborne reinforcements transported in hastily-formed flotillas of small coastal vessels. Cunningham was determined to hold the line in the Aegean Sea utilising light forces of cruisers and destroyers, backed by a division of battleships operating west of the Kithera Channel, the Aegean's western entrance.

To support their assault, the Germans concentrated an enormous force of dive bombers, high level bombers and fighters across the Peloponnese, Greek Islands and the Italian Dodecanese. With his one aircraft carrier replenishing its depleted air group and the decimated RAF driven from Crete, Cunningham was forced to combat enemy airpower with nothing but his ships' anti-aircraft batteries. The attack began on 20 May and at first, with German attention concentrated against targets ashore, the fleet was able to dominate the Aegean and, despite the loss of the destroyer JUNO on 21 May, annihilate one of two German convoys in the early hours of the 22nd. [2] But as the sun rose, the *Luftwaffe*, determined to exact retribution, turned its firepower upon the Navy.

HARD DECISIONS

For FIJI'S commanding officer, Captain Peveril William-Powelett, leaving GLOUCESTER to her fate was his only practical course of

HMAS PERTH (D29) from HMS GLOUCESTER (62) during the Battle of Matapan, March 1941.

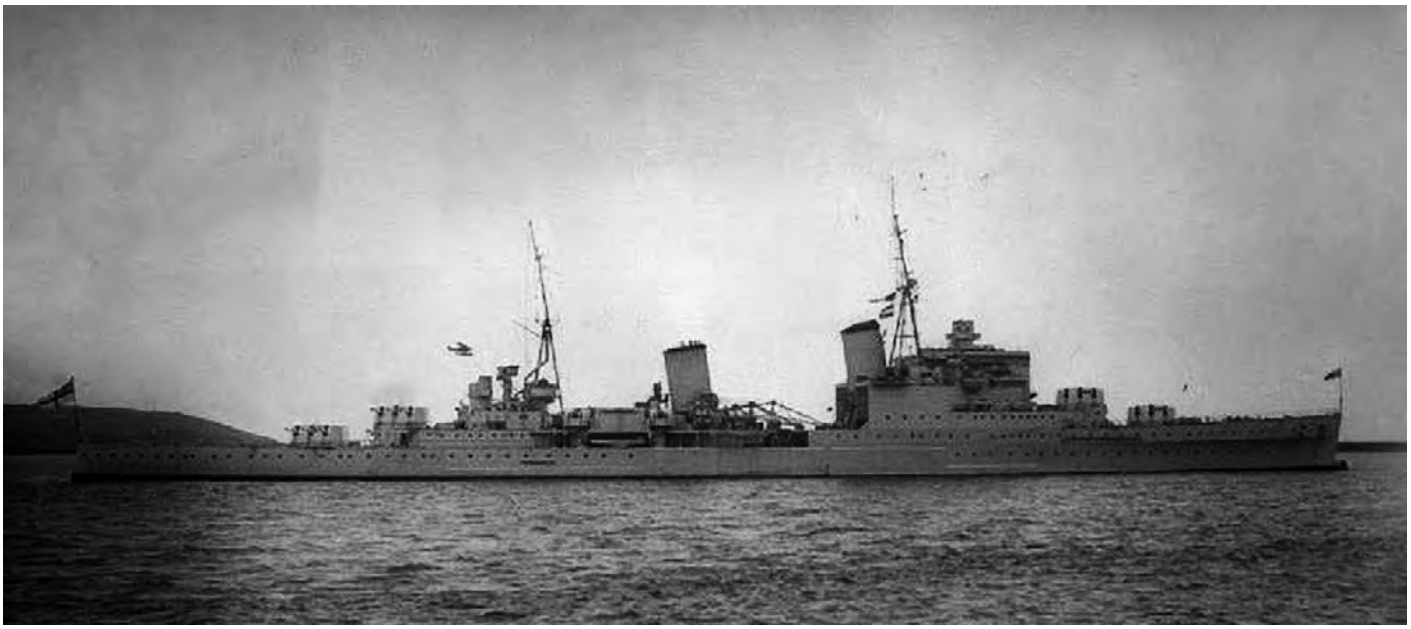
action. His command was damaged; near misses from aerial bombs having assailed the ship with splinters and blast, knocking out her only radar set, port torpedo tubes and crane as well as the port forward 4-inch mounting and two of four turbo-generators. Both destroyers were down to approximately 65 tons, or 13% capacity of oil fuel and increasing power above 27 knots would dramatically increase consumption. [3] But most significantly, the small detached force had entered the fight an hour previously already critically low on heavy anti-aircraft ammunition; FIJI with less than 320 of her warranted 1,600 rounds and the hordes of German aircraft, within easy reach of their own airfields, were not finished yet.

Thereafter, Rear Admiral Edward King's cruisers NAIAD, PERTH, CALCUTTA, CARLISLE and destroyers NUBIAN, KANDAHAR and KINGSTON, were driven away from the second convoy and out of the Aegean under a hail of bombs. Battered and almost out of anti-aircraft ammunition, they were succoured by Rear Admiral Bernard Rawlings' advancing battlefleet as they exited the Kithera Channel just before 1400. However, the destroyer GREYHOUND, detached from the battleships' screen to sink a lone caique full of German soldiers, was hit and sunk. King, assuming command of the combined force as senior officer, despatched KANDAHAR and KINGSTON to the rescue before ordering Rawlings' GLOUCESTER and FIJI to support them without enquiring into the state of the cruisers' already critically depleted ammunition. The detached ships were singled out for attack and as the fleet retreated to the southwest, GLOUCESTER was soon reduced to firing starshell at the diving bombers before the inevitable disaster ensued.

TECHNOLOGICAL ADVANCES

The RN had taken the technological challenges of anti-aircraft defence seriously throughout the inter-war period. But over 18 months of war experience had found the fleet's existing ordnance and control systems inadequate in both capability and quantity. While remediation measures gathered pace in home ports, Cunningham's hard-worked Mediterranean ships still fought largely in their pre-war configurations. Despite having only recently arrived from the UK, FIJI was no exception.

The 12 month-old, 10,700 ton (full load) cruiser fielded four of the excellent twin Mark XIX 4-inch heavy anti-aircraft mountings while her four triple Mark XXII main armament turrets could employ high explosive (HE) 6-inch shells at modest angles of elevation. But the capability of the High Angle Control System (HACS), directing the 4-inch weapons, ranged from poor against high-flying targets to useless against diving aircraft while 6-inch direction was little more than guess work. Their most effective use was barrage firing; shells being fuzed to detonate at pre-set altitudes through which pilots would have to fly. The close-range outfit, two quadruple Mark VII 40mm pom-pom and two quadruple Mark II 0.5-inch machine gun mountings, lacked the high muzzle velocity, hitting power and off-mount remote direction facilities needed to make them effective. [4]



HMS GLOUCESTER (62) circa 1939.

HMS KANDAHAR (G28).

BACK TO CRETE

As senior officer of the surviving detached ships, William-Powelett steamed south to make distance from the German airfields as rapidly as possible instead of regaining the support of the battlefleet; then slowly opening the range over the horizon on a divergent course. Despite the lure of two nearby battleships, the *Luftwaffe* proceeded to throw almost its entire weight against FIJI'S force throughout the remainder of the afternoon and evening. With ammunition supplies dwindling, the situation the near exhausted ships' companies found themselves in was desperate.

Attacks were unceasing. With complete air superiority and close to resupply of both fuel and bombs, the Germans discarded the necessity of choreographing the usual *gruppen* or *staffel*-sized formation attacks. [5] Instead, swiftly rearmed aircraft often approached in small groups or even individually, subjecting the ships to practically continuous 'shuttle bombing'. KINGSTON, temporarily isolated having fallen behind while taking avoiding action, was forced to increase to maximum speed and suffered nine attacks in 25 minutes whilst catching up. But FIJI was undoubtedly the primary target; the destroyers firing umbrella barrages of 4.7-inch HE over the cruiser up to the maximum 45° elevation of their guns. It was impossible to discern any distinction or maintain a clear impression of individual attacks as sailors, ordnance and machinery were pushed to the limits of endurance.

Despite the extemporized nature of the raids, high-level Dornier Do 17s, shallow-diving Junkers Ju 88s, high-diving Ju 87 'Stukas' and Messerschmitt Bf 109s acting as fighter-bombers, still cooperated to employ sophisticated tactics. Dive bombers gathered astern and on each bow while high-level aircraft bombed from abaft the beam. As soon as the bombs fell, the aircraft astern would dive in close formation, line ahead and firing their wing-mounted machine guns before the bow formations attacked in turn. Some dived before suddenly pulling out to attract fire or induce premature alterations of course while fighters, having dropped their bombs, conducted low-level strafing runs against exposed personnel.

Accounts testify to the incredible skill and bravery of the German pilots; especially those flying Stukas screaming down in near vertical dives. Of the 12 dive bomber *gruppen* in the *Luftwaffe's* order of battle, no less than nine were in action over Crete and surrounding waters that afternoon, having already accounted for GREYHOUND and GLOUCESTER. Highly manoeuvrable, these aircraft could absorb tremendous punishment and still remain airborne. One by one they were tipped over to stand on their wings before plummeting earthwards at angles of between 70 and 80°; dive brakes extended to ensure near constant rates of descent. Once committed, pilots flew a straight trajectory down to a bomb release height of between 300 and 500 metres. The lower the release height, the better the accuracy and as a manoeuvring vessel slid out of the cockpit crosshairs, pilots corrected for the change of course as well any strong winds on the way down.

LEARNING ON THE JOB

As a newcomer to the Mediterranean, FIJI'S bridge team and gunners were learning on the job in the most challenging environment imaginable. The navigator, [6] relying on flawless visual reporting by the air lookouts, conned the ship throughout. He had only developed his system of dive bomber avoiding action earlier that day. All orders were for the application of full helm as the ship turned towards each incoming attack. Having swung approximately 60° the helm was then reversed to bring the ship back on course before another alteration as the next attack developed. Stukas were seen to correct their angle of attack if the helm was put over too early while their bombs, initially watched all the way down, were ignored after a quick glance to ascertain their likely detonation point to allow concentration on the next attack.

HMS GLOUCESTER (62) Sinking 22 May 1941, Image from a German Bomber.

Junkers Ju 87 Stukas foperating from Argos airfield (Greece) during Battle of Crete, 22 May 1941.

From the destroyers, FIJI was seen expertly weaving her way through exploding towers of water to port and starboard. The cruiser was straddled a number of times by several machines diving simultaneously from different bearings; on one occasion four or five bombs were in the air at once on different sides of the ship. With attacks coming in so close together, the evasive manoeuvres took on the appearance of a series of violent, high speed zig-zags. Meanwhile, the Germans were not having everything their own way as FIJI'S gunners returned fire. Despite the much maligned British anti-aircraft gunnery ordnance and control systems failing to bring any aircraft down, they undoubtedly influenced the determination with which attacks were pressed home and therefore their accuracy.

The main armament, fighting in divided control, formed the first line of defence utilising the ship's limited supply of HE shells. The forward group of A and B turrets were controlled by the main director control tower abaft the compass platform against targets approaching from ahead, while after control, atop X turret, defended astern with X and Y. All guns were loaded and elevated to their maximum 45° with each group trained onto lookout bearings to either port or starboard awaiting the next attack. The directors controlled their respective groups onto approaching targets and engaged at an estimated 6,000 yards with shells fused to detonate at 4,000 yards followed, if time allowed, by another salvo set for 2,000 yards approximately seven seconds later. As aircraft approached from each bow simultaneously, the director layer ordered A and B turrets onto opposite bow bearings by telephone communications; each turret thereafter engaging in local control upon the order 'Shoot'. The effect of the heavy 6-inch barrage was marked; frustrating a number of attacks by inducing pilots to rapidly alter course or drop their bombs early. However, the HE supply was near exhausted forcing the gunners to fire contact-fuzed anti-ship [7] and smoke shells in increasing quantities.

The men serving the three remaining 4-inch mountings were also forced to use practice, smoke and star shell mixed with the occasional anti-aircraft HE round to maintain some semblance of a barrage through which the Stukas had to dive. Only aircraft already well committed were engaged. Under the direction of the Air Defence Platform (ADP), abaft the compass platform, target indication and barrage control was provided by combinations of the single HACS director atop the after superstructure and two forward directors, one either side of the forward superstructure. [8] The ADP took over one battery utilising star shell control sights when a near miss temporarily disabled the after director. As the highly-trained gun crews maintained the precision drill required to sustain high rates of fire against the seemingly endless procession of dive bombers, there was no ammunition to spare for their high level companions who were allowed to bomb with impunity. By 1700, with the magazine almost empty, only the after port and starboard mountings [9] were kept in action; the grave reduction in firepower resulting in attacks being pressed further home.

RUNNING SHORT

As the 4-inch supply gave out, the 2-pounder pom-poms found themselves as the ship's primary means of defence. Close-range crews kept up a constant and accurate fire on each aircraft coming into range, especially Stukas in the final stage of their dives. The pilots were only free to pull out and manoeuvre after bomb release and would often drop early when confronted by heavy defensive fire. Several aircraft were seen to be hit and trailing smoke, some jettisoning their bombs well away from the force, but none were seen to fall. As the attacks continued, some automatic weapons overheated. Others suffered stoppages from ammunition miss-feeds and spent cartridges jammed elevation mechanisms. Gunners and ammunition supply parties, exposed to gun blast, machine gun and 20mm cannon fire from diving Stukas, Ju 88s and Bf 109s as well as splinters and spray from near misses, were also steadily taking casualties.

Every type of bomb in the German arsenal appeared to be raining upon FIJI; everything from heavy semi-armour piercing to small anti-personnel bombs. Some detonated deep like a depth charge as shock waves hammered the ship's side while others exploded on contact with the sea in showers of shrapnel. The battering the ship was taking kept damage control teams and engineers in the machinery spaces busy with the accumulating damage while the torpedo department struggled to sustain the ship's combat power requirements from the two remaining turbo generators as well as affect electrical repairs. [10]

By 1845 attacks were reducing in intensity. The destroyers were undamaged and FIJI'S propulsion plant remained intact as they continued their run to the south. However, at least two hours remained before the safety of full darkness and the cruiser's 4-inch magazine was empty. It was then that three Bf 109s armed with single heavy bombs dived from low cloud ahead of the ship; one of the bombs landing extremely close alongside to port as FIJI began to answer the helm. 'A' boiler room took the brunt of the blast and rapidly filled with water amidst escaping superheated steam from fractured pipes and flooding open-faced boilers. Gallant efforts at stemming flooding in the adjacent forward engine room failed soon thereafter. There was also significant flooding on the lower deck above the two lost machinery spaces as well as port side forward up to the next watertight bulkhead including damage control

HMS FIJI (58) under attack, with bombs falling astern, shortly before her sinking (image IWM).

4-inch Mk XVI guns in 4 x twin Mk XIX mountings.

2pdr (40mm) Mk VIII guns in 2 x quadruple Mk VII mountings, 1,800 rounds per barrel.

headquarters, No. 1 transmitter room, the marine's messdeck and possibly two oil fuel tanks. Power failed in the forward half of the ship. With one of her two machinery units of alternating boiler and engine rooms lost, major flooding and a 25° list to port, exacerbated by the free surface effect of water sloshing around the large, semi-submerged messdeck, FIJI'S speed was reduced to 18 knots.

Damage control personnel once again went into action, topweight on the upper decks was manhandled over the side and a human chain formed to replace failed telegraph communications between the compass platform and the remaining after engine room. With counter flooding out of the question owing to the already dangerous loss of stability, correcting the list could only be achieved by rapidly affecting a complex redistribution of oil fuel utilising all available pumps and systems. But with key personnel otherwise engaged and uncontactable due to internal communication system failures, another crisis distracted attention. An open lubrication cross connection between the two remaining steam turbines, an innocuous state of affairs with the ship on an even keel, allowed the starboard turbine's vital lubricating oil to drain away to port, causing both engines to be stopped while the engineers attempted to establish proper system isolation and refill oil reservoirs. The turbines could still be turned and the shafts run in an emergency without lubrication, for a time, but at 1915 FIJI slowed to a stop and as darkness approached, so did another enemy aircraft.

LAST STAND – HARD LESSONS

The lone Ju 88 was spotted diving from dead ahead as S2 4-inch mounting fired its last ready-use rounds. It was also engaged by the starboard pom-pom; the powerless mounting being fought with hand operating gear. In the engine room, the throttlemen manning the manoeuvring valves frantically applied steam to the turbines in response to the unmistakable sound of renewed gunfire. But the ship's time had run out. Having been brought to her knees by continual near misses, FIJI'S fate was finally sealed by a direct hit. At least one bomb passed over the bridge at a very steep angle, penetrated the port hanger and detonated either just above 'A' boiler room or in the flooded space itself. The damage, unable to be ascertained at the time, wrought further destruction in the already largely flooded section of the ship and caused her to rapidly list past 30°. Furthermore, shock had damaged steam piping in 'B' boiler room causing the steam supply to the remaining turbines to slowly fail. Having lost their three and a half hour bid to escape, Captain William-Powelett ordered his exhausted crew over the side at 1930 to begin their own individual battles for survival. [11]

As night fell, the sea state increased and the water was far from warm. KANDAHAR and KINGSTON did what they could despite withdrawing for a time until complete darkness assured no further bombs would fall amongst the men in the water. FIJI finally capsized at 2015 and was last seen still floating bottom up. The destroyers were forced to leave a number of scattered survivors and withdraw at 2300 lest they both run out of fuel before reaching safety as other destroyers raced towards the scene. Tragically, Captain Lord Louis Mountbatten's KELLY, KASHMIR and KIPLING were urgently diverted to destroy German invasion craft approaching Crete while the extensive search conducted by Captain Hector Waller's Australians in STUART, VENDETTA and VOYAGER fell victim to an apparent error in FIJI'S final position as received from Rawlings' flagship. All those remaining in the water perished. While 780 officers and men survived, 257 were lost with the ship.

0.5-inch Mk III guns in 2 x quadruple Mk II mountings 2,500 rounds per barrel.

The action fought by HMS FIJI and her attendant destroyers was but one individual episode of a two-week battle in which British and Australian naval forces suffered grievous losses and damage attempting to single-handedly hold off the *Luftwaffe* in support of the Army. However, FIJI most certainly suffered one of, if not the most concentrated series of air attacks ever delivered upon an RN ship. Over 380 large bombs were aimed at the cruiser during the course of the afternoon. The limited ability of early-war British anti-aircraft systems to shoot down their targets is well documented. However, despite a number of losses, modern cruisers taking high-speed avoiding action under a full barrage, could keep attacking aircraft at a respectable and therefore relatively inaccurate arm's length and survive considerable weights of attack. [12] Captain William-Powelett, along with other survivors of 22 May 1941, was of the firm opinion that even though isolated, given sufficient 4-inch ammunition, both FIJI and GLOUCESTER could have fought their way clear. The fact that they failed was the result of a terrible tactical miscalculation amidst the heat of one of the Navy's most desperate battles. ■

HMS FIJI	
Main Armament	12 x 6-inch Mk XXIII guns in 4 x triple Mk XXII turrets 200 rounds per gun 1 x director control tower, 1 x after control position
Heavy A/A	8 x 4-inch Mk XVI guns in 4 x twin Mk XIX mountings 200 round per gun 3 x HACS Mark IV directors with 2 x calculating tables
Close Range A/A	8 x 2pdr (40mm) Mk VIII guns in 2 x quadruple Mk VII mountings 1,800 rounds per barrel
	8 x 0.5-inch Mk III guns in 2 x quadruple Mk II mountings 2,500 rounds per barrel
Torpedoes	2 x TR (Triple Revolving) Mark IV** mountings 6 x 21-inch Mark IX** torpedoes
HMS KANDAHAR and HMS KINGSTON	
Main Armament	6 x 4.7-inch Mk XII guns in 3 x twin Mk XIX mountings 250 rounds per gun 1 x director control tower, 1 x 12ft combined rangefinder – high angle director
Close Range A/A	4 x 2 pounder (40mm) Mk VIII guns in 1 x quadruple Mk VII mounting. 1,800 round per barrel
	8 x 0.5-inch Mk III guns in 2 x quadruple Mk II mountings 2,500 rounds per barrel
Torpedoes	2 x PR (Pentad Revolving) Mark II mountings 10 x 21-inch Mark IX** torpedoes

Table 1: Surface and anti-aircraft armament as fitted, May 1941

NOTES

[1] The modern cruiser HMS *Southampton* was sunk and the aircraft carrier HMS *Illustrious* heavily damaged by German dive bombers upon their Mediterranean debut in January 1941.

[2] *Juno* was lost to high-level bombing attack by Italian aircraft.

[3] At full load displacement, *Fiji* was designed to achieve 32.25 knots on 80,000shp while the K Class destroyers were rated at 32 knots on 40,000shp.

[4] The only effective close-range weapon in service in May 1941 was the recently introduced 20mm Oerlikon, but while a number of *Kandahar* and *Kingston's* sisters, newly arrived from the UK, carried two each, Fiji and her escorts fought without them; the destroyers making do with their as-built single Mark VII pom-pom and two 0.5-inch mountings. British destroyer policy at the time was to substitute a single 4-inch anti-aircraft gun in lieu of their after set of torpedo tubes but neither ship had yet received this modification.

[5] A nine-aircraft *staffel* was similar to a British squadron, but the nominally 30-aircraft *gruppen*, roughly equating to a British wing, was the smallest administrative unit and routinely operated together.

[6] Lieutenant PJ Norton, RN.

[7] Common Pointed, Ballistic Capped (CPBC).

[8] The after director fed a dedicated calculating table below decks while the two forward directors shared a second table. The 4-inch battery on each broadside could either be controlled by the after director and table or by the forward director on its own side utilising the forward table.

[9] P2 and S2 mountings.

[10] Prior to the post-war creation of the weapons electrical branch, the seamanship division's torpedo departments were responsible for electrical power generation, distribution and maintenance.

[11] The ships boats had been shredded by splinters and only three damaged Carley floats and a few Floatanets remained.

[12] The big, unwieldy Kent Class cruisers *Cornwall* and *Dorsetshire*, rapidly sunk by Japanese carrier-based dive bombers in April 1942 are notable exceptions.

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HATCH: RS PRINCE VLADIMIR (SSGN - K549) of the Borei-A project completed its state test cycle with the Northern Fleet in preparation for the Borei-K class.

MATCH: USS CINCINATTI (LCS20) transits San Diego Bay en route to arriving at its Base Port for the first time.

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