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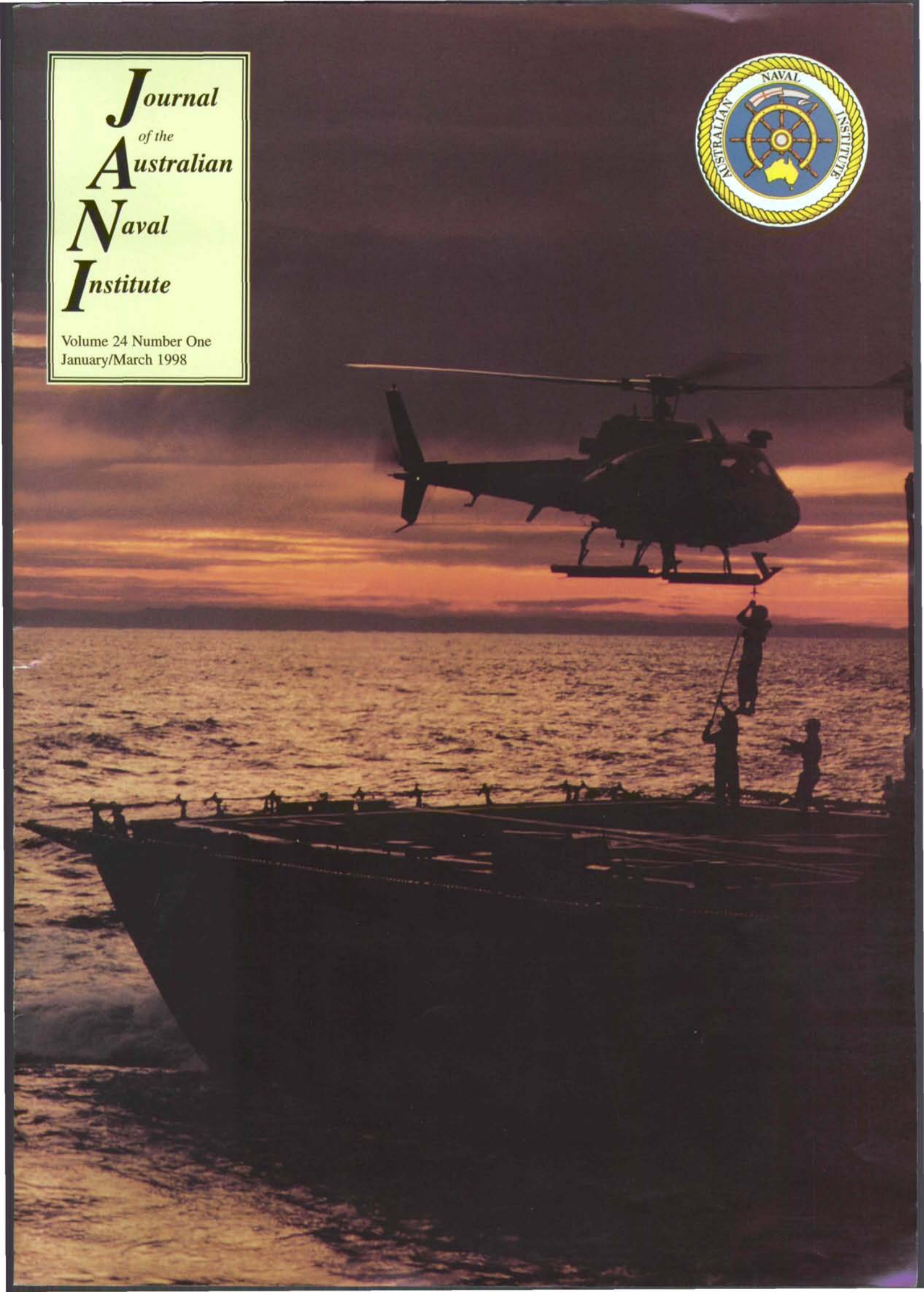

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The Australian Naval Institute was formed and incorporated in the ACT in 1975. The main objectives of the Institute are:

- to encourage and promote the advancement of knowledge related to the Navy and maritime profession; and
- to provide a forum for the exchange of ideas concerning subjects related to the Navy and the maritime profession.

The Institute is self-supporting and non-profit-making. Views and opinions expressed in the Institute's publications are those of the authors and not necessarily those of the Institute or the Royal Australian Navy. The aim is to encourage discussion, dissemination of information, comment and opinion and the advancement of professional knowledge concerning naval and maritime matters.

The membership of the Institute is open to:

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The *Journal of the Australian Naval Institute* welcomes articles and letters on any subject of interest to the Naval and maritime professions. In general articles should be no longer than 5000 words and should conform to the *AGPS Style Manual.* Spelling will be in accordance with the Editor's copy of the *Macquarie Dictionary.* Submission of a disk and hard copy is preferable. Enquiries, articles and letters may be directed to the Editor.

Journal of the Australian Naval Institute

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Cover – A Squirrel (HC723 Squadron) practises personnel transfers over HMAS MELBOURNE's *flightdeck.*

Back Cover – HMAS ANZAC *at sea.*

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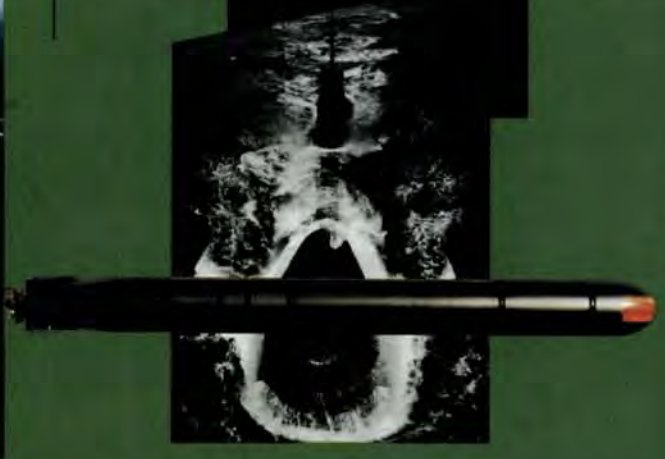

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From the President ...

During the last 12 months members of the Council have been examining ways to further the Institute's objectives, make it more relevant to the membership, and improve its management and operation. This is not new work: perusal of the Institute's files shows that these have been concerns of a succession of Councils. However, I believe that something must be done soon to invigorate the Institute or it will fade into irrelevance.

I have been concerned that, at a time of considerable change, there has been little or no debate within the Institute of the many issues that affect us as a professional organisation. I acknowledge that the means have been limited, but there have been few articles or letters submitted to the Journal Editor dealing with contemporary issues. I am hoping that we can stimulate activity at the local level to engender interaction and discussion, and ultimately improve both our understanding of the issues and our ability to translate that into our working environment.

We had a modest start in Canberra last year with presentations by Professors Van Creveld and Grunwald. But I intend to do better this year, and, as a starting point, have invited the Chief of Navy, VADM D. B. Chalmers, AO, RAN, to address the Annual General Meeting (AGM) on the evening of Tuesday, 24 March 1998 on the subject of the Strategic Review and its implications for the RAN. There can hardly be a more important topic for the Institute and VADM Chalmers is uniquely placed to discuss it, as he had a pivotal role in the formulation of the Review. He has kindly agreed to take part in a discussion period following his address and I urge all members to come and take part.

If the Institute is to be relevant and fulfil its Charter then these are the sorts of issues that we must tackle. They are also the issues that all of us should develop a sound personal understanding of, so that we can take the discussion into the community and into our workplaces. The venue will be Legacy House, 33 Geils Court, Deakin, ACT; with the evening commencing at 1900, for the AGM at 1930. VADM Chalmers' address will follow at about 2030.

I would hope that all members who are in a position to attend the AGM will do so. This is your Institute and the Council needs to know your views on its management and future development. There will be a number of changes to the Constitution proposed (reducing the size of the Council from 15 to 10, and some administrative measures to provide increased flexibility to the Treasurer), and I will be seeking your views on our future direction. Please make the effort to come along and participate in both the AGM and VADM Chalmers' address.

Finally, I would like to express my sincere appreciation for the efforts of the members of the Council over the last 12 months. At a time of increasing work loads they have put in a sterling effort, largely in their own time, to reshape the operation of the Institute.

Bill Dovers

From the Editor ...

Well this is an introduction and as the Navy would have it, a goodbye. Having recently finished a stint as Escort Officer to the Minister for Defence Industry, Science and Personnel, I am currently posted to the Directorate of Naval Officers' Postings as Staff Officer (Undergraduates). However, following in the footsteps of my predecessor, I have been posted to HMAS *Watson* from 1 June. The Institute is lucky to have Lieutenant Andrew Bewick as a volunteer for the position as Editor. Andrew is currently employed as the Escort Officer to the Minister for Defence and will take over the position from the AGM, on 24 March. His experiences 'on the hill' are sure to provide some topical and interesting input.

Personally, I enjoyed the opportunity to at least put one issue into print and I hope it meets your expectations. I should take the opportunity to thank Sue at National Capital Printing for her patience in getting me through – her expert advice proved invaluable. Thanks too to the regular contributors of the Journal. Of course, all our readers are encouraged to provide articles, no matter how short or lengthy, particularly any that are of current interest (our historical collection is fairly flush).

The Institute is entering a new phase as outlined in the President's words as its role in the era of technology is much different. I have enjoyed being part of this evolution, which began a number of years ago, during my time as Secretary. I wish the Institute and particularly the new Editor, every success for the future.

Wendy Bullen

THE AUSTRALIAN NAVAL INSTITUTE

Annual General Meeting

to be held at
Legacy House, 33 Geils Court, Deakin

Tuesday, 24 March, 7.00 for 7.30 pm

Supper and drinks to be provided

ILLUMINATION ROUNDS

Here are the thoughts of a Defence Academy third year Midshipman about 'Values' and leadership. Thought this might be of interest after the article on the *Australian Defence Force Academy in JANI 4/97.*

Ask just about anyone what sort of qualities and values a leader should possess and invariably, your list will look a lot like this:

Leadership Qualities

Motivation	Courage	Responsibility
Integrity	Selflessness	Initiative
Loyalty	Respect	Honour
Knowledge	Ability to Communicate	Judgement

Desirable Values

Honour	Integrity	Courage
Loyalty	Respect	Duty

Selfless service

Evidently there is a strong relationship between leadership and values. More often than not, the success of an organisation will depend largely on the quality of leadership of its members and the better the leadership, the better grounded it is on character and values. This especially applies to the military where rock solid values separate the real leaders from 'misleaders' such as Hitler and Stalin.

Due to the nature of the military, there is a relatively high congruence of values amongst its members, but it must be remembered that mere possession of the right values and leadership qualities will not guarantee the success of a leader. Training and education certainly play their part in the shaping of people's values and the Australian Defence Force Academy is a prime example. It is hailed as the 'University *for* Leaders' and whilst its cadets and midshipmen may already possess the desired qualities and values to be a leader, it is here that they are taught how to use those qualities to make the most of their leadership potential.

Unfortunately, some ADFA Graduates have the belief that once they have completed their three years at the Academy, they know all there is to know about leadership. This is not the case. The development of values and leadership is a lifelong process and there are many mistakes to be made along the way and so it is not only at institutions such as ADFA that we learn how to lead. After all, values are not something that can be taught in the classroom and many personnel will emulate the values displayed by the leaders they admire such: devotion to duty above self; honesty; loyalty and caring for subordinates. This is just one of the processes leading to our strengths becoming reinforced., We also learn to develop trust between ourselves and our subordinates in several ways. We lead by example with honesty and integrity and not be deceit or untrustworthiness.

It could be argued that honesty and integrity are two of the most essential values required for leadership. If we are to follow someone- be it during peacetime or into battle that person needs to be worthy of our trust. We see leaders as being honest when the leaders do as they say. If agreements aren't followed through, false promises are made, cover-ups occur or there are inconsistencies between word and deed, then the indications that this leader is not honest are very strong and it an lead not only to a loss of respect for the leader, but a break down in the unit.

General Alexander Patch considered the value of selfless-service to be a very important leadership quality, "Second to honesty and courage of purpose, I would place an unselfish attitude as the greatest attribute of a leader...Place the care and protection of the men first; share their hardships without complaint and when the real test comes you will find that they possess a genuine admiration for you. To do otherwise means failure at the crucial moment when the support of your men is essential to the success of the battle."

The bottom line here is that values and leadership are interrelated. The more sound a person's values, the more effective their leadership is – military or civilian. The school of values and leadership is one from which we never graduate. To be successful as a leader, you must accept and understand that leadership and values are ever changing and as a result, we are always learning.

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Letter to the Editor

Dear Sir,

On a recent trip to Canberra I visited the RAN Memorial located on ANZAC Parade. The Memorial was unveiled by Her Majesty the Queen in 1986 during the RAN 75th Anniversary celebrations.

On either side of the memorial are small cairns with bronze plaques listing the RAN's battle honours from EMDEN in 1914 to Vietnam in 1971. The RAN's most recent battle honour, however, is missing. HMA Ships *Sydney* and *Brisbane*, and Clearance Diving Team 3 were awarded the Battle Honour KUWAIT 1990-91 for the Gulf War.

It has been some years since the Gulf War, yet it appears no one has thought to update the memorial with our most recent battle honour. If the Navy does not take the initiative in looking after its own traditions and heritage no one else will do it for us. It is something that cannot be CSPed!

Yours sincerely,
Lieutenant Commander G. J. Swinden, RAN

A Royal Australian Navy Staff College Essay

Australia's Contribution to Peace in South East Asia: A Maritime Strategy

Major M. L. F. Spencer

'Australians now accept, not grudgingly but enthusiastically, the idea that the East Asian Hemisphere, within the wider Asia Pacific region is where we live, where we must find our security, and where we can guarantee our prosperity'

Senator Gareth Evans.

Minister for Foreign Affairs 1995[1]

Introduction

The demise of the Soviet Union and the diminution of the United States' presence has changed the balance of power in South East Asia and is reflected by an era of change and uncertainty. As the United States moves towards a policy of co-operative strategic leadership, its allies are expected to assume greater responsibility for their own security arrangements. Notwithstanding the fundamental importance of the ANZUS treaty to Australia and the reinforcement of political and military links with the United States since the recent change of government, Australia must assume a greater responsibility for its strategic security, and by extension, its responsibility to the maintenance of peace in South East Asia.[2]

Regional prosperity has continued to increase over the past decade, and the emergence of 'tiger economies' has prompted many powers to transfer new found economic strength into improved military capability in order to fill the vacuum left by the major powers. The navies of these regional powers are small with only a few claiming medium power status. These medium sized navies are each capable of contributing to the security and stability of the region, although increased projection of maritime power may also provide a catalyst for conflict.

Australia is a medium power, which as a maritime nation, is intimately tied to the strategically important region of South East Asia. Its interests are similar to those of other regional powers, and are potentially affected by political instability, international disputes and economic calamity. The enhancement of regional security is an important element of Australia's defence posture and is increasingly important to the maintenance of peace in South East Asia. Australia is strategically capable of contributing to regional peace and stability through a multi-dimensional strategy, par of which is maritime.[3]

To determine an applicable maritime strategy for Australia, this article will consider the nature of the South East Asian region and Australia's relationship with it, regional maritime interests and maritime security concerns. The region is considered to include the seven ASEAN nations (Malaysia, Singapore, Indonesia, Philippines, Thailand, Brunei and Vietnam), the remainder of Indo-China (Cambodia and Laos), Myanmar and the contiguous waters. The aim of this essay is to determine an Australian maritime strategy which contributes to peace in South East Asia.

The South East Asian Region

South East Asia is a distinctly maritime region, geographically consisting of archipelagos, islands and peninsulas which are traversed by the world's busiest sea traffic and trade routes. With the exception of Laos and Cambodia all states in South East Asia can be considered maritime nations and are characterised by coastal dwelling populations, whose focus for trade, commerce, domestic transport, and more recently security, is the sea. These nations are now placing greater emphasis on the control of offshore resources, the environment, security of Sea Lines of Communication (SLOC), seaborne trade, fishing rights and the law of the sea.

The region's countries have shown greater interest in their offshore development and its protection during the sustained period of economic growth. Such interest in maritime issues is relatively new, largely developing after the provisions of the 1982 United Nations Convention on the Law of the Sea (UNCLOS) and its ratification in 1994. Countries of the region with the exception of Singapore, have claimed extensive offshore resources encompassed by a 12 NM territorial limit and a 200 NM exclusive economic zone (EEZ).[4] The archipelagic regimes of the Philippines and Indonesia have gained most from the convention but for most nations, including Australia, the convention means

that their maritime jurisdiction now exceeds that of their land mass.[5] The expansion of national territory under UNCLOS has resulted in states finding common boundaries which had never previously existed. Australia, despite the relative isolation provided by the air-sea gap to the North-West, has also had to argue ownership of offshore resources.[6]

Geographically, Australia is an island maritime nation with interests extending into the Indian Ocean and the Indonesian Archipelago. Australia's relationship with the region has traditionally centred on Singapore and Malaysia under the Five Power Defence Agreement (FPDA), and through dialogue with Association of South East Asian Nations (ASEAN) and the recently formed ASEAN Regional Forum. Vietnam's admission to ASEAN and Australia's contribution to the Cambodian peace process have widened our commitment to include Indo-China.[7] The emergence of South East Asian communities vital to Australia's commercial interests and international relationships engaged Australia economically and politically to the region over the past decade.

Since 1989, the policy of comprehensive engagement committed Australia to the region as an equal partner. This foresaw Australia's gradual development and participation in a regional community based on a sense of shared security interests. The then Foreign Minister, Senator Gareth Evans, considered that regional security would be more effective if military capability was synergised with other relationships of common interest, and proffered that the security environment most favourable to Australia's interests would be multi-dimensional. This relationship would improve existing international links and incorporate all dimensions of politico-military, diplomatic and economic relationships.[8]

Australia has been proactive reticent in improving relationships with the region, conscious that national prosperity is intimately tied to the world's fastest growing economies. Reliance on shipping is paramount, and subject to the stability of a maritime regime which is largely controlled by our neighbours. Indonesia's claims for archipelagic status and the temporary closure in 1989 of Sunda and Lombok Straits, traditionally used by Australia, demonstrates the strategic importance and vulnerability of sea trade and communication routes which traverse the region.[9] Although the recently elected Australian government does not consider Australia part of South East Asia, it acknowledges the importance of maintaining links and improving both bilateral and multilateral relationships with the region.

Australia is strategically tied to a dynamic and potentially vulnerable region in which maritime interests increasingly dictate economic and security relationships. A comprehensively engaged Australia with economic and defence interests in the region presumes a strategic interest in the stability and well-being of our near neighbours. A claimant of status as an international citizen and proffering interest in the stability of South East Asia, Australia has a responsibility to assist in the protection of regional maritime interests in order to contribute to regional peace.

Regional Maritime Interests

Australia has a vested interest in the security of the region. Clearly, a medium power must itself be secure and provide for its own sovereign interests, specifically territorial integrity and political independence, before it can contribute to the security and stability of its region. Contemporary maritime strategist Rear Admiral J.R. Hill describes 'betterment' as a power's ability to initiate and sustain vital interests, paramount being national and international security.[10] Although Australia relies in part on its island status for security, a defence policy of self reliance is enhanced if the region and its interests are also secure.

Security of maritime interests has been considered a regional concern since the withdrawal of the stabilising influence of the United States. No longer faced with threats of land based insurgency, nations have increased maritime capabilities to control offshore resources and maritime boundaries. In this context, regional interests have increasingly focused on maritime issues concerning territory and EEZs, control of marine resources and activities that support national security and economic well being.[11] These can be broadly divided into: shipping and trade, offshore interests, and security and stability.

Shipping and sea trade are vital to the region, the bulk of merchant shipping depending on the Straits of Malacca, the Andaman Sea and the South China Sea for passage. National merchant fleets provide 99 percent of all intra-regional trade. Over 85% of Australia's international trade is carried by sea, 60 percent of it passing through or to South East Asia via the Indonesian Archipelago, and presenting concern of its control along unprotected SLOC.[12] This magnitude of sea trade is heavily dependent on transit rights and security, protection of which is inevitably a task for a medium power. Although the Radford-Collins agreement for National Control and Protection of Shipping allocates responsibilities for the security of regional SLOC, protection within South East Asia is by no means assured.[13]

Offshore interests include island territories, proximate oceans and natural resources both in and below the sea. Natural resources in the region are significant with 90 percent of all living resources, and half of the region's mineral and petroleum deposits encompassed by national EEZs.[14] Australia's proximate offshore

interests include the Cocos-Keeling and Christmas Island groups 200 NM to the South of the Indonesian Archipelago, which extend significant strategic reach into the region.[15] Within the EEZ are oil and gas platforms on the North-West Shelf, significant oil reserves in the Timor Sea (potentially constituting up to 70 % of Australia's undiscovered reserves), and extensive fishing grounds. The location and ownership of any significant offshore assets inevitably leads to ownership disputation regarding sea and seabed boundaries due to disparate interpretations of UNCLOS.[16]

Paramount to regional security and stability is international agreement on the status of territory, maritime boundaries and rights of passage. UNCLOS provides the determination of such maritime issues, however not all aspects of the convention are clear. Specifically, the basis of archipelagic regimes such as the Philippines and Indonesia and the delineation of maritime boundaries on EEZs and continental shelves are a common cause of disagreement. These have resulted in the imposition of coastal state jurisdiction, in some cases amounting to claims of sovereignty. The Spratly Islands is such a case, with Vietnam, the Philippines, Malaysia, Indonesia, Brunei, China and Taiwan making claims to all or part of the archipelago. The protection of maritime interests presumes a degree of threat or tension which may affect sovereignty and regional relationships. Even during peace domestic, bilateral and multilateral tensions will inevitably cause concern over regional security.

Maritime Security Concerns

> *'... war can be superannuated by elimination of its causes and the development of positive methods for the preservation of peace.'*
>
> Sir Thomas Barclay MP, 1911[17]

Although South East Asia is euphemistically termed 'at peace', it is nevertheless appropriate to consider the degree of tension or threat which exists. Sir Thomas considered peace to be the normal condition of mankind, although a more pragmatic approach would consider peace to include threats of force and projection of power within controlled parameters. Hill states that conflict occurs in four levels, the lowest being 'normal conditions', escalating through conditions of low intensity operations to higher level operations and peaking with general war.[18] Normal conditions incorporate controlled change through negotiation, accompanied by constabulary force and deterrence at internationally accepted levels. If not contained, normal conditions may escalate to conditions of low intensity operations which have traditionally focused on counter-terrorism and counter-insurgency. Low intensity operations include demonstrations of threat often accompanied by related acts of violence limited to proportionate self defence under international law. These in turn may lead to conditions of higher level operations, defined as organised hostilities with both adversaries using fleet units and weapons.[19] General war inevitably involves a superpower and is beyond the capacity of a medium power to deal with independently. Within South East Asia a state of relative peace exists. In this region, peace is considered to incorporate conditions of normal and low intensity operations, but is accompanied by the potential escalation to conditions of higher level operations. To maintain peace a diverse range of tensions have to be controlled, ranging from ethnic and religious concerns, piracy and illegal immigration to claims over territory supported by military force.[20]

Peace within South East Asia is accompanied by tension rather than threat. The heightened influence of Islamic extremism particularly in the Philippines, Indonesia and Malaysia is monitored cautiously by the region's nations. Domestic instability, poverty and ethno-nationalism in Thailand, Indochina and Myanmar continue to generate illegal transnational migration, characterised by movement of refugees, piracy and smuggling on the region's waterways. These domestic issues in conjunction with the control of shipping and marine pollution, are particularly sensitive to ASEAN nations and have the potential to disrupt the region's maritime environment.[21] Of greater concern are territorial disputes between members of ASEAN, notably over the Spratly Islands, but also between Malaysia and each of Thailand, Singapore, the Philippines, Indonesia and Brunei.[22] Although these internal tensions are generally controlled, threats from outside of the region present more volatile challenges.

Escalation to higher levels of conflict in North Asia and the Indian Ocean would be unlikely to affect South East Asia directly. However, confrontation between mainland China and Taiwan, North and South Korea, or suspected nuclear powers Pakistan and India could restrict sea passages linking South East Asia to major trade routes in the Pacific and Indian Oceans. Other concerns from outside the region include India's military presence in the Andaman Sea and her capacity to control the Malacca Straits, and China's increasing military capability and readiness to use force in support of claims for the Spratly Islands[23] Dialogue through regional military and economic forums are constructive in redressing such tensions but do not definitively correct the causes.[24]

Intra-regional maritime security issues are often addressed through ASEAN which risks the isolation of Cambodia, Laos and Myanmar. External influence is generally unwelcome due to sensitivities regarding sovereignty and there is no role for an outside medium

power acting as a regional mediator. As a near neighbour with defence links with the United States under ANZUS and formal defence ties with Malaysia and Singapore under the FPDA, Australia represents a credible and acceptable presence in the region's waters. A fundamental concern in the region is the security of SLOC and maritime focal areas, disruption threatening the economic well-being of both the region and Australia. Australian naval forces may well represent an acceptable contribution to security through a co-ordinated regional partnership.

A Maritime Strategy for South East Asia

The United Nations charter states that a nation's vital interests are territorial integrity and political independence.[25] Although a medium power is presumed capable of protecting its vital interests, a maritime strategy for South East Asia cannot be divorced from Australia's national strategy. The 1994 Defence White Paper proffers that it is important to establish Australia on the global and regional scene through a multi-dimensional approach of foreign, defence, trade and international policies. It further states that '... defence policy contributes to this integrated effort in two ways – by ensuring that we are able to defend Australia from armed attack, by sustaining our alliances and contributing to a global and regional environment in which attack on Australia is less likely.'[26] The foundation of this strategy of defence in depth is self reliance within a framework of alliances. Importantly, the White Paper clearly gives priority to naval and air capabilities to deny northern sea and air approaches.[27] Paramount to defence in depth in Australia's military strategy, is a maritime strategy.

Australia's maritime strategy must account for national and regional interests, and adhere to constraints imposed by existing capabilities and a limited defence budget. Clearly, it must be proportionate to the level of threat and interests to be protected, and incorporate both Australian and regional alliances. As support of regional interests must be conducted using existing capabilities, a strategy has to account for both regional security and traditional tasks, and must possess a force structure which is sufficiently balanced and flexible to fulfil both peace and war fighting roles.[28] The execution of such a maritime strategy in the region will be limited by Australia's sea power.

Sea power describes the influence exerted by military and non-military means in pursuit of national interests. Classical strategists spoke of the sources of sea power (a maritime community, resources, style of government and geography) which lead to three more immediate elements. The elements of sea power are: merchant shipping to provide stamina to moe and supply a navy; bases to support and sustain naval activity, and fighting instruments such as warships and maritime aircraft.[29] Australia's sea power is limited when compared against the scale of her interests. The combined size of South East Asia, the Australian littoral and other areas of strategic interest is immense and precludes the use of sea power as the sole instrument of strategy. By comparison to regional nations however, Australia's sea power is significant.

Australia's sea power is characterised by an effective navy, viable operational support from bases, but a limited merchant fleet. Naval forces are Australia's strongest element of sea power with capabilities and training that are respected throughout the region. Traditionally relying on advanced technology to compensate for a relatively small navy, the edge provided by superior equipment can no longer be relied upon as regional navies improve maritime capability and weaponry.[30] Bases to support operations in the region include significant facilities at Cockburn Sound and more limited facilities at Darwin. Apart from the provision of landing and limited refuelling of aircraft on the Cocos-Keeling and Christmas Islands, Australia has no offshore bases in the region and would require regional support to sustain long term operations in areas such as the South China Sea. The scarcity of Australian flagged merchant ships is a significant weakness. The propensity to rely on foreign vessels for 96 % of Australia's shipping limits the capacity to support naval operations in higher levels of conflict.[31] Although her potential to sustain operations is limited, in terms relative to the region, Australia has sufficient sea power to assert limited sea control in South East Asia.

Sea control is the fundamental constituent of maritime strategy. Modern strategic thought affords two complementary dimensions of sea control: sea assertion, which uses the sea for your own purpose; and sea denial, which prevents the enemy's use of the sea for his purpose.[32] In this peace time scenario, sea assertion is broadened to encompass diplomatic means. The first component is the projection of goodwill and national commitment as an instrument of foreign policy. The second component is deterrence through a demonstrated intent to protect national and regional interests. Sea assertion through politico-military means is the basis of this peace time strategy.

A regional maritime strategy is an adjunct to the military strategy, and has common objectives. This strategy has four objectives: defence of the Australian mainland, proximate waters, offshore interests and territories; conduct of Maritime Confidence and Security Building Measures (MCSBMs); provision of a credible deterrent to small or medium powers capable of disrupting the regional balance of peace; and protection of strategically important shipping through maritime focal areas and choke points. The

defence of Australia must demonstrate a seamless application of military strategy from the Australian littoral into South East Asia. It presumes Australia's constabulary and surveillance responsibilities within sovereign territory, and focuses on regional strategy using diplomacy, deterrence and the protection of shipping.

The first tier of the strategy is the conduct of MCSBMs, the principle aim of which is regional goodwill. The use of surface warships and demonstration of military capability provides the basis of MCSBMs and includes exercises and joint training to improve navies' inter-operability, and a demonstration of visible commitment to the region. The expansion of the Defence Co-operation Program and individual training to include isolated Indochina, and joint operations for routine surveillance, security patrols and hydrographic tasks would be conducted during benign periods of activity. The diplomatic presence provided during port visits is significant and scope exists for deployments to friendly ports to sustain longer operations. Although presence achieves some deterrence through MCSBMs, goodwill must be backed by a significant and transparent deterrent capability.

The provision of a credible deterrent is the second tier of the strategy. Although the aim of a deterrent is to prevent a threat before it occurs, it must be backed by credible and regionally acceptable military force. Australia's deterrence is twofold. The possession of a strategic strike capability provided by submarines and F-111 aircraft, presents a considerable power projection capability within the region and although restricted to higher levels of conflict is an effective deterrent. Australia's framework of alliances, principally FPDA and ANZUS, and bilateral agreements provide further deterrence. Regional security remains outside the scope of ANZUS, but ensures dialogue and a means of engaging US influence in the region. A detailed surveillance and intelligence gathering capability is essential and is superimposed upon the national defence in depth. Combined with sea assertion over maritime focal areas, regular exercises to escort Australian and South East Asian flagged merchant shipping over SLOC, this projects both a capability and intent to react to interdiction and piracy of strategic shipping. Although such presence may deter domestic and external interference it must also provide for the use of military force.

The final tier of the strategy provides for the escalation of conflict, and in concert with regional navies primarily projects sea control. This provides for the diversionary re-routing of routine shipping, escort and protection of strategically important shipping, and controls focal areas and choke points for limited periods. Such assertion requires a willingness to use proportionate military force and is limited by both sea power and regional will. As a final consideration, the strategy must recognise when escalation to higher levels of conflict are inevitable, and invoke international support though treaties and alliances.

The effectiveness of this strategy can be analysed by considering its contribution to regional peace It should be capable of maintaining or improving the status of the current peace; preventing escalation within terms of the defined peace, and, responding to a limited escalation to higher levels of conflict. In the first instance, the strategy improves dialogue between partners, enhances social, political and cultural links to assist in overcoming emerging security concerns, and provides presence. In this aspect the strategy enhances the strength of the peace. In the second instance, escalation can be prevented through highly visible operations demonstrating a visible commitment of capability and intent to 'would-be' adversaries. The deterrence value of a strategic strike force and a wide knowledge of US commitment to Australia is likely to ensure that an adversary would carefully consider offensive action. Finally, the strategy deals with escalation to higher levels of conflict by use of proportionate military force within regional limits, protection of strategic shipping and an increase in power projection, in readiness to invoke alliance support.

Conclusion

South East Asia relies on the sea for its prosperity and security. As the focal point between the Indian and Pacific Oceans the region is traversed by the worlds busiest shipping routes and is dependant on a secure maritime environment. Australia's economic interests in the region are mainly maritime in nature and as shipping carries the majority of her trade through South East Asia, the maintenance of peace is vital. Australia's comprehensive engagement to the region has increased economic and security links, and conscious of the need for a stable neighbour, has a vested interest in contributing to a lasting peace.

Although the region is considered at peace, it is accompanied by tensions which have the capacity to quickly escalate. The economic growth of the region's powers has enabled greater budgets to be allocated to improve naval capabilities and weaponry, which in conjunction with tensions rising from territorial disputes in the region's waters, can quickly develop into conflict. Combined with threats to free passage and security of shipping, such security issues could disrupt both Australia's, and the region's economic welfare and security. Although the fundamental concern to Australia and the region is the security of the maritime environment, Australia can only execute a strategy for peace in co-operation with its neighbours.

Australia's strategy to the region must be applied on the basis of a partnership using diplomacy, deterrence and presence. The strategy must conform both to Australia's interests in which the main objective is the nation's defence, and also account for regional interests. Although Australia's sea power is limited when stretched to cover all strategic areas of interest, it is significant in regional terms, sustaining limited sea control, and providing the basis of a credible maritime strategy for the region.

A maritime strategy which contributes to peace in South East Asia must be proportionate to the level of threat and sensitive to the needs of the region. The strategy proposed encompasses such requirements within the framework of Australia's force-in-being and national strategy. It asserts sea control and a combination of international goodwill through joint operations and dialogue between neighbours, provides a credible deterrent backed by a combination of strategic strike and alliance support, and has the capacity to escalate to a higher level of conflict. A strategy is only a means to an end, and requires flexible application to suit a fluid environment. A strategy for South East Asia can contribute to peace if Australia accepts its commitment as an equal in the region.

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Challenges Facing Maritime Defence Industries: A Regional Assessment

presented by the Australian Minister for Defence Industry, Science and Personnel, The Honourable Bronwyn Bishop MP at the Malaysian International Maritime Conference on 4 December 1997.

"Distinguished guests, ladies and gentlemen.

Let me begin this morning by saying how pleased I am to speak at this conference, as part of my visit to Malaysia leading an Australian defence industry mission. My remarks will deal with the region of Southeast Asia with a focus on our host, Malaysia, and Malaysia's connections to Australia. However, in doing so, I recognise that the region cannot be considered in isolation from broader Western Pacific and East Asian concerns.

Geography

The sea is our highway as well as a source of food and energy. All our economies are dependant on it. Other factors also contribute to our complex maritime environment. A history of colonialism and changes of sovereignty has left ownership of some offshore territories open to dispute.

Added to these complexities is the coming into force of the UN Convention on the Law of the Sea including Exclusive Economic Zones and new laws covering the Straits and archipelagic waters. Difficulties which will no doubt arise will stem from new energy resource discoveries and the demands that rising populations place upon fisheries, which in turn can generate political tensions and acts of piracy.

Marine pollution in the region may threaten fish farming and related industries vital to the support of coastal populations. The recent fires in Indonesia have shown that pollution problems do not respect state boundaries.

Arms acquisitions and implications for regional security

The strong economic growth experienced throughout most of East Asia over the past two decades has facilitated impressive military modernisation programs.

Regional countries have been quick to harness the benefits of global developments in military affairs. A general trend is towards a broader suite of capabilities, structured around high tech conventional forces, particularly in the maritime field. These developments reflect a more prosperous, confident and outward looking region.

However within Southeast Asia we see no country acquiring capabilities disproportionate to their legitimate needs.

Regional Co-operation

Fortunately, the region has seen a strongly co-operative approach to dealing with many of these strategic issues. Some successful examples of multilateral mechanisms include:

- the ASEAN Regional Forum (ARF);
- the Council for Security Co-operation in the Asia Pacific (CSCAP);
- the South China Sea Indonesian Workshop series;
- the Malaysia-Thai Joint Area for off-shore development (MTJA); and
- the Australia-Indonesia Joint Development Area in Timor Gap.

I will comment more specifically on the potential for co-operation by defence industries as we proceed.

Malaysia/Australia defence relationship

In the context of strategic trends and co-operation, we might also take a moment to consider the Malaysia/Australia relationship. Our association is a long one that evolved through the Five Power Defence Arrangement. Our two defence forces retain a high level of operational co-operation, witnessed by our continuing deployment of fighter and maritime surveillance aircraft to Malaysia. But the emphasis has now shifted to a broader, mutually beneficial relationship which is more developmental than operational. We are focusing on co-operation in logistics, strategic planning, defence science, and defence industry.

Naval and Defence trends

Another factor in the equation is the changing nature of regional defence forces – particularly the navies.

Regional defence forces are changing their focus away from what has often been an internal security role, to that of national defence. Regional navies are

currently going through a significant evolution, as growing national wealth is translated into new, sophisticated weapons platforms and systems. This transition process has significant technology and financial implications. Effectively carrying out maritime defence, surveillance and patrol functions requires a complex and costly array of command, control, communications and intelligence systems that must be fully interoperable and capable of real-time data transfers between ships, aircraft, ground stations and headquarters.

The speed at which these systems are being developed and put into service may pose difficulties when we wish to integrate allies and partners into combined and coalition operations. But cost constraints are likely to lead to three further challenges:

- Beyond the acquisition programs currently planned, platforms will continue to age and be kept in service longer than anticipated. The challenge facing maritime industry is not one of shipbuilding per se, but increasingly will be one of upgrades to combat systems especially systems integration.
- The comparatively small inventories of individual ASEAN and Australian defence forces can be a major limiting factor in achieving economies and efficiencies of scale.
- There will always be competing pressures for the acquisition dollar. In Australia's case, however, the policy of the previous government of acquiring combatants "fitted for but not with" has proven to be an unwise decision. Hollow capabilities are a false economy.

Another challenge is the changing nature of the maritime threat environment. Except for the United States Navy most navies have their maritime investment tied up in a small number of hulls in the water. Should a ship be lost, it is likely that the capability will be lost with it. This factor and the high cost and value of surface combatants has necessitated the a requirement to place the accent on the defensive aspects of our strategy. For example we are seeing:

- an increasing global mine threat which is driving new approaches in sonar and remotely controlled minesweeping;
- advances in submarine technology and significant increases in range, speed, and sensors for torpedoes which then dictates a far greater need for torpedo countermeasures and general ASW capabilities (with a special emphasis on sensors); and
- the introduction of leading edge anti-ship missiles calling for new directions in naval surveillance radars and integrated self-defence systems.

The increasing technological complexity of military systems in service also has personnel implications. The acquisition of modern equipment necessitates greater specialisation in military training and employment. What then, are the implications for industry of this process?

Industry restructuring and Privatisation

The first challenge facing industry is the nature of the maritime industry itself and its ability to support naval forces. In the last five years the world has witnessed a degree of defence industry restructuring never before seen. Shrinking defence procurement budgets have forced the need to seek greater efficiencies.

In the last few years the RAN brought into service the guided missile frigates Melbourne and Newcastle built by the then Transfield, now Tenix, Defence Systems in Melbourne, and the first of the new ANZAC Class frigates, also built by Tenix. Also being introduced into service are the new Huon Class Minehunters, built by ADI in Newcastle, and the Collins Class submarines, built by the Australian Submarine Corporation in Adelaide.

By early next century the projected defence ship construction and repair activities in Australia will decrease significantly. This changing pattern of expenditure will increase the pressure for rationalisation in the shipbuilding and repair industry. But any restructuring must be consistent with providing through life support for the platforms currently being built.

Therefore the Government announced in the 1996-97 budget that it expected to consider in 1997-98 the optimal timing for offering ADI Limited for sale, with the means of sale and other sale issues also to be considered. The Government has also decided that the future of the Commonwealth's shareholding in the Australian Submarine Corporation will be considered in conjunction with the proposed sale of ADI.

The government's primary interest in any industry rationalisation is to maintain, without interruption to the support function, key commercially viable capabilities which meet strategic priorities for self reliant through-life support and longer term development. The skills of Australian industry at managing such change was demonstrated in Tenix's (then Transfield) successful take over of the former government AMECON shipyards, turning them into what is now one of Australia's leading shipbuilding facilities, building amongst the most advanced ships, on time and on budget.

In the course of these projects, Tenix developed an extensive network of hundreds of sub-contractor companies scattered all over Australia and New

Zealand, supplying components of the ships. Many of these companies had never been involved in defence business before. Tenix's skill lay in mobilising the resources of so many companies, and helping them to acquire the technologies, quality standards and equipment that go to create an overall shipbuilding capability.

Given the similar challenges that face the shipbuilding industries of the Philippines, Thailand and Malaysia, Australian industry's experiences would be of considerable benefit to regional co-operation.

Commercialisation

A related development is the privatisation of support services, the role industry can play in providing such services to regional navies and the opportunities this represents for greater regional co-operation.

The Australian Commercial Support Program (CSP) aims to ensure that non-core support services and products are provided to core defence activities in the most cost-effective manner. CSP maximises the use of the civilian infrastructure by contracting out non-core support services where it is operationally feasible and where industry can demonstrate better value for money. As of August this year, CSP had commercially tested the work of 7233 positions in 80 separate activities and announced the contractor selections. 65% were won by commercial contracts, 29% by an in-house option, while 6% retained the current arrangements.

New work valued at A$1.488 million has been awarded to industry and in-house options while projected recurring annual savings resulting from CSP were A$153 million or 33% of baseline costs.

In Australia two recent examples of commercialisation in the naval sector bear mention:

- In January this year a five year contract was let to an In-House option to provide for Navy Specified Weapons Maintenance at Garden Island, Western Australia. This contract covered the management and operations at a new facility for the maintenance of torpedoes and other underwater weapons and targets in Western Australia.
- In October this year a ten year contract was signed with Defence Maritime Services, a joint venture between P&O and Serco, to provide and manage a wide range of offshore and inshore afloat support services for the Royal Australian Navy Australia wide.

Our own CSP is speeding up. As part of the Defence Reform program, CSP will be broadened and accelerated over the next four years through the market testing of about 16,000 military and civilian positions.

Increasing use of commercial off-the-shelf technologies is a further characteristic of this changed outlook. There are now more opportunities for local suppliers from both of our countries to supply the needs of our military forces. In this new environment, relationships between industry and defence forces should be characterised by evolving partnerships, rather than the old customer/supplier model.

Co-operation between defence industries

I spoke earlier about the importance of co-operation from a broader security perspective.

Co-operation presents opportunities for enhancing inter-operability and strengthening our mutual defence technology base. If economies of scale are to be realised in the production and support of platforms, there must be an early recognition of the strengths of each participant and the building of co-operative frameworks.

Industry has a fundamental role to play in this co-operation. It must establish a sound technological basis, and be able to assist defence forces with the process of adapting systems to local conditions. What works in the cold waters of the North Atlantic may not work here. Our geography requires shallow draft, smaller vessels that can operate efficiently in the coastal waters around South East Asia. This has enabled the development of recognised expertise in suitable marine construction. Australia, for example, has become the world leader in the small to medium fast ferry market, and is also adept at building suitable patrol vessels and warships.

Competition and Intellectual Property Issues

All of us face the challenge of developing critical maritime industry capabilities. This requires a complex mix of industrial capabilities, research and development, capability planning, project management and sophisticated design skills across diverse sectors including electronics, communications, and shipbuilding.

We also face the strength of competition from well established competitors in Western Europe and the US which operate in a larger international market. Regional shipbuilders also face significant intellectual property issues which can limit their capacity to further develop products or sell to third parties. This is one of the biggest problems we face. In Australia's case after spending billions of taxpayers' dollars on shipbuilding, we are dependent for any further sales of submarines, ANZAC frigates or coastal minesweepers for example, on the goodwill of foreign companies who own the intellectual property.

Co-operative R&D

High-end scientific co-operation in collaborative research and development is critical to self-reliance. In particular, our combined knowledge and understanding of our maritime environment should be unmatched – it is, after all, our region. Research and development should focus on our regional environment in ways that will optimise the effectiveness, maintenance and longevity of our platforms and equipment.

A recent example of the benefits of government and industry R&D co-operation is the Australian Laser Airborne Depth Sounder, or LADS. In 1975, less than 50% of Australia's continental shelf was adequately surveyed. In response, the Defence Science and Technology Organisation developed a technology – LADS – that has now been in routine service with the RAN for four and a half years, and has reduced the survey backlog from an estimated 100 years to a mere 15.

The Australian company that built LADS has since invested in an advanced R&D program to commercialise LADS and provide contract survey services to hydrographic agencies around the world.

The defence science exchanges between Australia and our regional neighbours are not only an integral part of enhancing regional engagement but also reflect the contribution that defence science can make to closer contact on a wide range of issues, including defence industry collaboration. DSTO interaction serves as a useful lead for industry co-operation to follow. Australian and regional armed forces face comparable challenges in applying science and technology to their operating environments, and this facilitates both co-operation and opportunity. DSTO's experience in maintaining expensive platforms is a key area where we can work with our neighbours. Budget pressures have led to this approach in Australia and it is, therefore, also applicable in South East Asia where budget pressures may dictate keeping platforms longer than may have been the original intent.

DSTO's own industry alliances contribute to two important objectives: These are, better communication between defence and industry: and earlier involvement of industry in Defence's planning process for capability development. There are now 19 Alliances between DSTO and Industry. On the maritime front:

- in November 1996, DSTO and ADI Ltd signed an industry alliance which will facilitate further collaboration in the area of mine warfare technologies.
- in May 1997, DSTO and the Royal Australian Navy formed a triple alliance with Thomson Marconi Sonar in the area of acoustic signal processing.

Conclusion

Let me conclude by saying that the Governments of the region have built co-operative structures that are already bearing fruit. There remains however, enormous scope for widening and strengthening the bridges across South East Asia. This must happen not only between governments, and Defence Forces, but between industries, and research institutions at all levels, especially in the maritime sector.

At all levels we should be asking 'where do our comparative advantages lie?' We should also be teaming with others, in government and industry, in our own country and in the region, who can offer complementary skills. This partnership will go a long way towards creating the optimum environment to secure the region's maritime security; develop its industry capabilities; and foster stronger trade with the rest of the world."

Copies of other major speeches can be found on the Minister's Home Page www.adfa.oz.au/dod/mdisp/.

Baby Daniel's Medal
The Naval General Service Medal 1793-1840

Graham Wilson

One of the more interesting byways of naval and military history is the study of campaign medals and stars. This field is particularly interesting and rewarding when considering British awards, especially as they relate to the 18th and 19th centuries. Britain was at war somewhere in the world for almost all, if not all, of those centuries and the medals eventually awarded for service in these wars, conflict, whatever, make an extremely rich field of study.

The subject of this article is the Naval General Service 1793-1840 but before considering this fascinating medal, an examination of the background to British campaign medals is in order. It is widely felt that Britain and its various governments have always been parsimonious in the awarding of medals to its fighting men and women and I am personally not able to put up any strong arguments to counter this.

Authorities on the subject agree unanimously that the first British campaign or battle medal is the so-called "Dunbar Medal", awarded by Parliament to all officers and men of the Parliamentary forces engaged at the Battle of Dunbar in 1650. This was not, however, a "British" medal as such, as it was not awarded by the British government but rather by the House of Commons in its own name and right.

Between 1650 and 1847, the year in which the Naval General Service Medal was established and authorised, a number of medals were struck and issued to commemorate various battles and campaigns. These were not, however, campaign medals in the manner which we accept today. In the first place, all of the medals were struck at the instigation of Parliament, private organisations or individuals, not by the government. An example of the first type is the Naval Gold Medals which were instituted in 1794 and continued to be issued until 1815. These medals were awarded by parliament to admirals and other senior officers for various fleet actions up to 1815. A good example of the second type is the Seringapatam Medal 1799, which was awarded to both Company and King's troops by the Honourable East India Company. Probably the best known of the third type is Mr Boulton's Trafalgar Medal, struck at the suggestion and expense of a certain Mr Boulton of Birmingham and presented to every person present at the Battle of Trafalgar.

A notable feature of medals awarded by Parliament is that they were for award to senior officers. The Naval Gold Medal was awarded to admirals and captains only, the only way a lieutenant could qualify for one being to assume command during an action in which his captain was killed. The same was true of the Army Gold Medals and the Army Gold Cross (also referred to as the "Peninsular Cross").

As medals only went to admirals and captains, the medals presented by Mr Boulton for Trafalgar and earlier by Mr Davidson for the Nile, were highly prized and appreciated. Junior officers, warrant officers, petty officers, sailors and marines awarded the medals treasured them and were greatly appreciative of the donors. In an act of hypocrisy typical of governments in all times and places, His Britannic Majesty's Government was magnanimously pleased to confirm the right of recipients to wear the medals in uniform, doubtless at the same time congratulating itself on having got out of it as usual at no expense to itself!

Following the end of the Napoleonic Wars, Europe entered into a long period of lack of open warfare often referred to as "the Long Peace". But while Europe itself was (relatively) peaceful, the world was not, and British soldiers and sailors were active in many parts of world, expanding the borders of the Empire and defending Britain's interests. Various medals were awarded in the three decades following Waterloo, the Honourable East India Company being fairly generous in visual recognition of the service of both its own troops and those of the Crown. But there was a great deal of ill-feeling holding over from the period of the Napoleonic Wars, ill-feeling engendered by the then practice of only officially rewarding senior officers with medals.

A great deal of spirited debate was carried in both Houses of Parliament over the years and finally, in 1847, the government acceded to the legitimate petitions of surviving veterans and issued a notice via a government gazette of 1 June advising of the intended establishment of the Naval General Service Medal and the Military General Service Medal.

Unlike previous medals, especially those issued by John Company, the two new medals were not designed to have the name of a particular campaign or battle engraved on the reverse. Instead, it was decided to issue a standard medal and award bars or clasps to worn on the full size ribbon to denote service in

particular battles or campaigns. For this purpose, a board of four senior admirals was appointed to prepare a list of actions for which bars would be awarded. Originally it was intended that bars would only be awarded for actions for which Naval Gold Medals had been awarded but the terms of reference of the Board were expanded by a notice of 7 June 1848 and the Board eventually prepared a list of 231 actions for which bars would be awarded. On 25 January, 1849 it was announced that the medals were ready for issue.

The Naval General Service Medal itself is a fairly attractive and very well made medal, being struck from a high silver content alloy. The obverse bears the diademed head of Queen Victoria with the legend "VICTORIA 1848 REGINA". The reverse bears a figure of Britannia, seated on a sea-horse, with a trident in her right hand and a laurel branch in her left. The medal is suspended by a plain silver clasp from a ribbon which is white with dark blue edges.

Approved by Parliament and the Queen in 1847, the medal was not gazetted until 1848. The Gazette states that the medal is to awarded to all persons present at particular campaigns, battles or actions "regardless of sex". This last point is significant and important. The Gazette goes on to list a total of 230 bars authorised backdated to 1793 and covering the period up to 1840. The first clasp listed is NYMPHE 18 JUNE 1793 and the last listed is SYRIA 1840.

Those who believed that they were entitled to the award of the medal were directed to apply in writing to the Admiralty. On an application being accepted, the recipient's name, rank or grade at the time of qualification, and bar or bars entitled to were entered onto the Admiralty Medal Roll. This Roll makes fascinating reading, especially in regard to the ranks of the recipients. Many of the ranks, although obsolete, even in 1840, are fairly straight forward - "captain-of-foretop", "captain-of-maintop", "topman", "captain-of-hold", "quartermaster", "boatswain" are all recognisable and evoke the so-called "romance" of sail. Some, however, are a bit more obscure. While, for instance, "lamp-trimmer", "clerk" and "ship's corporal" are reasonably self-explanatory, and I know what a "landsman" was, also a "volunteer", "yeoman of sheets" borders on the arcane. And what in the world was a "krooman"? "Swabber" and "shifter" are also very intriguing. How about "loblolly boy" (I actually know what that one is – bet you don't)?

An interesting rank is that of "Passenger", listed against the medal awarded to a gentleman who was being carried aboard HMS *Venerable* when she fought an action against two French frigates off the Canary Islands in 1814.

The oddest rank, however, is that of Daniel Tremendous McKenzie, who applied for his medal in 1848 or 1849. On presentation and acceptance of the necessary proofs, his name was entered onto the Admiralty Medal Rolls with his rank officially given as "baby". Baby? Yep – baby.

Daniel McKenzie's father was a member of the crew of HMS *Tremendous*. In those days, it was common in larger ships of the Royal Navy for a portion of the married men to be granted permission to take their wives to sea with them. These women looked after their husbands while at the same time performing such services as cooking, mending and cleaning in return for a small sum from the mens' pay. As they were on the ship's ration strength, they were officially regarded as part of the crew and therefore entitled to whatever benefits accrued to the other members of the crew.

It was practice to put the women ashore if possible when it was known that the ship was sailing into action, but this was not always possible. This latter eventuality was the case when HMS *Tremendous* sailed into action on 1 June 1794 to take part in that famous engagement which was to become known in naval history as "The Glorious First of June". Daniel's father was aboard during the fight, and so was his mother. His mother, however, would have been of small use during the battle as she was very much pregnant. Reports differ as to exactly when but McKenzie the Younger was actually born aboard *Tremendous* either just prior to or actually during the battle. As he was born to a member of the "ship's company", Daniel, who was also name "Tremendous" following a very old nautical custom, was taken on the ration strength. Thus, although he was only a day old at the time, Daniel Tremendous McKenzie qualified for the Naval General Service Medal with bar "1 JUNE 1794".

It is generally accepted that the Naval General Service Medal was the first service medal awarded to a woman. A certain Jane Townsend was aboard HMS *Defiance* at the Battle of Trafalgar and applied for the medal with appropriate bar. Although someone had written "not admissible" against her name on the roll, it appears that she in fact did receive her medal – quite rightly so too!

The maximum number of bars issued for any one medal was seven and there were three such recipients. Interestingly, one of these seven bar awards was to Lieutenant (later Rear Admiral) John Hindmarsh, RN, first governor of the Colony of South Australia (1836-38).

A number of six bar medals were awarded. One of these went to Rear Admiral Sir George Cockburn, the officer who escorted Napoleon to St Helena and who still holds the record for *continuous* naval service – sixty-eight years! Another six bar medal went to Stephen Lawrie who set his own record by qualifying

for all six bars (including TRAFALGAR) while serving in the one ship, HMS *Phoebe*. He received his first bar (PHOEBE 21 st DECEMBER 1797) as Boy and his sixth bar (PHOEBE 28th MARCH 1814) as Captain of Foretop – a record of at least 17 years continuous service in the one ship.

A total of 121 medals were awarded to soldiers. These were to officers and men who had been members of Army detachments drafted aboard HM Ships for marine service. It should be noted that there were also a number of awards of the Military General Service Medal to naval recipients – but that's another story.

The 231 bars authorised for the Naval General Service Medal 1793-1840, are a roll call of the days when Britannia truly ruled the waves. Bars include NILE, COPENHAGEN and TRAFALGAR, great battles which are forever linked with the name of Britain's great naval hero, Nelson. Other bars, such as SHANNON WH CHESAPEAKE and THE POTOMAC 17 AUG 1814, commemorate actions against the bumptious new North American republic. But the bars commemorate not only great fleet actions, such as Trafalgar, and smaller ship to ship actions, such as that for the fight between *Shannon* and *Chesapeake*, they also commemorate small actions often involving a single boat load of sailors and marines employed on raids, cutting out parties and shore actions. These bars are referred to as BOAT SERVICE bars and a total of 57 were authorised covering the period from 1793 to 1814 .

It is illuminating to note that while he had qualified for the medal as a new born babe, Daniel McKenzie was actually a grown man well past middle age when he received his award which a not particularly grateful government had only just established. Due to government parsimony and intransigence, he was in fact one of the relatively few people to live long enough to receive the medal! The passage of time ensured that many of those who would otherwise have qualified for a medal were deceased by the time it was established and in fact seven of the bars authorised were never awarded as there were no claimants left to apply for them. As an example of how the passage of time had whittled down the numbers of claimants, only 1,710 bars were issued for Trafalgar, despite the fact that 33 ships of the RN, crowed by tens of thousands of British sailors, were engaged at the battle. Similarly, and with specific reference to the award to "Baby" McKenzie, HMS *Tremendous* was a 74 gun First Rate Ship of the Line with a crew of about 800, but there were only 21 claimants from her crew for the award of the medal and bar for the Glorious First of June.

Following the establishment of the Military and Naval General Service Medals, the British Government fell into the established practice of authorising medals to recognise service in campaigns or wars by members of the armed forces. Although the numbers of medals awarded by the British government continue to be far less than those of many other countries, still, at least now Britain no longer restricts recognition of service to senior officers only. It was the Naval General Service Medal, and its sister Military award, which set the precedent for this. Still, it is doubtful if any existing or future medal rolls will carry Daniel Tremendous McKenzie's unique rating of "baby."

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Australian Naval Shipbuilding – 1960s to the Present

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Disclaimer

The views and opinions expressed in this article are those of the author and do not necessarily represent those of the Australian Department of Defence.

Introduction

The construction of major naval ships in Australia has been relatively dysfunctional over the years, brought about by the absence of a consistent focus in Australian industry development and a rather foggy notion of the industry capabilities needed for local support. Although many major warships were built here, there was a hiatus in local ship construction from the mid 1960s. It was not until the Liberal Coalition Government declared its policy in the mid to late 1970s to re-establish warship construction, and the Hawke Labor Government's considered implementation of a similar policy, that a coordinated Federal and State approach has been developed in recent times to revive local construction.

This article will focus on Australian construction of major warships, such as destroyers and frigates, from about 1960, when Australia began to obtain support for warship capabilities from the United States, as well as the United Kingdom. For example, the Commonwealth Year Book for 1961 provided the first mention of RAN liaison staff in Washington DC, and the comprehensive exchange of information that flowed from that link (Year Book of the Commonwealth of Australia, No 47, page 1095). The Commonwealth Year Book for 1964 (page 1190) recorded that three Charles F. Adams guided missile destroyers were being acquired from the United States. Australian Defence decision making from about 1960 therefore, ushered in a new era regarding warship construction and support. Australia had become a more discriminating customer, obtaining its Naval requirements from the most appropriate source.

In discussion of Australian naval shipbuilding from 1960, a number of lessons will be developed.

The Early Years

From early this century Australia tended to acquire its warships directly from the United Kingdom, some were gifts, or built in Australia to British designs. The trend towards local construction reached its peak during World War II, with the following range of warships built here: 3 Tribal Class destroyers, 56 Bathurst Class Corvettes, and 6 Frigates. Australian industry also carried out repairs, refits and maintenance on a range of ships: RAN 4008 ships, Royal Navy 391 ships, US Navy 513 ships, and Dutch Navy 171 ships. This trend continued after the war, but at a reduced rate. The following Table lists a selection of warships in-Service with the RAN in the late 1970s, and where they were built.

NAME	BUILT BY	RAN COMMISS'D
Aircraft Carriers		
Sydney (formerly HMS *Terrible*)	Devonport, UK	December 1948
Melbourne (formerly HMS *Majestic*)	Vickers, UK	October 1955
***Queensborough* Class Destroyer Escorts**		
Quiberon	J.S. White, UK	July 1942
Quickmatch	J.S. White, UK	September 1942
Queensborough	Swan Hunter, UK	May 1946
Daring Class Destroyers		
Voyager	Cockatoo, NSW	February 1957
Vendetta	Williamstown, Vic	November 1958
Vampire	Cockatoo, NSW	June 1959
Duchess	Thorneycroft, UK	May 1964
Battle Class Destroyers		
Tobruk	Cockatoo, NSW	May 1950
ANZAC	Williamstown, Vic	March 1951
River Class Frigates		
Gascoyne	Mort's Dock, NSW	November 1943
Barcoo	Cockatoo, NSW	January 1944
Diamantina	Maryborough, Qld	April 1945
Culgoa	Williamstown, Vic	April 1947
River Class Destroyers		
Parramatta	Cockatoo, NSW	July 1961
Yarra	Williamstown, Vic	July 1961
Stuart	Cockatoo, NSW	June 1963
Derwent	Williamstown, Vic	April 1964

Swan	Williamstown, Vic	January 1970
Torrens	Cockatoo, NSW	January 1971

Charles F. Adams (Perth) Class Guided Missile Destroyers

Perth	Defoe, USA	July 1965
Hobart	Defoe, USA	December 1965
Brisbane	Defoe, USA	December 1967

All six *Oberon* submarines were built by Scott's, Greenock, UK. The first four were commissioned in the RAN between 1967 and 1969, and the last two in 1975. Australian coastal mine-hunters or sweepers HMAS *Curlew, Gull Hawk, Ibis, Snipe,* and *Teal* were all former Royal Navy vessels, while the Battle Class Destroyer, HMAS *ANZAC* was built to UK design, but modified for Australian conditions, and had the distinction of being the first RAN warship to carry 4.5 inch guns and mountings of completely Australian manufacture.

The Table indicates that up to the early 1960s a significant number of warships were obtained from the UK. However, a large number of warships were also built locally, primarily at Williamstown and Cockatoo. It could be argued therefore, that Australia possessed a strong shipbuilding capability right up until the early 1970s, but the capability had been in gradual decline since about 1960.

It is important to note here that the focus on warship construction should not be considered in narrow terms. While all warships were not built locally, once commissioned into the RAN, generally all modifications, upgrades and conversions were carried out in Australia. Australian industry therefore developed over time a very strong capability to perform this type of work, in addition to routine maintenance, repair and refit. Not only did local industry have a full through life capability, it possessed the full range of essential project planning and project management skills.

It has been noticeable over the last 10 years or so, that even though Australian industry and the RAN possessed skills in key 'smart' systems and upgrades, when total, or 'whole of project' construction skills needed to be applied, the result is a steep learning curve followed by delays to delivery and significant cost increases, as evidenced by the HMAS *Tobruk, Success,* and early Australian Frigate project performance. Government ownership and operation of Garden Island and Williamstown dockyards also contributed to highly inefficient work practices, low productivity, and ongoing demands for dockyard modernisation. Part of the reason for inefficiency was Defence's Head Office interference in dockyard operations and a lack of dockyard management autonomy, particularly in personnel employment and dismissal matters (see for example, Joint Committee of public Accounts [JCPA 1986] Report 243, Vol 2, page 69 synopsis of the HMAS *Success* project, where costs rose by about 200 percent and delivery slipped by about 3 years).

Trends in the 1970s

The DDL Light Destroyer

HMAS *Torrens* was the last major warship built in Australia in the late 1960s and early 1970s. As a result of Australia's experience during the Malaysian/ Indonesian Confrontation, a requirement emerged for a new light destroyer (DDL) (Parliamentary Paper No. 138, page 17).

The DDL Project had been initiated in the late 1960s. The preliminary DDL design for a general purpose destroyer of about 4,000 tons, powered by gas-turbine engines, was completed in 1971. Armament was to include a single 5 inch gun, two armed helicopters, a medium range surface-to-air missile system, radar controlled close range guns, anti-submarine homing torpedoes, surface-to-surface missiles, electronic warfare equipment, and torpedo tubes. She was also to have long endurance, high habitability, and surface, anti-aircraft and anti-submarine capabilities. A high degree of automation promised to give significant reductions in personnel, leading to a complement of about 200. It was originally planned to build three ships, as the first batch of a potential fleet of up to 24 ships.

The project therefore, promised a significant level of work for Australian industry, and a measured workload that, following the end of construction of the River Class Destroyer Escorts, would enhance and sustain project and construction skills over time. Through life maintenance, refit, modifications and upgrades offered the potential for further enhancement of local industry capabilities.

The preliminary design was undertaken by the RAN's Technical Services Division and tender documents were issued for prime contractorship on design (allocated to the British consultants, Yarrow Admiralty Research Department, closely followed by Request for Tenders for studies on a host of major sub-components. Study contracts were issued to industry and most of them were completed by mid-1971. However, 'the fact that there was a local design, catering ostensibly for unique Australian conditions, was an invitation for enterprising operational and maintenance officers to load the specifications with all their real needs as well as with various fancies and hobbyhorses, without regard for costs', which were the responsibility of other Defence areas (Schaetzel, pages 16-17). While the result was a potentially very capable ship, its displacement rose by almost 1000 tons and the projected costs almost doubled.

The DDL project was approved by the then Liberal Coalition Government in August 1972 but, based on

Navy recommendations, cancelled in August 1973 by the new Labor Government, 'because of the high cost and technical risk of an Australian design' (JCPA 1986, Vol 2, page 15). A further factor was the low productivity of the Government dockyards at that time. A key lesson from this project was that 'firm boundary conditions are essential if size and cost are to be contained. What had started as a relatively simple 1500 ton ship to be designed and built in Australia, eventually grew to over 4000 tons' (Berlyn, pages 293-301). The main problem therefore, was the lack of control of design requirements and an absence of appropriate cost-performance trade-off decision making.

Another report indicated that Navy's lack of experience was 'the main reason for the cancellation of' that project (Schaetzel, page 1). As Schaetzel (page 4) further argues, 'Experience is what the Australian industry has been aiming for in defence development work but, unfortunately, has not been allowed to achieve in the last 20 years'. There may be some truth in these claims given the findings of the 1986 Joint Committee of Public Accounts following its review of Defence project management. Schaetzel's (page 22) project lessons were as follows:

- Australian defence industries are capable of developing state-of-the-art projects.
- A single prime, responsible for all aspects of the project is the preferred development agency.
- Best results seem to be obtained when industry and the Defence Science and Technology Organisation are left alone to provide products defined by mutually agreed broad requirements rather than over-detailed specifications.
- Over-specifications and changes introduced by people without responsibility for cost and schedule are an invitation to disaster.
- There must be a high level forum for discussion of cost-performance trade-offs between the prime contractor and customer.
- Over-controlling by inappropriate methods and personnel actually increases the cost of projects and extends their duration.

Many, if not all of these issues have been addressed by Defence over the past five to 10 years. However, the main lesson from the DDL project is that Australian industry and Defence will realise the benefits of indigenous design and a significant workload that creates the critical mass necessary for sustained cost effective warship construction and support, only if Australian industry is productive and competitive. 'Bounding' specifications is an essential ingredient in this project mix. Following the cancellation of the DDL Project, four guided missile frigates (FFGs) were eventually acquired from the United States.

Comparison Between the DDL, FFGs and ANZAC Ships

The four guided missile frigates, HMAS *Adelaide, Canberra, Sydney,* and *Darwin* were acquired by Defence through US Foreign Military Sales (FMS) arrangements. This project was considered in some quarters to be:

> *partially successful. The ships were delivered broadly within the required time frame but cost considerably more than initially budgeted. The ships entered service minus an integral part of their capability and in the case of the first three, requiring major modifications and retrofits to make them fully meet the RAN's original requirements...The level of Australian industry participation (AIP) (was) well below target because of the inherent difficulties of securing AIP under US FMS purchases and the unsatisfactory management of this aspect (JCPA 1986, Vol 2, page 13).*

Schaetzel (page 17) called these FFGs, 'a very austere, single screw ship', and this is supported to some extent by the JCPA (1986, Vol 2, pages 20-21), which reported concerns regarding the limited FFG capability, particularly in the areas of shipborne anti-submarine warfare, anti-air warfare, its potential vulnerability to 'cheap kills', and the lack of growth and modernisation potential.

By contrast with the proposed DDL, the locally built *ANZAC* Ships are of moderate capability, suitable for patrol and surveillance operations in Australia's resource zones and areas of direct military interest. The ships are about 3540 tons (3600 tonnes) and have the RAN/RNZN's first combined diesel and gas propulsion plant, necessary to meet specified speed and range requirements economically. The *ANZAC* Ships have a complement of about 165 and are armed with the vertical launch missile system with NATO Seasparrow surface-to-air missiles, and a single intermediate size helicopter primarily for surveillance, but equipped with weapons such as the Penguin missile. A 5 inch gun for anti-shipping and shore bombardment was added to the *ANZAC* design after contract signature, but which increased project costs by over $100 million. The Warfighting Improvement Program (WIP) seeks to provide self defence capabilities, particularly against supersonic anti-ship missiles.

The DDL represented a Tier 1 capability. The *ANZAC* Ships were originally designed as a 'second tier' surface combatant with lesser capability than 'first tier' destroyers and frigates, such as the RAN's Guided Missile Destroyers (DDG) and Guided Missile Frigates (FFG). In fact the decision to acquire a Tier 2 capability was criticised by some. It was observed for example, that an absence of:

discussion of operational concepts or the operational impact of particular decisions (resulted in the) decision apparently to downgrade the replacements for the former Tier 1 surface combatants to ... ANZAC *frigate (Tier 2) derivatives...there was simply no evidence that its potential impact on maritime operations had been taken into account (Woodman, pages 115-142).*

In fact, there was exhaustive discussion by the higher Defence committees over the capabilities, roles and tasks needed of the new ships, and this resulted in the definition of a Tier 2, *ANZAC* Ship type capability. Prima facie at least, there appears to be some similarity between the capability proposed for the DDL and those promised by the FFGs and *ANZAC* Ships following implementation of the WIP and the FFG Upgrade Project to enhance the capability of those ships.

The total project cost of three DDLs was estimated at $355 million (in 1972 prices), or about $75 million per ship (Parliamentary Paper No. 138, page 26), and is comparable to the US FFGs. The sailaway cost of a US produced FFG rose from an estimated $83 million in March 1974 to $256 million in the early 1980s (JCPA 1986, Vol 2, page 17), and the cost of an *ANZAC* Ship is between $500 and $580 million, including non recurring costs, shore facilities, etc. The sailaway (marginal) cost of a new (additional) *ANZAC* is about $275 million (December 1996 dollars). Of course, the costs of the FFG Upgrade Project and *ANZAC* WIP would need also to be added to the ship costs.

The main reason for the cancellation of the DDL might not therefore, be solely cost. For example, then Labor Shadow Defence Minister Lance Barnard's view in June 1972 was that 'The trend in...other navies is towards faster, smaller and heavily-armed vessels of the light corvette and fast patrol boat types ... For escort, patrol and surveillance duties it is hard to justify the DDL when these tasks could be done by smaller and cheaper ships' (Parliamentary Paper No. 138, page 8). The Labor Opposition had therefore, foreshadowed its concerns over the Navy's definition of capability requirements, as well as its unease regarding Australian industry's ability to produce a major warship on time, and to cost. When in Government, new Labor Defence Minister, Barnard, mitigated these concerns by acquiring new warships from the US. Given the track record of major shipbuilding projects of that era, it is very likely that DDL costs would have increased significantly, but by how much is a moot point.

Trends in the 1980s

The major warship decisions of the 1970s were to cancel a locally designed light destroyer project, and then to acquire up to four guided missile frigates from the United States. However, the Liberal Coalition Government of the mid to late 1970s sought to effect a different strategy.

The Australian Frigate Project

The Australian Frigate Project (AFP) was the mechanism by which, from the mid 1970s, key Defence Ministers Killen (Liberal) and Beazley (Labor) sought to enhance self reliance by re-establishing a major warship construction capability in Australia. This capability was eventually established by the construction of two FFGs, HMAS *Melbourne* (FFG 05) and HMAS *Newcastle* (FFG 06) by Tenix Defence Systems (formerly Transfield, AMECON[1] and before that, Williamstown Naval Dockyard [WND]).

The decision to build the ships at WND was courageous, particularly as WND's record of industrial dispute and low productivity was a major factor in the Whitlam Labor Government's 1973 decision to reject local construction and acquire four FFGs, HMA Ships *Adelaide, Canberra, Sydney* and *Darwin*, from Todd Pacific Shipyards in the United States under FMS arrangements. When the Hawke Government approved the AFP in 1983, the industrial situation at WND had not improved much beyond that of the 1970s and contributed to the Government's decision to offer the dockyard for sale in 1987. The sale process delayed ship construction by several months, but resulted in significant work place reforms and efficiency gains.

The decision to acquire two FFGs was a fairly straight-forward decision for the Hawke Government. Following on from the Whitlam Government's decision, the acquisition of that type of ship was 'pretty well set in concrete ... There was a lot that was just proforma about (the AFP and) in many ways it was the last of the old fashioned acquisitions' (Beazley 1994). Nevertheless, the AFP still offers a number of useful project lessons.

Project Process

In the early years, the AFP was known as the Follow On Destroyer (FOD) Project, and on 6 March 1980, the FOD project office was formally established to resolve the preferred ship option, estimated costs and ship numbers.

In May 1978, the Defence Naval Destroyer Group (DNDG)[2] was established to examine and resolve a range of complex FOD force requirements and acquisition issues. The DNDG was led by then Commander Rob Walls and Mr John Mortimer, representing Navy and Force Development and Analysis respectively, and in July 1979, recommended that two ships be short listed, the

United States FFG-7, and the Netherlands M-Class. Although both ships would have met the capability sought by Australia, the FFG was preferred because it offered a relatively straight-forward program and could move early to local construction. Higher Defence committees commented that the DNDG report provided them with an unusually comprehensive basis in strategic, capability and technical terms, on which to develop discussion on the future destroyer force. A crucial element in the selection was the strategic need to regain shipbuilding skills, which the majority of Defence committee members perceived was practicable only through the FFG-7 option. The FFG also met the criterion that any ship design chosen should be well established or well advanced. Nevertheless, selection between the FFG and M-Class options was not clear cut, the M-Class ship appeared to offer the lower unit price, and lower life-of-type costs, but involved too many perceived development uncertainties and risks.

Another advantage of the FFG was that it had been designed to be built in a number of shipyards, which offered construction flexibility for both Defence and potential contractors. It was also believed that an Australian built FFG would allow the incorporation of local technological initiatives and offer potential savings. The Australian designed and built Mulloka sonar system, for example, was expected to be more expensive, but was potentially operationally superior to the US produced AN/SQS 56 Sonar fitted to FFGs 01 to 04, and offered substantial local industry participation.

On 25 February 1981, the Fraser Liberal Coalition Government agreed, inter alia, that further development of the project proceed with HMAS *Darwin* (FFG 04) as the base-line configuration, and possible installation of the Mulloka system. Government also gave approval for Defence to seek a Letter of Offer and Acceptance through the FMS process for long lead items to support the construction of two FFG Class vessels in Australia. Navy had initially sought a commitment to three, and a program of up to six, vessels but accepted that two was the minimum number needed to re-establish the shipbuilding capability. A decision on where the ships were to be built was not required until 1982. Several higher Defence committee members doubted whether WND could meet the productivity and personnel requirements of the FOD program.

Over the period March/April 1982, Defence committees noted that an accurate assessment of the cost to build the FFGs at WND (excluding overheads) was not possible because the expected productivity increases were yet to be realised. Navy, however, argued that a 30 percent cost premium for local construction would be reasonable in terms of general Government policy. The cost of local construction for two FODs was estimated at about $228 million, compared with $175 million from Todd Seattle, and a total project cost of $625 million (in January 1982 prices), based on up to 3.2 million man hours for FOD 01 and 2.8 million man hours for FOD 02 (compared with 1.8 million man hours per ship for Todd Seattle) and WND overheads of 170 percent. WND submitted its proposal for ship construction in February 1983, and received endorsement by the (then) Department of Defence Support, with the qualification that the quality of the estimates should be regarded as Class B (plus or minus 15 percent).

When the Hawke Labor Government came to office in 1983, it was prepared to use WND to demonstrate its willingness to employ commercialisation measures to achieve public sector and micro-economic reform. The reason for such an approach was the poor record of major defence shipbuilding projects in Australia, particularly the escalating costs and extended delays associated with the construction of HMAS *Success* at the Vickers Cockatoo dockyard in Sydney. The fact that a Labor Government was now in power did not comfort those who wanted to build the ships in Australia, particularly the Unions, because 'It was a Labor Government which elected to buy the US-built FFG-7 class instead of the RAN-proposed DDL-class...designed in (Australia)' (Cranston, F. 'Naval Programs in Serious Doubt', *Canberra Times*, 8 September 1983, page 6).

The new Labor Government also foreshadowed a review of Defence infrastructure. On 14 March 1983 the then Minister for Defence announced the Government's decision not to acquire an aircraft carrier, and indicated that if WND's costs for the FODs were not reasonable, Government would re-consider the need to maintain a warship building capability in Australia.

Defence committees acknowledged that the choice between construction of the new FFGs in Australia or overseas would have strategic implications for the maintenance of an Australian capability to build modern warships. It was also noted that if an order for two FFG-7 Class Ships were placed with WND by November 1983, it would allow the ships to be delivered to the RAN within the time bands of about two years centred on 1991 for the first ship, and 1993 for the second ship. Making allowance for programming pressures and other priorities, higher Defence committees recommended that Government approval be sought for the project.

Project Management

Williamstown Naval Dockyard

On 12 October 1983, Government approved the construction of two FFG-7 type ships at WND at an estimated total project cost of $830 million, but with authorisation for ship construction conditional upon

satisfactory productivity improvements and the signing by all parties of a formal agreement on industrial relations issues and work practices. In approving the project, Government also agreed that delivery of ships should occur within a two year window. This innovative approach recognised the impracticality of expressing such a major undertaking in terms of a specific date against which all other project achievements could be measured. Also in October, the project name was changed to the Australian Frigate Project. HMAS *Darwin* was to be the design and configuration base-line, with the possible substitution of Mulloka for the SQS-56 Sonar. Metrication was not required.

In agreeing to construction, Government asked to be advised regularly of WND progress, and requested advice on how WND was handling the AFP from the wider perspective of the ability of Australian Unions and management to sustain collaboration on a major and demanding project. One of the reasons for this request was to determine the capability of Australian shipbuilding to engage in a number of high cost, high profile acquisitions being planned at that time, specifically the ANZAC Ships and the new submarine projects. In the context of these latter projects, the construction of the FFGs at WND was seen to provide significant opportunities for both Defence and defence industry (Grazebrook, A.W. 'Naval Shipbuilding Program Provides Big Opportunities' *Pacific Defence Reporter*, Vol. 12, No. 2, August 1985, pages 30-32).

In November 1983, the Australian Frigate Shipbuilding Agreement (AFSA) between Defence and the (then) Department of Defence Support for the supply of Australian Frigates 05 and 06 was signed. A further agreement was concluded with the United States Navy (USN) FFG Program Office for support in building the FFGs in Australia.

The AFSA required that FFG 05 be delivered by 14 May 1991, and FFG 06 by 30 November 1993. This delivery schedule recognised the learning curve expected and the uncertainties associated with restarting major ship construction after a 20 year period. Implicit in this arrangement was that delivery of the ships was to be achieved as early as practicable within a two year time frame, FFG 05 – mid 1990 to mid 1992, and FFG 06 – mid 1992 to mid 1994.

Construction of the first Australian Frigate commenced on 4 March 1985, even though WND was unable to meet all of the necessary pre-requisite conditions stipulated by Government. These issues were addressed in a Naval Quality Assurance audit of WND on 28 and 29 August 1985. Government was informed that construction was behind schedule because of WND difficulties in recruiting sufficient skilled tradesmen, particularly welders, and delays in the procurement of materiel from Australian industry. A recovery plan had, however, been formulated by WND. Six months later, the AF Project Director (AFPD) informed Government that construction of the first ship was three months behind schedule. In February 1986, the project was also criticised for incurring 'a substantial premium in terms of cost and time' (JCPA 1986 Vol 2, page 57).

In October 1986 the AFPD informed Government that the construction of FFG 05 had slipped nine months against the schedule set by the AFSA. The main reason given was the difficulties experienced in re-starting warship construction after a gap of 20 years. Some cost overrun had also occurred on the work completed to that point, partly due to start up problems and partly to lower than expected productivity. As a result of these deficiencies, the dockyard proposed a revision to the construction schedule. The slippage in delivery dates reflected in the revised schedule was about 18 months, placing the new dates almost in the centre of the delivery bands.

In February 1987, Government was informed that a further revision to the construction schedule had been agreed to take account of the earlier productivity difficulties, but that this had resulted in the slippage of delivery dates of the order of 16 months for FFG 05 and 25 months for FFG 06: to mid 1991 and late 1993 respectively. The dates were, however, still within the delivery bands.

More extreme measures were considered necessary to remedy the situation, and on 1 April 1987 the Minister for Defence announced major changes aimed at restructuring the Australian shipbuilding and ship repair industries. This included the sale of WND, and some $280 million of work remaining on the two Australian Frigates, as 'a last-ditch effort to achieve efficiency and cost cutting before the *(ANZAC)* frigate project (was) awarded' (Greene, G. 'Navy to Sell Dockyard', *Adelaide Advertiser*, 2 April 1987, page 18). The proposed sale was supported by senior dockyard management, however, the Government's decision came as a surprise to the Labor Party Caucus, which had established a committee to examine the proposed privatisation of the dockyard and had not completed its investigation.

Following the Government's announcement, an Invitation to Register Interest and then a Request For Tender were released to consortia interested in purchasing the dockyard, entering into a contract for the completion of the Australian Frigates and tendering for selection as Prime Contractor for the *ANZAC* Ship Project. Following the evaluation of tenders, two consortia were selected by Defence to enter parallel negotiations covering both the sale of the dockyard and the completion of the frigates. Both tenderers stated a preference for a fixed price contract for frigate construction. On 11 December 1987 Defence Minister Beazley announced the sale of

WND to AMECON for $100 million. Within a few months, AMECON was acquired by Tenix, an initially unsuccessful bidder for the dockyard and FFG construction. From the time of the sale, AMECON began a program of significant work place reform.

In the Government's view, the sale of WND to AMECON virtually guaranteed the dockyard to be one of the final tenderers for the ANZAC Ship Project (Milne, C. 'Eglo in Dockyard Deal to "Win Navy Contract"', *Adelaide Advertiser*, 12 December 1987, page 8). Late in 1989 Government awarded the $3.7 billion contract to build 10 *ANZAC* Ships to AMECON. Although the bids were very close, 'Williamstown's bid had...begun to look more credible since AMECON began work on (the) two FFG frigates for the RAN' (Bradley, A. 'High-Tech Frigate Work Will Sail North', *Herald*, 15 August 1989, page 10).

If there had not been reforms of the magnitude experienced within the Williamstown dockyard following the sale to AMECON, it may not have won the contract for the *ANZAC* Ships. But, 'having done the reforms...there wasn't a strong inclination on the part of Cabinet to deny (Williamstown the project)'. Nevertheless, the 'politics were so difficult on location (between Newcastle and Williamstown) that there was an audible sigh of relief within Cabinet when the price came in as it did'. Even so, the 'politics of location' was not the primary driver for the decision. Those members of Cabinet 'who were impressed by (inter-state, inter-town) rivalry discovered that their colleagues were disinterested. They would move off arguing the merits of towns and start getting into the merits of the capabilities of this or that type of equipment'. Government also used the *ANZAC* Ship Project to involve New Zealand, and thus tie New Zealand and Australian defence postures more closely together, 'Incorporating New Zealand was enormously important...Basically, the defence of New Zealand is the defence of Australia' (Beazley 1994).

AMECON Ship Construction

On 4 February 1988, the contract for the completion of construction of FFGs 05 and 06 was signed, and the AFSA was replaced by the Australian Frigate Shipbuilding Contract (AFSC). Not surprisingly, several changes to the previously agreed shipbuilding arrangements were incorporated in the new contract. The more significant of these were a real price increase of $80 million, with $50 million to be paid 'up front', extension of the delivery date for FFG 05 by three months to August 1991, and modification of the cost/schedule control system to provide visibility of schedule and earned price elements without disclosure of the contractor's actual costs. The delivery schedule for FFG 06 was unchanged from 1983, ie. 30 November 1993.

On 22 February 1988, in pursuit of achieving respondent status with AMECON, the Federated Storemen and Packers Union of Australia (FSPUA) began picketing the dockyard. Following the refusal of a mass meeting to endorse AMECON's 'Three Union' Industrial Agreement on 18 March 1988, AMECON declined to offer employment to the production workforce (primarily Government employees). A Conciliation and Arbitration hearing into the dispute was held on 10 May 1988 and the picket was lifted. One month later, the Australian Council of Trade Unions accepted the Industrial Agreement, including coverage by three Unions. The dispute resulted in a five month hiatus in ship construction.

By 26 August 1988 AMECON claimed a total delay of 13 weeks for each ship and additional costs of $12.5 million resulting from FSPUA disputes between 18 February and 5 August 1988. This claim was rejected by the AFPD following detailed discussions with Defence and the Attorney General's Department.

By the end of 1988 AMECON's rate of work had increased significantly, and frigate construction continued to accelerate, but at a significantly slower rate than planned. AMECON had not achieved the necessary productivity from its workforce, although personnel levels were not far short of their target figures. Nevertheless, no adverse impact was expected on the planned launch date for FFG 05 (5 May 1989). However, the overall rate of construction continued to fall behind the rapidly accelerating requirements of the contractual program. In May 1989 AMECON began to submit revised Performance Measurement Base-Lines (PMB).

On 5 May 1989, NUSHIP *Melbourne* (FFG 05) was launched at AMECON's shipyard, the first launch of a major Australian built ship since HMAS *Torrens* at Cockatoo Naval Dockyard in 1970. Although *Melbourne* was reportedly successfully launched to schedule, AMECON was not granted the milestone achievement because it had not accomplished all contractual pre-launch activities, such as the installation of propeller shafting, the consolidation of superstructure, and the erection of masts.

AMECON's overall poor rate of construction schedule performance during 1989 was such that the AFPD considered the Contract Delivery Date of August 1991 for FFG 05 to be unattainable. On 15 December 1989 therefore, AMECON submitted a revised PMB designed to establish an acceptable way forward to complete the contract. The plan was based on moderate increases in demonstrated progress but required a seven month extension to the period of construction for FFG 05 to March 1992. The planned delivery of FFG 06 remained at November 1993 and both dates remained within the approved ship delivery bands.

HMAS HUON, *first of six HUON Class minehunters, built by ADI Limited.*

HMAS TOBRUK, *built in Australia and commissioned in 1950 (Navy Photographic Unit).*

Progress on FFG 06 was slow. Although AMECON had officially laid the ship's keel on 21 July 1989, there were few follow-on events achieved to the hull modular construction by either AMECON or Eglo Engineering, Newcastle. The only satisfactory progress made during these months was on the aluminium superstructure by Eglo Engineering, Adelaide. Construction of FFG 06 hull and superstructure units proceeded throughout 1990 but behind schedule, indicating that the December 1989 plan might not work. When analysed, AMECON's December 1989 plan was found to contain unachievable rates of production for most of 1990. AMECON responded outlining appropriate amendments but advised that a further 16 weeks was required to develop the necessary details. The project office believed that a period of 11 months to produce a realistic construction program was far below the standard required from a major contractor.

On 29 June 1990 a revised PMB was received. Navy's perception was that for the first time since contract award, this revised plan provided AMECON with a realistic way forward to manage the construction of the ships to meet the mutually agreed delivery dates. Even though progress on the FFG 06 hull assembly at both AMECON and Eglo Newcastle work sites was substantially behind the December 1989 PMB, work progressed according to the schedules specified in the July 1990 PMB (1990 to mid 1992 for FFG 05 and mid 1992 to mid 1994 for FFG 06). To enhance its managerial expertise, AMECON acquired the services of an ex-Todd Los Angeles senior manager with considerable experience in FFG-7 Class production.

FFG 05 was taken to sea on 15 September 1991 for Builders Trials in Port Phillip Bay and adjacent Bass Strait waters. Initial reports indicated overall successful testing, but in line with normal practice, some activities were postponed until supplementary trials in November 1991. On 22 November 1991 FFG 05 successfully completed acceptance trials. In excess of 2000 minor deficiencies were found as a result of the Builders Trials, Acceptance Trials, Inspection and Survey Board review and Shock Inspections. The number of defects was similar to that experienced by the USN with its FFG-7 program. The RAN formally accepted delivery of FFG 05 on 7 February 1992, and one week later, the ship was commissioned as HMAS *Melbourne*.

On 24 August 1992 AMECON completed Post Shakedown Availability work on FFG 05, and after completing successful Combat System Sea Qualification Trials, HMAS *Melbourne* returned to the AMECON yard on 24 September 1992. The consequent 'Acceptance into Naval Service' was effected in Sydney on 28 September 1992 and a few days later, the project office was presented with a commendation from Assistant Chief of Materiel – Navy (ACMAT-N) for the successful acceptance of the ship.

The assembly of FFG 06 proceeded rapidly during the latter half of 1991 with the delivery of the hull and superstructure units from Eglo Newcastle, and Adelaide. Consolidation of the forward and mid-ships sections of the superstructure to the hull had also advanced well in preparation for its launch (as NUSHIP *Newcastle*), which occurred on 21 February 1992. HMAS *Newcastle* was delivered on 20 October 1993, one month ahead of the original schedule, and commissioned into the RAN on 11 December 1993. Following shakedown and other trials, HMAS *Newcastle* was accepted into RAN service on 8 August 1994.

Delivery of both FFGs was achieved within (although at the extremes of) the bands established between Navy and WND some 11 years earlier. The final AMECON FFG product was also very similar to HMAS *Darwin*, but there were differences. In addition to the Australian designed and manufactured Mulloka sonar, other departures from the *Darwin* configuration base-line were the replacement of the Motor Whaleboat with a rigid inflatable boat, modified corrosion protection and paint scheme, increased limiting displacement, and a later base-line Close In Weapon System and Fire Control System.

The RAN is very pleased with the overall performance of both HMAS *Melbourne* and *Newcastle*, and consider these ships to perform better than those acquired from the US. The only real initial concern was non-AMECON specific, the US supplied Phalanx Close-In Weapon System. Although it met capability performance requirements, the levels of maintenance and 'down time' were unacceptable. The problem has since been remedied.

Australian Industry Involvement

Australian Industry Involvement (AII) in the project was based on maximising local content and support. This translated into a number of goals: to use the FFG AII program to expand local industry involvement in the project; to establish local manufacturing capabilities for a number of important systems/equipments principally relating to the hull, propulsion and auxiliary machinery; and to establish in-country support facilities.

The AII component of the project was substantial, primarily because of the extent to which Australian industry was expected to participate. For example, before the contracts were negotiated with the US and WND, industry participation was planned in the following areas; manufacture of Government Furnished Equipment; establishment of overhaul or repair facilities in Australia; offset arrangements; incorporation of Australian sourced parts; and those items which should be manufactured in Australia to increase self reliance and preparedness.

However, it was also determined that the substitution of Australian sourced equipments for US items would

proceed only if it could be accomplished within project schedules, without significant impact on the design and construction packages from the US, without significant complication of the ship construction task, and within the AII premium included in project funding. To facilitate the process, an AII Planning Contract between Todd Pacific of Seattle and WND was completed on 29 June 1984. 800 line items of shipbuilder furnished equipment and materials were identified as having potential for supply by Australian industry. 649 requests for budgetary proposals were sent to Australian industry from which 196 proposals were received. 373 companies advised that they would not bid and 80 companies did not respond.

Virtually all tasks associated with the construction of the Frigates were undertaken by Australian industry. The contract with AMECON required that the company achieve a minimum of 75 percent AII of the contract price. AMECON exceeded this requirement and achieved over 90 percent AII, and an overall project AII level of about 67 percent. Included in the AII program was the local acquisition of two Mulloka Sonar Systems from Thorn-EMI, two Mk 75 76mm Gun Mounts through ADI Bendigo, and castings for two sets of propellers by Timcast in Western Australia, with machining and finish by ADI Bendigo. For those equipments procured through the USN, negotiations were undertaken with US suppliers to obtain agreement on the level of AII to be achieved against USN orders.

Organisational Arrangements

Following the Government's approval of the Australian Frigate Project in 1983, a staff organisation was established to allow the AFPD to achieve project objectives. The organisation comprised the AFPD and central staff in Canberra, and a small overseas project team located in the Offices of the USN Program Manager. Initially, an AF Project Director's Representative organisation was established at WND to provide on-site supervision of the shipbuilding process. In March 1985, this organisation was transferred from the AF Project and established separately as Supervisor of Shipbuilding – Victoria to overcome prevailing management problems with the Destroyer Escort modernisation program.

The Project Office was structured along autonomous functional lines, and reflected the intention to minimise the need to seek support from external agencies. Accordingly, individual managers were appointed as specialist members of the project team.

Education and Employment

During the course of the project, there were a number of AFPD incumbents, including Captain Nisbet (later promoted to Commodore), Captain Hammond (later to be promoted to Rear Admiral and ACMAT-N), Captain McNally, Captain Lamacraft (now Commodore and until recently Project Director [PD] of the *ANZAC* Ship Project), and Mr Ron Irwin, the only civilian to have held the position and currently Director Project Support for Surface Warfare Systems, which includes the FFG Upgrade Project. For the Australian Frigate Project, the AFPDs were well qualified and experienced to undertake their project management duties.

Project Evaluation

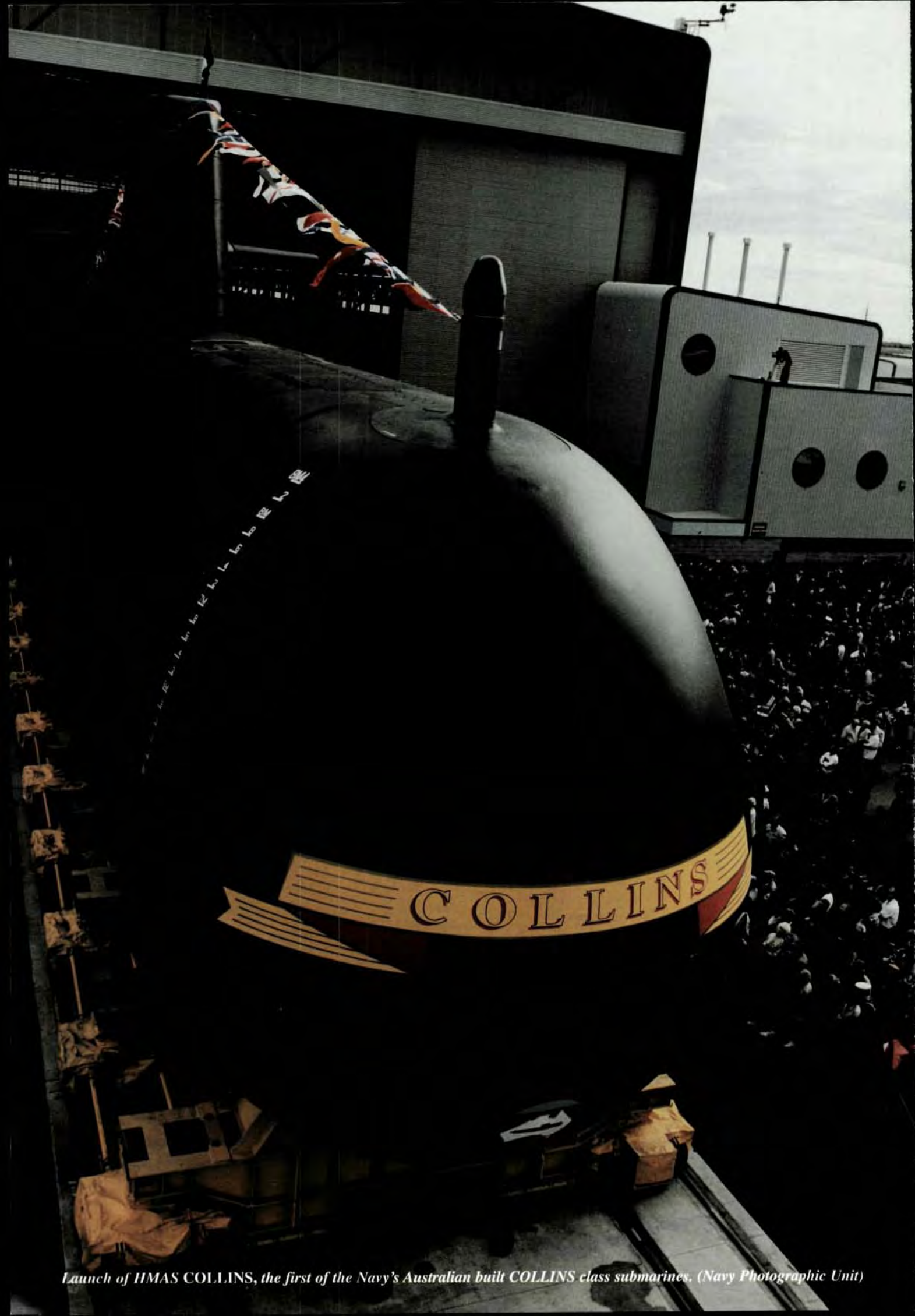
Management Reviews

A comprehensive audit of the AFP was conducted by the Defence Audit Branch between April and October 1985. In the audit report of July 1986, the AFP was thought to be unduly reliant on ad hoc and informal managerial and financial measures, both in Canberra and WND. The report stated that ideally, all planning for financial and managerial controls should have been determined and in place as soon as possible after the AFP commenced, but acknowledged that tight time constraints, heavy workloads and limited staff militated against the early preparation of formal procedures. The audit also found that there could be a gap of some years in Naval capability between decommissioning the first two Destroyer Escorts and commissioning the two Australian Frigates, and noted that there was considerable slippage in the earlier stages of the project.

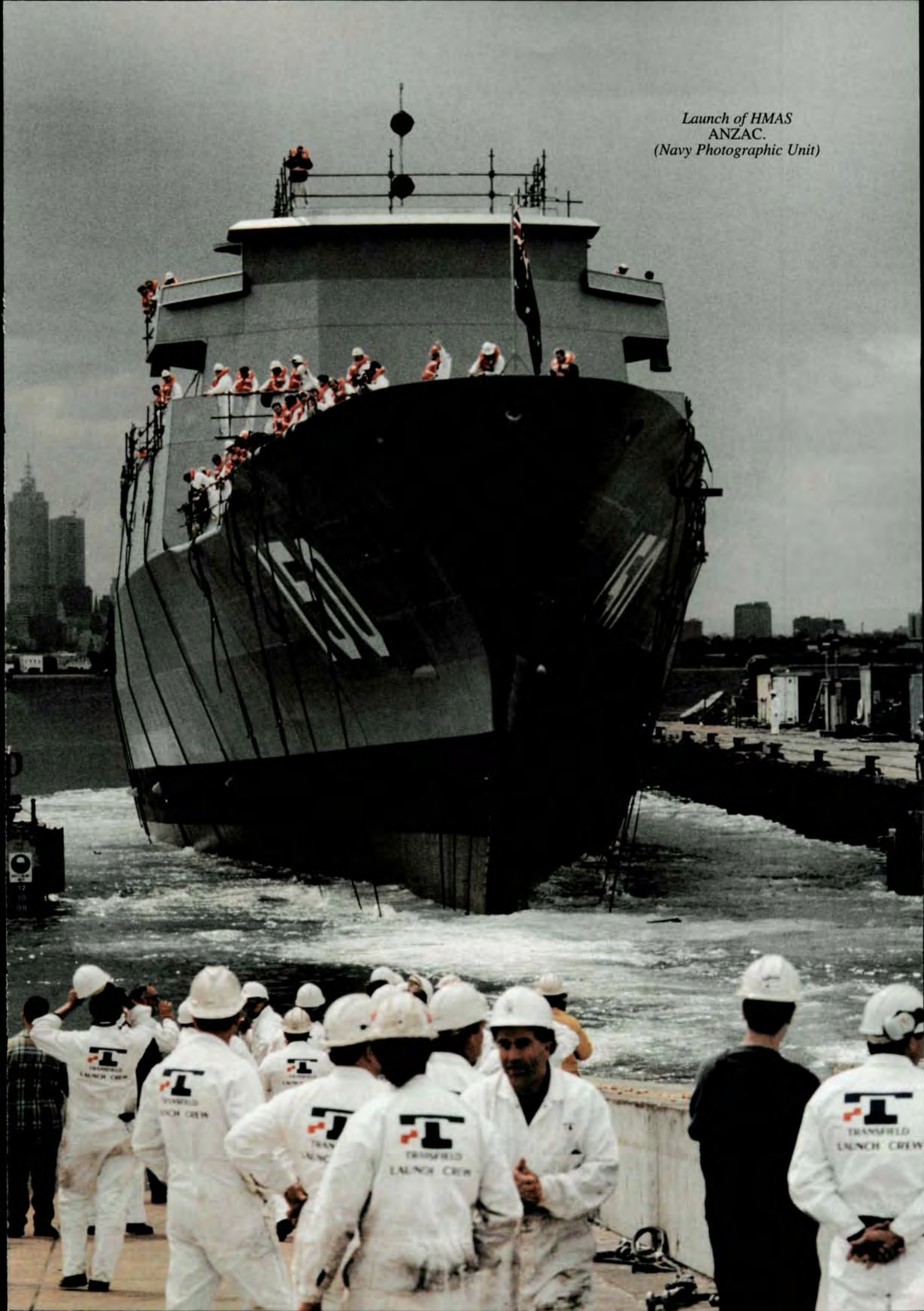
The findings of the audit team also indicated that the degree of autonomy afforded WND fell short of earlier recommendations, and that this had influenced the performance of the dockyard. The audit team recommended that an official implementation schedule be developed for every project (initially in the broad sense for large projects), and that amendments and flow-on effects of changes be closely monitored. It also suggested that for major projects stretching over 10 or more years, the PD should not be changed too frequently, with a hand-over/take-over period in the order of two to three months.

The Management Audit Branch conducted another review during 1989. The audit was not overly critical of the project, and considering the complexity of management requirements, was almost complimentary. In the opinion of audit, the AFP was managed in an efficient and effective manner, with the project on time and within budget (specifically, construction of the ships was within the production window and within approved cost). Competent Navy project management over the years in Canberra, and by the Navy representative at the dockyard, was found to have contributed to the project's success.

The efficient management of the AFP was also found to have been facilitated by a sound commercial



Launch of HMAS **COLLINS**, *the first of the Navy's Australian built* **COLLINS** *class submarines. (Navy Photographic Unit)*



Launch of HMAS ANZAC.
(Navy Photographic Unit)

contract based on USN shipbuilding experience. The primary recommendations of the audit indicated however, that the efficiency and effectiveness of project management could be further enhanced by including in the various project plans, the roles, responsibilities and reporting arrangements between the AFPD and related functional areas.

A further audit of the project on 11 January 1990 focused on Integrated Logistics Support. The general observations were that the project benefited from Mr Irwin's long-term association with the project, and that his corporate knowledge and understanding of project requirements were invaluable.

Project Team Lessons

A number of lessons learned were recorded by the project, and were formulated primarily at the time of hand-over of responsibility from the outgoing to the incoming AFPD. The record of lessons learned for the AFP is substantial. On occasions, these lessons were passed to other Navy project offices.

One of the earlier AFPDs observed that the establishment of clearly defined project objectives had been extremely beneficial and recommended that objectives be promulgated for all significant projects. Also considered invaluable were a dedicated computer system for project management purposes, and the establishment of a Project Director's Representative cell at WND. The AFP was also regarded as fortunate in its ability to recruit a considerable number of staff with previous USN FFG program experience.

Several project deficiencies during the earlier years of the project were also noted. For example, it was recommended that there be greater trading of information between PDs to permit more experienced PDs to provide guidance and assistance to those with less experience. It was also considered that about five years was optimum for a PD to be in charge of a major shipbuilding project – any less time would be disruptive, but any longer could have adverse consequences for the officer's career.

Another point was that a major project must be adequately staffed. Although the AFP had a large staff (36 in Canberra, 22 at WND, and six in the US) and seemed excessive when compared with other projects, there was still a number of tasks that the project was unable to perform satisfactorily, such as configuration management, and AII achievement. It was noted that one of the reasons the AFP was successful was that the project had been largely autonomous.

The achievement of AII in the project was found to be demanding of resources and it was recommended that every major shipbuilding project have its own AII cell. The Mulloka Sonar and the Mk 75 76mm Gun Mount were perceived to require substantially more effort to place to procurement than buying similar equipments through FMS.

Multiple activities (parallel or series) were found to invariably take longer than originally planned and result in schedule slippage if an appropriate allowance was not included in the original schedule. The time allowed between the receipt of the tender and contract award was inadequate. The departmental processes required during these two events mandated a project planning period of 12 months rather than nine months; and a minimum of 18 months was needed between contract award and the commencement of construction by the shipbuilder. It was also noted that in developing detailed cost estimates, the project had the benefit of cost details of the USN FFG program and that this enabled the development of accurate costings and the categorisation of the project as a low cost risk program.

In a report dated 26 April 1985 on the condition of a number of projects, RADM Bill Rourke, then Chief of Naval Materiel made many important observations concerning the AFP, some of which were later adopted by Defence:

- Higher Defence committee processes were generally protracted, and the project development process made no commitment to project decision timetables. This made planning impossible.
- Staff requirements detailing the project proposal were usually developed by a staff specialist in collaboration with Defence Science and Technology Organisation and Chief of Naval Engineering staff. The staff requirement was commonly over-ambitious, over specific and over optimistic in regard to cost.
- Greater weight should be afforded equipment solutions that offered lower costs and simplicity, and commercial rather than specially designed solutions.
- Capability options should be kept open until a capability requirement and associated costs could be endorsed by both Defence and Government.
- Inflated force structure and capability expectations encouraged unduly high unit costs, and when reconciliation occurred it was commonly achieved by a belated reduction in unit numbers.
- A greater time and cost realism would be obtainable by establishing a cost assessment group and ensuring that the group, rather than the project manager, provided estimates of time and cost.
- Not enough had been done to train project managers, particularly in financial management, although the level of training and experience had improved.

Although a significant amount of project procurement and logistics work was satisfactorily conducted by

functional divisions, the AFP was one of the first Navy project to utilise a highly autonomous organisational structure. There was a strong perception that matrix structures were inappropriate for large, complex projects; creating too many communication problems, conflicts of interest, and a lack of functional division loyalty. Matrix arrangements were also found to diminish project control over related functions and result in delays to project activities[3].

Navy tends to put more people into their projects than the other Services and the AFP was probably the first large Navy project where a good number of specialist staff were appointed. While this 'hurt' other areas for a time, it was a sound investment. The key to project success was the right number of staff in the project office, at the dockyard, and overseas. For example, Navy had a very strong project team at WND, it was also useful for on-site trouble shooting purposes, and its information was a major factor in determining shipbuilding progress.

There was a need to monitor contracts closely, but initially there was very little contracting experience in the team and the project was not particularly good at monitoring other than major contractual milestones. A consistent problem throughout contract management was claims for excusable delay. Since such claims can add substantial costs to a project, a project team must include a dedicated contract specialist.

The AFP used milestones in its Agreements and contracts, and while this was a new innovation for that time, it caused problems. Even though payments were not tied to milestones, but against completed work, it was found that the contractor would do everything possible to meet a particular milestone, but not necessarily complete work in other areas as planned. It was also difficult to adequately define milestones, so that interpretations of what elements comprise the event and whether they had been achieved became contentious.

The ANZAC Ship Project

The *ANZAC* Ship Project was established to acquire 10 ships, eight for Australia (*ANZAC, Arunta, Warramunga, Stuart, Parramatta, Ballarat, Toowoomba,* and *Perth)* and two for New Zealand (NZ) (*Te Kaha* and *Te Mana*), to replace the RAN Destroyer Escorts and the RNZN's *Leander* Class frigates. The scope of the project also includes three shore facilities: the *ANZAC* Ship Support Centre at Williamstown, Victoria, and two Combat System Tactical Trainers, one each located at HMAS *Watson, Sydney,* and HMNZS *Tamaki* in New Zealand.

The *ANZAC* Class is based on the Blohm and Voss *MEKO 200* Frigate, a proven design in service with the Turkish, Portuguese and Greek Navies. The F-124, Germany's latest naval program is also based on the *MEKO* design. A major feature of the design is its ability to accommodate a wide range of weapons and other equipment and consequently, there is significant variation in the ships of each country. The unsuccessful final contender for the project was again, the Netherlands M-Class ship, subsequently named the *Karel Doorman* Class.

The *ANZAC* Ship Project was designed 'solely and specifically to contribute to greater self reliance in terms of independent or joint Australia-New Zealand operations' (McLean and Ball, page 1). The spirit of *ANZAC* cooperation goes back at least to 1915, however, what is not generally known is that the '1983 NZ Defence Review rehearsed the advantages for New Zealand of phasing out the frigate force and establishing a new operational concept based on a small force of conventional submarines'. This led to RNZN involvement in RAN proposals to replace the *Oberon* Class submarines. Even though NZ withdrew from this project, 'The experience of working together in a complex evaluation process was...important when it came to establishing combined ANZ procedures for handling the *ANZAC* Ship Project' (McLean and Ball, page 14).

The *ANZAC* Ship Project cemented a new relationship between Australia and New Zealand. Kim Beazley, the Australian Minister for Defence at the time saw this project as an opportunity to forge Closer Defence Relations between the two countries, aimed at enhancing 'the military and economic benefits flowing from cooperative defence equipment projects', as well as offsetting in part the effects of 'the dispute arising from New Zealand policy between the United States and New Zealand' over visits to NZ by nuclear capable US Navy ships (Defending Australia 1994, page 101). As Beazley (1994) commented, 'The Defence of New Zealand is the Defence of Australia', a view largely shared by NZ (McLean and Ball, pages 6-7).

A Memorandum of Understanding (MOU) was signed in March 1987 between the governments of Australia and New Zealand for the ANZAC Ship Project. Under the MOU, a supplementary 'Agreement between Australia and New Zealand concerning collaboration in the Acquisition of Surface Combatants for the RAN and RNZN', also termed the Treaty, was signed in December 1989. Under the Treaty the Australian and New Zealand Defence ministers agreed to treat the industries of Australia and New Zealand as a common industrial base for the purpose of defence procurement and to treat the other's industry as it treats its own (Beck and Lord, page 3). In recent years Australian industry has come to the view that under this arrangement New Zealand is more equal than Australia, with a great deal of work traditionally undertaken in Australia now going to New Zealand companies, such as F/18 Hornet engine maintenance. Although when particular cases were investigated, NZ

Launch of HMAS ARUNTA. *(Navy Photographic Unit)*

Blessing of HMAS ARUNTA *and all who will serve on her. (Navy Photographic Unit)*

firms were found to have won Australian Defence contracts because they were more competitive.

Unfortunately, the Treaty established between Australia and New Zealand covering the *ANZAC* Ships is not easy to read or understand, and has proved in practice to be too detailed, and to include too many management and working level details. The status of the Treaty also means that a number of stakeholders are involved in any proposed changes, consequently, it took four years to effect the first amendment to the Treaty.

The *ANZAC* Ship Project is the largest defence project, and arguably the largest project of any type, undertaken in Australasia, with a total cost of about $6 billion (in 1996 dollars). An early statement by the *ANZAC* Project team in its briefing to industry on 3 February 1987 was that the project would start from the basis of an existing design built or under construction, and that sufficient shipbuilding capability existed locally to negate the need for establishing any new sites. An Australian prime contractor was to be selected for the project.

When Tenix acquired WND and the contract to complete construction of the two Australian Frigates, the company was also entitled to bid for the *ANZAC* Ship Project. Tenix was awarded the *ANZAC* contract in November 1989, over Australian Warship Systems Ltd, which had proposed to build the ships at Newcastle. As Beazley (1994), indicated, 'there wasn't a strong inclination on the part of Cabinet to deny (Williamstown the project)'.

The Tenix bid was based on German productivity levels, which at the time were about 35 percent higher than Tenix's productivity. However, Tenix achieved this productivity level by early 1996, as planned. The *ANZAC* Ships are assembled from 12 major modules built at three sites. Construction of the hull modules is conducted at Newcastle, and superstructure at Whangarei (NZ). Completed modules are shipped to Williamstown, where all ships are assembled and launched.

Contract Performance

Total project cost for the ANZAC Project remains at $6 billion (in December 1996 prices), which is within the original project approval, except for real price increases occasioned by the change from a 3 inch to a 5 inch gun ($104 million), and the incorporation of travel costs ($7 million) and direct legal expenses ($0.6 million). The contract with Tenix is fixed price.

The companies involved in the project have established a range of new construction and systems engineering/integration capabilities. However, because work has been conducted in batches, the level of industry capabilities in some areas, such as the combat system, are winding down. For example, design work is complete, including software development, however, in-service support arrangements that would provide *some* ongoing work have yet to take full effect. It may be difficult therefore, at this relatively late stage of ship construction to interest firms in the remaining *ANZAC* work, partly because industry could use the capabilities developed through *ANZAC* to participate in more attractive commercial work, and which offers ongoing business, particularly in NZ.

However, the *ANZAC* Ship WIP, an Australian only program aimed at improving the defensive and offensive capabilities of the ships offers further opportunities for new, high technology work, as well as ongoing work. A key initiative of the WIP was the formation of an Industry Consultative Group (ICG) in February 1997. The ICG has provided Australian industry with the opportunity to contribute to the early development of capability requirements, and comprises Defence and industry representatives, including Tenix, ADI Ltd, Australian Submarine Corporation, and British Aerospace Australia.

The prime contract requires Tenix to achieve a total Australian and New Zealand Industry Program of about 80 percent of the contract price (73% ANZ content and 7% Defence Offsets), about $2.6 billion for Australia and about $510 million for New Zealand. Under the *ANZAC* Ship Treaty, Australia has guaranteed New Zealand a total industry program of about $585 million, with any shortfall made up by providing NZ industry with access to the Australian Defence procurement program. At the end of December 1996 Tenix had arranged sub-contracts totalling about $2.4 billion ANZIP, and had achieved ANZIP of about $1.7 billion. Major sub-contractors undertaking design work are Australian Marine Technologies (formerly Blohm and Voss Australia) for ship design, Celsius Tech Australia for the combat system, and Computer Sciences Corporation Australia for combat system shore facilities. The *ANZAC* Ship Support Centre (ASSC) has been established at Williamstown, Victoria, and will manage all follow-on support, including training, software management and development, configuration control and be a problem resolution centre for the *ANZAC* Class. About 70 percent of the estimated *ANZAC* project cost by late 1997, including Government Furnished Equipment, was spent in Australia and New Zealand, and the expertise gained by ANZ industry will contribute to whole of life local support for the ships.

The lead ship, HMAS *ANZAC* was launched on 16 September 1994 and commissioned into the RAN on 18 May 1996. HMNZS *Te Kaha* was delivered to the RNZN in May 1997. HMAS *ANZAC* was reportedly delivered on time, within budget and fully functional, and all other ships are expected to be delivered on or before the delivery dates specified in the contract, with the last ship scheduled for delivery on 31 August 2004. However, this statement needs to be considered

in the context of Navy delivery plans. The acquisition strategy specified specific delivery dates but indicated that any delivery was acceptable within a delivery band of nine months for HMAS *ANZAC* and six months for every other ship. The specific delivery dates identified in the ship construction contract were at the very beginning of Navy's delivery band. To be accurate therefore, both HMAS *ANZAC* and HMNZS *Te Kaha* were delivered later by about six months and two months respectively than the original contract dates, but not when considered in terms of Navy's delivery band.

A more recent major milestone occurred in June 1997, the successful completion of NATO Seasparrow missile firings in the Pacific Missile Range Facility Hawaii. Under Phase 3 of the Project it is expected that enhancements will include the fitting of Harpoon surface-to-surface missiles, introduction of a mine avoidance sonar, full integration of surface launched torpedo tubes into the combat system and a torpedo self defence system.

Lessons

The *ANZAC* Ship Project, as with many other major projects, experienced a number of problems from its inception, and no doubt will experience many more. For example, Defence intended that the Ship Specification be equipment non-specific to allow the prime contractor an appropriate level of discretion to meet functional specifications. However, there were believed to be significant logistics and support advantages in standardising major equipment across the Class, and a Standardised Equipment List of major systems and equipment was developed (Beck and Lord, page 7).

Defence believed that the *MEKO 200* ANZ design baseline had been clearly established at contract signature, and that design and construction was therefore low risk. However, there was too little time left to fully establish the high level of ANZII required. Some contractors were well placed to meet ANZII objectives, but many others were not. Some contractors in the winning team also used the opportunity to increase their prices. Faced with a fixed price contract, Tenix then took the unusual step of re-competing nearly all of its sub-contracting arrangements for equipments, including those on the Standardised Equipment List. While this strategy was endorsed by Defence and facilitated the achievement of ANZII, as well as controlling costs, it had a negative impact on both schedule and the 'low risk' aims of the project. By the end of 1995, the extent of changes to the combat, command and control, and propulsion systems, incorporated in HMAS *ANZAC* meant that the original low risk strategy of 'an existing design' was no longer valid (Beck and Lord, pages 7, 10 and 15).

The Auditor-General Audit Report of 17 November 1993 on the *ANZAC* Ship Project agreed (page ix) that the project was significant in terms of the defence of Australia and our relationship with New Zealand. The Report also noted that the progress monitoring arrangements were satisfactory but that the contract should have included better provisions to reduce risk and costs to the Commonwealth, specifically:

- It was not clear that progress payments made to the contractor were protected by bank guarantees.
- There would be benefit in obtaining expert financial advice on departmental methodology for monitoring the financial viability of contractors.
- Alternate ways need to be examined to achieve delivery of equipment on the due date and the required levels of industry content, with a view to including more effective mechanisms than liquidated damages (the Report, page 4, noted that the Commonwealth had agreed to a five month delay in the delivery of Ship 01 [*ANZAC*] and a one month delivery for Ship 02 [*Te Kaha*]).
- The department did not adequately justify its decision not to use an incentive contract for this project.

Both Defence and Tenix responded to the Audit Report (at pages xiv-xv) in the constructive spirit that such reports require. For example, Defence commented that 'the ships will be delivered within the time windows specified in the acquisition strategy', and Tenix commented that 'it would have been inappropriate to have adopted an incentive type contract for the *ANZAC* Ship Project'.

The delivery band issue reflected Navy's pragmatic approach to major warship deliveries and followed the approach adopted for the Australian Frigates. Other lessons that flowed from the Australian Frigate Project to the *ANZAC* Ship Project were as follows:

- The Project type organisation was used, and provided the project team with a significant level of autonomy.
- All Project Directors were extremely well qualified for their duties and had managed other major naval projects. For example, Commodore (later Rear Admiral) Nick Hammond was a former Australian PD, as was *ANZAC* Project Director, Commodore Richard Lamacraft.
- The Project office was well staffed, and a significant number of Navy project personnel were located at the prime contractor premises.

The *ANZAC* Ship Project office recorded the following key project lessons:

- Build a little, test a lot
- Test Facilities by integrating real equipment and software

- Complete software early
- Select and employ modular construction
- Use performance specifications but minimise ambiguity
- Involve the user early

Heritage of the Australian Frigates and *ANZAC* Ship Projects

Through the Australian Frigate and *ANZAC* Ships projects, the capability to build major warships in Australia has been re-established. While many major project difficulties have been overcome, such as steep learning curves, obtaining the right number of appropriately skilled personnel, and competitive dockyard productivity, the challenge will be to sustain this self reliant capability. If it is not sustained, it will eventually disappear. Australia will then face the prospect of continuing the cycle experienced over the past 20 years or so, including paying premiums of about 30 percent, or limiting Australian industry participation to through life support activities, dictated in major part by the overseas prime contractor. Whether the capability can be sustained depends on the nature and extent of future work.

To be really self reliant we need in-country design skills. The practice of stop/ start building and the use of overseas designs may not provide the skills and products Australia needs, or to be successful in the export market. On the other hand, many other Navies also prefer a 'proven' warship, perhaps suitably modified for their environmental conditions. There may be a strong connection therefore, between indigenous design, Australian Defence Force acquisition and use, and export opportunities for warships. Given the relatively small and irregular demand of the Australian Defence Force, there is a general view that exports are needed to generate an appropriate market size if Australia is to be self reliant. Another method of course, is to build a relatively high number of warships of a similar modular type to fulfil a number of operational capability requirements.

Australian Defence Project SEA 1400 seeks to acquire a New Surface Combatant. Planning for this project includes consideration of naval capabilities needed for about 2010-15. The problem is that the tenth *ANZAC* Ship is scheduled for delivery in 2004. Thus, there may well be a gap of about five to 10 years before the high level design, development and construction capabilities established by the Australian Frigate and *ANZAC* Ship projects are utilised. It is likely therefore, that these strategic skills may be further eroded significantly or will be lost, and that this will result in steep industry learning curves, significant training programs, and no doubt insufficient time to properly conduct future warship construction project activities. This will, in turn, probably lead to higher than planned costs, delivery delays and difficulties in meeting performance requirements. The HMAS *Success* Project clearly shows the problems that can occur in such situations.

Options to preserve key indigenous capabilities pending the award of the new surface combatants might include construction of two more *ANZACs*, bringing forward the New Surface Combatant project to build on *ANZAC* design skills, focusing relevant Defence business in a smaller number of firms and providing those firms with ongoing work designed to sustain the more important project, design and technical capabilities needed for 2010, or encouraging Australian industry participation in overseas projects. If Australian industry is to remain competitive and avoid being marginalised into a future small role in warship construction, it must develop its own strategies. Consequently, Australian industry must look to the future and determine its destiny, but it cannot do this alone. It needs the support of Government, as in Jim Killen and Kim Beazley's vision to re-establish warship construction, and the Defence organisation. Consequently, Australian industry could be invited to outline realistic sustainability strategies and identify how Government and Defence might assist this objective. However, an earlier lesson needs to be emphasised, Australian industry must be productive and competitive.

One-off Projects

When compared with the Australian Frigate and *ANZAC* Ship projects, there are a number of projects that could be termed 'one off', where a significant design and construction capability is developed at some cost, and then left to degrade. These projects might well represent the future for Australian industry should warship construction capabilities not be sustained. It is useful therefore, to examine one of these major projects briefly.

Collins *Class Submarines*

In the late 1960s the RAN acquired four 1950s designed British *Oberon*-Class submarines to provide the RAN's surface ships with anti-submarine warfare (ASW) training. With ASW practice, the strategic and tactical advantage of these submarines was realised and a further two were ordered in the early 1970s, again from Britain. At about the same time, the RAN initiated the Submarine Weapons Update Program in Australia, which enabled the *Oberons* to use MK 48 torpedoes and the Harpoon anti-ship missile. Software development and work was carried out primarily by the RAN, but with assistance from Australian industry. The RAN therefore, acquired a British designed submarine and upgraded it to meet our

specific defence requirements, a very familiar trend with Defence procurement across all industry sectors.

When seeking to replace the *Oberon* capability however, Navy recognised that overseas designs, even if modified, were not necessarily appropriate for Australia's operating environment. A dedicated project office was established in 1982 and tasked with selecting a cost effective diesel/electric submarine that satisfied the RAN's requirements, including a state-of-the-art combat system. There were seven contenders for the submarine platform and five for the combat system. The RAN then short-listed potential suppliers to two for the platform and two for the combat system to engage in a competitive project definition study (PDS) phase. On 20 May 1985, the Government agreed that IKL/HDW/Ferrostaal (IKL 2000) and Kockums (TYPE 471) should undertake the PDS, each working with the combat systems contenders, Rockwell and Signaal. The potential contractors were requested to provide proposals for six submarines with an option for eight, and were informed that the Commonwealth intended that construction of all submarines be carried out in Australia. The PDS was released in August 1985 and responses were received in November 1986. During the PDS phase, RAN personnel were located overseas to provide necessary assistance and guidance to contractors in developing their proposals.

The subsequent evaluation of proposals involved hundreds of RAN, Defence and Government personnel. A key feature of the source selection strategy was the competitive negotiation of production contracts in parallel with the source selection process. On 18 May 1987, the Government announced that the Kockums design had been selected, with Rockwell to supply the combat system, under a fixed price contract at a total project cost of about $3.9 billion. The design, while regarded by the RAN as 'proven', had a submerged displacement of more than double the largest submarine Kockums had ever built, and a highly advanced combat system. The construction of the *Collins* Class submarines therefore, involved significant departures from a proven design (Beck and Lord, page 1).

The contract was based on a very detailed performance specification but which allowed the contractor freedom to implement the chosen design and use the most appropriate technology available. One result was an increase of a couple of meters to the boat's length to optimise equipment layout for trim and weight. The prime contractor, Australian Submarine Corporation (ASC), was given total responsibility for cost, schedule and technical performance. ASC was formed specifically to build six *Collins* Class submarines, with the possibility of a further two boats at a 'greenfield' site on the Port River in Adelaide. ASC comprises three shareholders, Kockums (49%), the Australia Government's Australian Industry Development Corporation (AIDC) (48.45%), and RCI Pty Ltd (a member of the James Hardie Group) (2.55%). The current Liberal Coalition Government recently announced its intention to sell its AIDC shareholding, as well as ADI Ltd, and has begun the sale process.

The 'greenfield' Adelaide site was selected by Government based on the recommendations of both Kockums and IKL following their examination of proposed sites. A 'greenfield' site at Newcastle was the second choice. It could be argued therefore, that during the 1980s and early 1990s the Labor Government tended to share Naval construction work between the States, with two Australian Frigates and 10 *ANZACs* built at Williamstown, 6 Mine Hunters (by ADI) at Newcastle, and 2 Hydrographic ships at Cairns. Politically this may have been desirable because major naval projects attract a wide range of work and can boost the local economy significantly. For example, 70% of submarine project funds will be spent in Australia, not including the value of accommodation, services and domestic goods provided by local suppliers to the submarine labour force. On the other hand, sharing work around may not result in a sustainable ship building capability in all areas, particularly if some dockyards do not win follow on work.

The first submarine, *Collins*, was launched on 28 August 1993, commenced contractor sea trials in 1994, and was commissioned into Naval service on 27 July 1996, albeit without full operational capability owing to an 18 month delay in delivery of a satisfactory combat system, and some noise and leakage problems. All of the submarines will eventually be home ported at HMAS *Stirling*, WA.

The challenge for Defence is not only to operate these highly capable submarines, but also to sustain the industry capabilities necessary to support the submarine fleet and evolve the submarine operational capability. This is a major reason behind discussion over the past two years or so as to whether Defence should order two more submarines. However, in some cases, the skills required to build additional submarines are no longer available within ASC. Tradespersons would need to be recruited and trained, and additional materials acquired, all at start-up cost. Consequently the cost of building further boats would be far higher than if eight had been ordered at contract signature.

It may be assumed however, that since ASC was formed solely for the construction of six submarines, that it was an economical proposition to also develop the infrastructure and perform this task in Australia. Consequently, should ASC receive no other work and shut down its operation following delivery of the last submarine, the cost would have been worth it. If a premium up to about 10 percent was paid for local

construction the cost might have been justified because of benefits to the local economy, balance of trade factors etc, as well as the transfer to Australian industry of necessary intellectual property and technology. As indicated by the Australian Frigate Project, a premium higher than 10 percent may have been justified only if further projects would utilise the capability established.

Clearly, Australia has received a great deal of economic and technological benefit from the *Collins* Submarine Project. However, if a further two submarines are not acquired and there are no follow on submarine projects, the design development capabilities established are likely to diminish over time. In fact, this process has already begun. Consequently, if Australia wishes to design and build the next generation of submarines in about 20 to 30 years time, we will likely again need to import key skills and capabilities, probably pay a substantial premium, and experience a significant learning curve that will ultimately pose a high level of risk in terms of capability performance, project schedule and project cost. Some of the strategies that may be considered for sustaining submarine construction skills might include local industry performing refit and modernisation work, as well as through life support. Should a further two submarines be ordered by Defence, design skills might be sustained or enhanced by conducting a design study for an improved *Collins* Class Submarine. However, whether even this will prepare Australian industry to design and construct new submarines of the 2020 era is debateable.

The key issue therefore, is whether the opportunity cost of sustaining the submarine capability compares well with the cost of re-establishing these skills in 20 to 30 years. This is an extremely complex question that demands the attention of Government, and Australian industry, which may be able to identify ongoing commercial opportunities utilising these skills, perhaps akin to the *ANZAC* Ships experience. The basic question is, does Australia want to be in the submarine construction business, and are the skills so vital to self reliance that they must be sustained locally, and are they affordable? We need also to reflect on the fact that most of the key strategic skills available locally are provided by foreign owned companies, such as Boeing, Celsius Tech, and Kockums, and that these skills are therefore, international rather than Australian. In the absence of a Government commitment that the next generation of submarines will be built in Australia, and design and construction skills will be sustained and enhanced over time, the *Collins* program must be considered a one off. Perhaps of interest in this regard is the Labor Party's 1994 Policy Platform, which includes a statement to the effect that all naval ships will be built locally.

Continuing Australian industry capability in key systems, such as the combat system, and smart areas, such as software development and control may reduce project risk and enable more accurate project forecasts. However, empirically this has not proved to be the case. Perhaps the situation might be compared with focusing on sustaining one body part, such as the brain, while neglecting the rest of the body. We know from experience that a well functioning brain is not the sole determinant of functional and personality outcomes. A lack of technical control over at least all of the major component parts will therefore, lead to steep learning curves, technical, financial and delivery uncertainty, and potentially poor overall weapon system performance. Sustaining expertise in a few key areas thus, may not guarantee that Australian industry can or should prime the new project, or that overseas companies will allow Australian industry to participate fully in First Tier sub-contracts.

Should Australian industry sustain capabilities in warship construction, and other major naval capabilities that have the potential for follow on orders, including key systems, and overarching project planning and management skills, then Australian industry should be well placed to prime major new projects on an ongoing basis. The benefits of priming such projects extend to control of the program and all necessary technology, participation in all relevant areas, either ownership or access to appropriate intellectual property, and responsibility for weapons system performance.

Conclusion

These views are broadly consistent with the recommendations of a recent report on Australian and New Zealand shipbuilding capabilities (Defence Industry Committee, May 1995). The Report (pages viii and ix) states that:

- Given the strategically significant role that the ship construction and repair industry plays in supporting the fleet, Defence should continue its commitment to ensuring the viability of the industry. An important element is the planning of Defence shipbuilding and refit programs in order to sustain industry capabilities. Such planning should consider:
  - (a) further development of long-term commercial relationships with industry; and
  - (b) elimination of artificial breaks in major procurements between design, construction and support.
- Defence should seek to further advance Australian naval design capabilities and, to that end, should:
  - (a) develop a policy of encouraging local design

for smaller vessels whose design lies within Australian capacity and competence;

(b) maintain a significant and independent in-house capability in concept studies and preliminary design which can be used to provide expert advice and ensure that Defence continues to be an informed customer in naval construction and refit technologies

(c) consider, in conjunction with other agencies, the feasibility of establishing a national design network.

These recommendations emphasise the need to sustain warship design and construction skills, albeit in a minimalist way, by concentrating skills in areas where some management control is possible. These views also reflect Defence Minister Killen's belief espoused in the mid to late 1970s, supported and implemented by the Hawke Labor Government, that for self reliance reasons, Australia needs to re-establish all skills relevant to warship construction. Australia therefore, needs not only to be a discriminating customer, but also a discriminating designer and manufacturer. The greatest potential for this capability appears to be warships. While there is a strong belief that Australia will need to export its products and services to maintain capabilities, the current reality is that we have not been particularly successful in exporting major warships or submarines. Therefore, either Australia must focus much harder on exports, or other ways of sustaining capabilities need to be identified. Focusing on discrete areas such as combat systems and software development, modernisation programs and refits, will help to sustain some key skills, however, long experience has shown that by itself, it is not an entirely satisfactory strategy.

NOTES

1. The acronym for the Australian Marine Engineering Corporation was AMEC, which was formed from a consortium including Eglo Engineering, Australian Shipbuilding Industries (ASI), and International Combustion Australia (ICAL). A few days after AMEC acquired the dockyard, Tenix acquired Eglo. In February 1988, Tenix attempted to takeover ASI, but in a countermove, ASI was acquired by ICAL. By August 1988, Tenix had acquired ICAL and, therefore, completely owned the Williamstown dockyard. On 9 January 1989, the company name changed to Australian Marine Engineering Consolidated Limited (AMECON). Since then, internal company restructuring has led to a number of name changes. Most recently, Transfield Defence Systems has been restructured and renamed Tenix Defence Systems to reflect its focus on further enhancing company efficiency and effectiveness to provide improved products and service to Defence. Core activities of Tenix Defence Systems are ship design and construction. For consistency, the acronym AMECON has been used in this article.
2. The DNDG report was a remarkable achievement, particularly as there was no budget allocated specifically for this research, or people appointed solely to conduct the research and evaluation. In excess of seven ship types were evaluated.
3. An example of the problems of matrix arrangements relates to Government Furnished Equipment, where substantial delays were experienced in the processing and ordering of requirements by functional areas. This became frustrating for project personnel who had little control or influence over functional areas priorities and work rate. Navy has since reduced the extent of problems by bringing relevant areas into a project and making them specialist members of the project team.

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Family Tree of the *African Queen*

Geoffrey Bewley

The *African Queen* is a movie in the class of *Casablanca, High Noon, 2001, The Cruel Sea.* Just about everybody knows it, or at least knows about it. It's brisk, witty, economical, nice to look at, generally great fun. Plausible? Well, not as obviously plausible as *The Cruel Sea,* but fun, anyway.

John Huston's screen ending isn't as plausible as the ending of C.S. Forester's original book. Each time, the *African Queen* founders in a sudden storm on the Central African lake. In the movie, the German gunboat Captain's about to hang Mr Allnutt and Miss Sayer at the yardarm, when the gunboat accidentally mines itself on the launch's hulk. In the book, the German captain passes the pair into British hands under a flag of truce, then loses his ship to an attack by British armed motor-boats, much less coincidentally.

Keen Forester readers know it's the book ending that sticks more closely to the history Forester drew on. In the book, the fictional launches *Matilda* and *Amelia* sink the fictional gunboat *Konigin Luise* on an unnamed lake. In real life, the real launches *Mimi* and *Toutou* sank the real gunboats *Kingani* and *Hedwig von Wissman* on the real Lake Tanganyika.

In a short essay written after the movie came out, Forester said the germ of the story was an idea of a man and a woman in a boat together on a lonely river. He looked for characters at odds with one another, for a river they might be chugging along, for something they might be doing there.

Forester being Forester, the odds were heavily in favour of a setting in the middle of some war or other. At that time, 1933 or 1934, the First World War was still fresh in everybody's mind. Even as the memories of its horrors were starting to fade, it was just starting to look as if the Germans might be warming up for a second innings. For one reason or another, more and more war books were coming out.

The war against the German colonial forces in Africa made an interesting setting. It was a change from trench fighting in Flanders, blockade in the North Sea. Forester probably collected his tiny cast of characters without too much trouble. The German gunboat on the lake gave them a motive. It would have been just a bit too penny dreadful to actually have them sink it, but the British motor-boats borrowed from real life gave him a happy enough ending.

Would Forester's ending have worked as well on screen as Huston's? Probably not. It would have looked a bit awkward, with the hero and heroine failing, the Royal Navy's boats turning up out of nowhere, and the *African Queen's* efforts turning out to be totally beside the point. The Huston version was tidy, suspenseful, satisfying. It wasn't perfect, but it was perhaps the best ending to be had.

The true story of the British motor-boats is one of the war's minor epics. *Hedwig von Wissman* and her small consorts had given the Germans command of the lake and its shores. This set a German wedge between the British forces in East Africa and the Belgians in the Congo. "It was irksome that there should remain a scrap of water on which the White Ensign did not reign supreme," Forester explains.

The Allies had nothing at the lake fit to fight the Germans. The Admiralty found two craft to send from England. They were fast motor launches building at Thorneycroft's' yard, meant for tenders to Greek seaplanes, 40 feet long, 8 feet beam, good for 15 knots. Each could carry a 3-pounder quick-firer and a Vickers machine-gun.

They were big enough to do the job, small enough to be shifted out there. The nearest useful British base was about 3000 miles from the lake, so getting there took a while. They were shipped from Tilbury on 11 June, 1915. They landed at Capetown, and they went up by rail through Rhodesia to Funguruma in the Belgian Congo. The next leg was 140 miles north to Sankisia, on wagons towed by steam tractors. From Sankisia, rail again, 18 miles to the Luluaba River. Then 400 miles through swamps and shallows downstream to Kabalo, and east by rail to Albertville, on the Belgian side of Lake Tanganyika.

The trip was terrifically adventurous, but not much actually went wrong. Commander G. Spicer-Simson got the two boats, crews, stores, guns and ammunition all the way in to the heart of the dark continent without any notable loss or damage, without the Germans ever waking up to it.

The launches reached the lake in October. The next weeks were spent getting them ready for action, while the news went on failing to reach the enemy. On 23 December, 1915, they were launched as H.M.S. *Mimi* and H.M.S. *Toutou,* and put through their trials. Three days later they went into action, when they attacked the small German armed steamer *Kingani.*

Spicer-Simson had decided the 3-pounders could only be fired through a narrow arc over the bow, so the shock of firing wouldn't strain the light hulls. Even with this handicap, their speed, handiness and rate of

fire did the trick. *Kingani* surrendered, then foundered in shallow water. Spicer-Simson refloated her and put her into commission as H.M.S. *Fifi*, armed with a 12-pounder from the Belgians.

The Germans noticed when *Kingani* didn't come home, but they still didn't know what they were up against. On 9 February, 1916, *Mimi* and *Fifi* at last caught the gunboat *Hedwig von Wissman* out on the lake. She was slow, unhandy and slowshooting, and they shot her full of holes, set her on fire and sank her. Soon after, they captured the last German launch, and the Germans scuttled the steamer *Graf von Gotzen* themselves when they retreated. So, Lake Tanganyika became one more scrap of water where the White Ensign flew in the right place.

When Forester wrote *The African Queen*, he based his launch's action on the sinking of the *Hedwig von Wissman*, in the time frame of the sinking of the *Kingani*. In the details, he didn't try to improve much on real life. Nor was this the only place where he borrowed from history.

In the novel and the movie, the *African Queen's* weapons are two gas cylinders packed full of blasting gelatine, with wood-mounted, nail-fired revolver cartridges for detonators. They're fixed in the bow of the launch, poking through holes above the waterline, so they'll go off when she rams the target. She's seen as a sort of big torpedo, with the cylinders for a warhead. An attack will be a suicide mission for her, and for anybody on board her who doesn't jump out in time, but sinking the *Konigin* justifies the loss and the risk.

Why did Forester choose this arrangement? Something on the lines of a spar torpedo, with an explosive charge out on the end of a pole jutting a few yards ahead of the bow, might have been better. Spar torpedoes had been tried in action in the American Civil War. Sometimes they'd worked, and sometimes the torpedo-boat had actually survived the blast. For the next couple of decades, they'd been regular naval weapons.

Forester knew all about spar torpedoes. He touches on them in the book, when the idea of attacking the *Konigin Luise* first comes up. The *African Queen's* way is closer to history, though. Those makeshift torpedoes of hers really were devised in the First World War. They really were fitted to a launch, and the launch really did attack a gunboat. It really did happen in Africa. The gunboat wasn't German, however.

The story of the Lake Tanganyika launches isn't as well known as it used to be. The story of the homemade torpedoes has faded even farther back into the mists of time. It didn't take place on a Central African lake, but up a West African river, where British forces were invading the German colony in the Cameroons.

The gunboat was H.M.S. *Dwarf*, 710 tons, launched in 1898, with two 4-inch guns and four 12-pounders. This smart little ship looked like a baby third class cruiser, but she was small and handy enough to work in the winding creeks and shallows of the Cameroon River. In September, 1914, she was leading a flotilla of small armed steamers and launches there. She shot up the German port of Victoria, she cut out four lighters from the anchorage. She scared off the crew of a 3700-ton German steamer, and that became a prize, too. She fought a gun action with a German armed yacht.

The Germans quit Victoria and fell back up river to Duala. They'd sunk blockships downstream, with shore guns to cover them. They'd got rid of all the channel markers. They were greatly outnumbered, with no hope of reinforcement, but they were taking their duty to the Kaiser very seriously. A German army might be in Paris by Christmas. With luck, they might hold out until then. Afterwards, at the peace table, the fewer German colonies in British hands, the better.

Dwarf was a nuisance and a threat. She was the sharp spearhead of the probing British force. If she were out of the way, the British mightn't find it easy to call up another ship so handy at that sort of work. The Germans singled her out as a target. Sir Julian Corbett touches on this in his official history, published in 1920.

> *"For her benefit they constructed a kind of infernal machine made of steel gas cylinders with percussion fuses and attached them under the bows of a launch. One of these was sent against her on the night of the 15th, when she was barrage guardship. The attack was duly made and a large explosion heard. In Duala they counted it a sure success, but in the morning there was the* Dwarf *as usual. She had, in fact, detected the attempt in time, and under her fire the man in charge lost his head, lashed the helm wrongly before he leapt overboard, and the torpedo exploded against the bank."*

Between the world wars, at least two other writers covered it in more detail. Both their books were sets of descriptions of naval actions in the First World War's more remote theatres. Conrad Cato had his account in *The Navy Everywhere*, in 1919, beating Corbett into print. E. Keble Chatterton's was in *Gallant Gentlemen*, in 1931.

Both of them quote from the captured diary of Lieutenant Nothnagel, or Nathnagel, one of the leading Germans in Duala.

> *"Tonight," wrote Nothnagel on 11 September, 1914, "a launch with a mine built in under her keel is to be let loose against her. The engineer, who will have to remain on board almost until the*

last, will be as good as lost, but none the less three brave men have volunteered for the fatal journey."

Cato gives a pretty full description of the "infernal machine", and Chatterton gives a sketch. There was an upright frame fixed with struts on the motor-boat's bow, and this held a sliding bracket on each side. Each bracket held a dynamite-filled gas cylinder, five feet long, tipped with detonators. These could be carried high and dry while the boat was under way, and let down under water for the final ramming attack.

Nothnagel's diary gave a German view of the attack. The sortie on the night of 11 September failed, because the Germans judged the boats couldn't get close enough to *Dwarf* before they'd be seen in the bright moonlight. The same thing happened the next few nights.

On 16 September, Nothnagel recorded a serious attack made the night before.

> *"The first torpedo attack on the* Dwarf *unfortunately has failed," he wrote. "The man in charge lost his head and jumped out with the rudder wrongly lashed. In consequence, the boat ran round in circles with the torpedo set, and endangered the other boat, which had to retreat, and in the meantime the torpedo-man was drowned. The torpedo exploded uselessly in the mangroves."*

Chatterton gives the log entries by *Dwarf's* captain, Commander F.E.K. Strong. These show how *Dwarf's* crew managed to deal with this bizarre menace without ever actually realising what was going on.

> *"11 p.m.," he wrote. "A motor-boat came from behind the wrecks and dashed past the ship quite close, and too fast to be fired on. Twenty minutes later another steamboat approached us. Fired four rounds at her, and she disappeared. Shortly after this a boat appeared right ahead, trying to deceive us by flashing a light. Made the challenge to her, which she failed to answer; so fired on her and she disappeared."*

At about 5 am, *Dwarf's* gunners opened fire again when a launch was seen off the starboard bow. Soon after, in the early daylight, *Dwarf's* lookouts noticed a launch lying aground, abandoned, on the mud by the channel, and a half-naked white man waving to them from the mast of a sunken blockship.

Nothnagel's record of the German failure was wrong in most of its details. The torpedo-boat's rudder wasn't exactly lashed. It was meant to be fixed by a pin, and in the heat of the moment the helmsman put the pin in the wrong slot. The second boat retreated from *Dwarf's* fire, not from its circling consort. The torpedoes didn't blow up, and the helmsman wasn't drowned. The boat engaged at 5 am was either the second torpedo-boat trying again, or a boat looking for the lost helmsman. A British boat rescued the German helmsman and towed his boat off the mud. The crew were puzzled by the weird structure on its bow, and they only found the dynamite cylinders when it was hoisted free alongside *Dwarf.* The torpedo lieutenant from the big cruiser *Cumberland* came for a look at them. Commander Strong sketched them, but he decided they'd be too dangerous as souvenirs and he ditched them out at sea.

Dwarf had another narrow escape the next evening, when she was out after the 300-ton German armed steamer *Nachtigal.* While she was anchored out on the river for the night, *Nachtigal's* steered out of the dark to try to ram her. Dwarf slipped her cable and went full speed ahead, and caught *Nachtigal* with her searchlight. Her alert gun crews opened fire at once, and riddled the German ship at point blank range.

The bold German effort didn't quite come off. *Nachtigal* hit *Dwarf* abreast of the foremast at an angle, gashing the side, not doing much serious harm. In return the British gunners set her on fire, and she staggered away across the river with her crew jumping overboard, and half an hour later she blew up and sank. Dwarf was soon patched up by the *Cumberland's* engineers.

While she was being repaired, the second German torpedo launch was looking for her. Cato gives more from Nothnagel's diary.

> *"20th September – The second torpedo-boat has been out since yesterday evening. We hope it has not been blown up by its own torpedo. Anyhow, the* Dwarf *has not been blown up."*
>
> *"21st September – Till now no news of the torpedo."*
>
> *"22nd September – Some of the native crew of the torpedo-boat have returned, and report that the boat was attacked from in front and behind by launches; the benzine tank caught fire, and the crew surrendered. A thousand pities, but still better than if it had been uselessly blown in the air."*

As Cato notes, it's not easy to see exactly why Nothnagel thought this was really better. Maybe, because the crew at least survived. The British launches were actually ship's boats from H.M.S. *Cumberland.*

On 27 September, with the cruiser H.M.S. *Challenger* ready to bombard Duala the Germans ran up the white flag. There was more fighting up country, but the naval side of the campaign was over.

It's interesting now to compare the three accounts of the German home-made torpedoes. Corbett seems to have relied on German reports rather than British. He and Nothnagel both say the runaway torpedoes exploded. Catols book, with the full facts, came out the year before Corbett's, but probably not in time for

Corbett to put his version right. But Corbett should have checked with Commander Strong's log.

Cato and Chatterton each give a good account of the torpedo attack on *Dwarf* and the *Dwarf-Nachtigal* action. Chatterton concentrates on Dwarf's doings, and he leaves out the action between the second launch and the boats from *Cumberland*. Cato's writing sooner after the war, and he puts in more details of German treachery.

The tale of the home-made torpedoes turns up again in *Send a Gunboat*, by Antony Preston and John Major, published in 1967. They tell it from *Dwarf's* point of view, apparently drawing from Chatterton's version.

"Cf. the device imagined by C.S. Forester in *The African Queen*," says one of their footnotes.

"Imagined?" Just plain "used" would be a better word. *The African Queen* came out in 1935, fifteen years after Cato's and Corbett's books, four years after Chatterton's. Forester may have started with an image of a man and a woman in a boat on a river, but it looks as if he built it up with a lot of research.

Maybe he already knew the two true stories. The Tanganyika motor-boats, at least, were pretty famous. If he'd ever come across the tale of the Cameroon torpedo launches, he wasn't the sort of chap to forget it. If he did go searching for material, he'd have found both in the Official History.

In one way, he improved on history. The *African Queen* carries her explosive cylinders above water, poking neatly through the timber hull, not on an awkward underwater frame like the German boats'. So, less extra weight forward, no drag to affect speed and steering, fuses easy to get at, less chance of water spoiling them, less chance of them hitting a stray drifting log and blowing up the boat too soon.

(Cato points out that the German way was ingenious but a bit too complicated, and he suggests a spar torpedo would have been better. Forester's Mr. Allnutt doesn't know about spar torpedoes. His way is simpler and surer still, and probably only slightly more suicidal.)

The Germans' way had one point in its favour. Their charges would have gone off under water, and a blast under water would have hurt the target more than a blast above. On the other hand, considering the great size of the blasting charges and the modest size of the target, a foot or two one way or the other probably wouldn't have made a lot of difference.

Forester might have picked up the idea for Mr. Allnutt's effort from Corbett's history, but one detail suggests he read a fuller account, Cato's or Chatterton's or somebody else's. In the novel and the film, Miss Rose Sayer, who urges Allnutt to make the torpedoes, is the sister of an English missionary.

> *"The idea for these 'torpedo-boats'," Chatterton says, "emanated from Duala's assistant harbour-master; but it is regrettable one has to state the unpleasant truth that the device was manufactured by a German missionary, whose sense of honour was so distorted that he volunteered to ram the* Dwarf *by daylight under cover of the white flag. The Commandant at Duala declined to allow such treachery."*

When H.M.S. *Cumberland's* boats trapped the second German launch, Cato says, "the great inventor was captured at the same time, and was retained as a prisoner in spite of the plea that his missionary work in the Cameroons was likely to suffer by his absence."

Wherever the first idea came from, Forester did a good Job, and the movie very nearly did him justice. No wonder it all made such a fine story. It turns out it was almost a case of divine intervention.

How Senior Are You?

By Commander Brian J. Barry USN

Commander Barry was the Commanding Officer the USS David R. Ray (DD971) when he developed this self-diagnostic test for anyone who was puzzled as to the definition of a "senior" officer.

	Senior Officers	*Middle Ranking Officers*	*Junior Officers*		*Senior Officers*	*Middle Ranking Officers*	*Junior Officers*
Forms of Address	Call junior officers son	call junior officers by their first names	Call other junior officers by the nicknames they earned on leave	**Bridges**	Only see them when they tour ship	Are allowed to sit while on them	Know which windshield wipers work
Base Parking	Are driven in official cars and are unconcerned with parking.	Get reserved parking spaces	Get parking tickets	**Base Housing**	Live there	Remain on waiting list for it	Have no desire to live on base
Racks	Sleep in beds. Have separate sofas for daytime	Sleep in berths that convert into day sofas	Don't have sofas. Always in the rack	**Eating**	Eat by themselves	Eat with others, but get served first	Never stop eating.
Sound Powered Phones	Recognise them when they see one.	Remember how to make up a set.	Frequently have sore ears.	**Micro-Computers**	Have government purchased computers that someone else dust for them.	Have government-purchased comuters that they dust themselves.	Buy their own computers and actually use them
Ship's Schedule	Don't know what it will be	Don't know what it will be, but believe that senior officers do.	Enjoy starting remours about it.	**Letters**	Dictate intelligent, witty ones to expert stenographers	Write boring ones in longhand.	Would rather deploy to the Indian Ocean than write one.
Ideas	Have them and write memos that are read and acted upon.	Have them and write memos that are read and ignored.	Have ideas, but that fact is largely irrelevant.	**Arriving**	Get piped onboard ship	Worry about when to pipe	Have a hard time taking it seriously
Physical Fitness Training	Write messages about the importance of physical fitness.	Worry about injuring themselves while taking the test.	Take the test and then go work out.	**Movies onboard**	Always enjoy a good John Wayne film	Stop by for popcorn and go back to work	Are needed to operate the projector
Coffee	Someone pours it for them, using a clean cup and saucer.	Have pitchers delivered to their staterooms and use mugs that they rinse out weekly.	Walk to the wardroom to get it and use mugs they wash annually, just before the Admiral's inspection.	**Briefcase**	Someone carries theirs for them	Carry their own.	Carry tennis rackets instead
Gossip	Gossip about other senior officers.	Feel privileged to overhear gossip about senior officers.	Couldn't care less	**When on Leave**	Tell sea stories about good times they used to have on leave	Listen politely to the senior officers stories whilst wishing they could go off and have a good time	Go off and have a good time
Accountability	Hold others accountable	Get held accountable	Foul up and watch others get held accountable.				

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Underwater engineering at the US Naval Academy – focusing on novel ROV designs

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The Department of Naval Architecture, Ocean and Marine Engineering at the United States Naval Academy (USNA) has developed within its engineering programmes curriculum the general area of 'underwater engineering'. Currently, the engineering programmes within the department are being so aligned that the midshipmen (students), by selection of a mixture of relative courses, coupled with the opportunity to undertake individual research, are able to follow an 'underwater engineering track'. The courses comprise specialist electives which address the varied technology aspects associated with 'man and machine underwater', and a one semester ocean engineering systems design course. Individual research may be undertaken outside these courses subject to certain scholarly requirements. The ocean engineering systems design course revolves around a 'design and build' project in which groups of midshipmen are presented with scenarios which reflect real-life underwater engineering tasks and requirements. One recent project, which is ongoing in collaboration with the Naval Surface Warfare Centre, is the design and evaluation of a prototype Automated Hull Maintenance Vehicle (AHMV). This paper describes how specialist courses in an undergraduate programme have been developed to address the man and machinery aspects associated with underwater engineering. Further, the philosophy by which these courses have been used to support specialist projects is detailed, with particular focus on the design of an AHMV to undertake in-water environmental cleaning operations.

Introduction

The Department of Naval Architecture, Ocean and Marine Engineering at the USNA has developed a focused, attractive and relative curriculum within the general area of 'underwater engineering'. This curriculum was pioneered in the 1970s with the introduction of an accredited interdisciplinary programme in ocean engineering, which was developed to provide midshipmen with a programme of study emphasising ocean technology. This ocean engineering programme operates in conjunction with two sister programmes within the same department, covering the disciplines of marine engineering and naval architecture.

The current underwater engineering curriculum is supported by three elective courses which address various topics associated with man and machine underwater. The specialist courses are:

1. underwater work systems;
2. life support systems;
3. underwater power systems.

The objectives and themes of these courses are described later. Individual project work is undertaken in these courses but the ocean engineering systems design course, which revolves around a 'design and build' exercise, is a group affair. These group projects are, as far as possible, designed to reflect real-life underwater engineering tasks and requirements. All too often, engineering students find themselves equipped with the fundamentals of maths and science but without the experience and guidance to integrate their knowledge to some real purpose. Subsequently, this approach provides the students with the opportunity to work on open-ended design problems, to work as part of a team, to demonstrate project leadership and to enhance their levels of written and oral communication within an 'environment' that will allow them to exhibit technical creativity.

The alignment of these courses is such that the specialist elective courses serve as feeders in which the midshipmen are able to 'arm' themselves with the necessary fundamental knowledge with which to address design solutions to real-life problems. These real-life problems are addressed in the one semester ocean engineering systems design course.

Environmental studies are now included in most engineering and science degree programmes. Majors in environmental engineering are quite commonplace although the content of these courses focuses, in the main, on the land-based environment and water quality issues. The USNA has adopted a progressive environmental theme throughout its programmes by the inclusion of maritime environmental topics which address concerns both above and below the waves.

The group project work has, over the years, revolved around a number of specialised student projects. In recent years the theme of these projects has been directed to the design, construction, operation and evaluation of remotely operated vehicles (ROVs). The current ROV projects are supporting a requirement of

the US Navy for an effective in-water Automated Hull Maintenance Vehicle (AHMV). One goal, among other hull husbandry tasks, is to provide an underwater cleaning system incorporating an integral effluent capture system.

Organisation and mission of the USNA

Founded as the Naval School in 1845, the USNA today is a four-year service academy that prepares midshipmen morally, mentally and physically to be professional officers in the naval service. The clientele, know as the Brigade of Midshipmen, is a body of some 4000 young men and women. Bachelor of Science degrees are awarded to midshipmen upon graduation and 18 different fields of subject area are offered, of which eight are in engineering.

The mission of the Naval Academy is:

> *'To develop midshipmen morally, mentally, and physically and to imbue them with the highest ideals of duty, honour and loyalty in order to provide graduates who are dedicated to a career of naval service and have potential for future development in mind and character to assume the highest responsibilities of command, citizenship, and government'.*

The Naval Academy's 600-member faculty is composed of about equal numbers of civilian professors and experienced military officers. The civilian professors give the academic programme continuity and a foundation of scholarship and teaching experience. The officers, who rotate every two or three years, bring fresh experience and ideas from operational and staff assignments.

The whole training package at the Naval Academy is holistic in nature, with the midshipmen being the ultimate focus. The vision is, therefore, to provide total quality education over a four-year period which fully integrates a curriculum of academic studies, athletics, leadership, and ethics. This vision is documented and supported by the USNA Strategic Plan. The strategic plan is progressive and comprehensively documented, and provides focus on efforts and methods that will achieve a vision of what the USNA could or should be in 10–20 years time.

General curriculum

The curriculum at the Naval Academy has been developed to provide each midshipman with the skills and knowledge necessary for the performance of duties as a junior officer in the US Navy or the US Marine Corps. All midshipmen are given a broad education in mathematics, science, engineering, social science and the humanities, regardless of which majors programme they elect to follow. The elected major adds educational depth in a particular field of interest chosen by the midshipman. In addition, the curriculum also provides midshipmen with a background in leadership, military law and customs, seamanship, navigation, tactics and weaponry.

Table I Approved majors
(a minor in language studies is also offered)

Group I	*Group II*	*Group III*
Engineering	*Science and Maths*	*Humanities*
Aerospace	Chemistry	Economics
Electrical	Computer science	English
General	General	History
Marine	Maths	Political science
Mechanical	Oceanography	
Naval architecture	Physics	
Ocean		
Systems		

Academic programme

There are three Academic Divisions and one Professional Division. Each division is made up of a number of departments which, between them, offer 18 approved majors. The majors are classified into one of three groups given in

Underwater engineering curriculum

The inclusion of underwater engineering curricula into the department's engineering programmes has been undertaken in a number of ways, via specialist elective courses and an ocean engineering systems design course. There is a large emphasis placed on group design project work, which is detailed later, although there is the capability for students to undertake individual research. The current philosophy is aimed at promoting an interdisciplinary and integrative curricula, whilst combining the elements of traditional education with socio-environmental factors and communication skills to address the requirements and impacts of underwater engineering into the 21st century.

Specialist elective courses

Life support systems
This course is concerned with introducing the student to the requirements, constraints, and alternate approaches for supporting life in an undersea environment. Also, the various types of underwater breathing apparatus are described and an overview of the critical engineering concerns which must be considered when designing these breathing circuits is presented.

Underwater power systems
This course introduces the student to advanced power systems and energy conversion techniques which have applications in underwater systems. This includes the study of battery and fuel cell systems, and the principles associated with direct energy

conversion, advanced thermodynamic power cycles, fission and fusion.

Underwater work systems

This course covers the vehicle aspects of sub-sea intervention and serves to acquaint the student with the operational and design considerations with regard to manned and unmanned untethered submersibles, remotely operated vehicles (ROVs) and deep dive systems. It is a multi-disciplinary course covering all the underwater aspects associated with naval architecture, materials technology, power transmission and propulsion systems, underwater tools and work operations.

These courses act as a 'feeder' to the ocean engineering systems design course by providing the fundamental tools and knowledge with which the midshipmen can undertake a detailed design exercise. The interdisciplinary nature of the course material, coupled with the requirement to provide up to date technological information in a rapidly advancing discipline, meant no standard text was available. Subsequently, throughout 1994–95 the combined efforts of faculty at the USNA, coupled with specialist collaboration in Canada, published a book which now supports the underwater engineering curricula.[1]

Ocean engineering systems design

This is in effect a capstone design course with the aim of enhancing the student's design capabilities and understanding of the design process, and to provide the student with an opportunity to utilise prior academic training and experience through group participation in a design project related to ocean applications.

As an ocean engineering capstone course, students prepare conceptual and/or detailed design(s) for selected ocean related applications. Designs must encompass aspects of economics, criteria satisfaction, environmental quality, safety, fabrication and maintenance. Oral and written design reports are required.

Individual research

During the final year selected midshipmen are given the opportunity to conduct original research under the guidance of faculty. Midshipmen projects in recent years have been concerned with carbon dioxide absorption for underwater life support, design of human powered submarines and ROV systems.

Facilities

The midshipmen at the USNA are fortunate to have some of the best undergraduate laboratory facilities in the world. In particular, the underwater engineering courses and projects are supported by these specialist facilities:

Hydrodynamics laboratory

The hydromechanics laboratory consists of three major experimental facilities, including a 116m towing tank facility equipped with a dual flat wave generator. The towing tank is fully computerised and instrumented for data acquisition over a wide range of carriage speeds.

Life support laboratory

Established in 1988, the Life Support Laboratory promotes midshipmen and faculty research in underwater life support systems design. Equipped with a 2.5m deep test pool, a hyperbaric chamber capable of simulating depths to 610m, and an electro-mechanical breathing simulator, this laboratory emphasises research in carbon dioxide absorption, breathing apparatus dynamics, and diver thermal protection.

ROV laboratory

The ROV laboratory supports the multi-disciplinary nature of vehicle design, build and test. The facilities allow the midshipmen to examine in detail vehicle propulsion systems, tether management arrangements, electrical distribution networks and remote operation technology.

Group project work and specialist student projects

Project work, both individual and group, is an essential part of a student's learning process, particularly when investigating real-life open-ended problems. Although individual projects are more easily assessed than group projects, they offer limited scope for developing all round communication skills. Such skills are vital for team work, project leadership and in resolving conflicts. The main problem with group projects is the difficulty in assessing individual effort and contribution and also, with larger groups, a lower productivity rate can be observed due to the lack of cohesiveness within the group. However, from the learning point of view these group projects are invaluable vehicles for exposing the students to real-life situations and the frustrations of working closely with other people.

Subsequently, this approach provides the students with the opportunity to work on open-ended design problems, to work as part of a team, to demonstrate project leadership and to enhance their levels of written and oral communication within an environment that will allow them to exhibit technical creativity. The strategy behind group project work is discussed later.

The students come to the course with experience in design but with little exposure to undertaking group openended technical investigations. Subsequently, in

Figure 1: The Squid *human powered submersible.*

the early stages of the project the group gets frustrated owing to the lack of any detailed criteria and without a previous tried and tested 'recipe' to follow. It soon becomes apparent that there is no 'ideal' or 'staff' solution to the problem, which is in stark contrast to the traditional method of asking engineering students to solve problems we already know the answers to. Without reference to any standard material the students soon find themselves in an iterative and integrative design/decision making spiral.

Over the years a number of specialist student projects have been undertaken and these are described below.

Medusa underwater habitat

In the early to mid-1970s an underwater habitat was designed for human occupancy through multiple independent research projects. Affectionately referred to as the Medusa Project, this design included all subsystems, such as the 2.5m diameter by 5m long habitat shell, ballasting, and life support. In June 1984 Medusa was commissioned as an underwater classroom off Key Largo, Florida. It continues to operate as part of a marine ecology programme for high school and college students and is sponsored by the Marine Resources Development Foundation.

Human-powered submarine project

In recent years, the most popular project among ocean engineering majors has been their design efforts for the International Human-Powered Submarine Races, held biannually at Riviera Beach, Florida. These efforts produced the *Squid* (Submerged Quick Intervention Device) in 1989, and the *Subdue* in 1991 in response to guidelines established by the race sponsor, the HA Perry Foundation. The *Squid* submersible, shown in Fig 1, evolved from a conceptual design proposed by midshipmen as a class project. From this initial concept, engineering students were involved in hydrodynamic modelling, propulsion design, life support, emergency subsystems and, finally, construction.[2] This project won national recognition by the Ocean Engineering Division of the American Society of Mechanical Engineers (ASME) as the 'Best Student Project of 1988'. The *Squid* won the prize for best overall performance in the 1st International Submarine Races held in 1989 in Florida. The midshipmen returned in June 1991 with a new vehicle, *Subdue*, to defend their title. Although the Naval Academy did not repeat the performance of overall winner, the educational benefits of this project were again outstanding. Indeed, the midshipmen that participated in this project came away true 'winners' from an educational standpoint.

ROV projects

ROV projects commenced in 1992. They are viewed as excellent vehicles for developing multidisciplinary skills and for exposure to group project work. Since these projects were started they have become increasingly more technically demanding as the focus is directed towards real-life problems.

Sea-Goat project

The *Sea-Goat* 360 project was an exercise in ROV design which started in 1992. From concept identification through the design and build stages, an operational low cost ROV, shown in Fig 2, was completed as a class project in a four month period.[3] The object of the project was to help the students gain hands-on experience in an actual engineering environment and to give them a chance to apply some of the knowledge gained in the classroom.

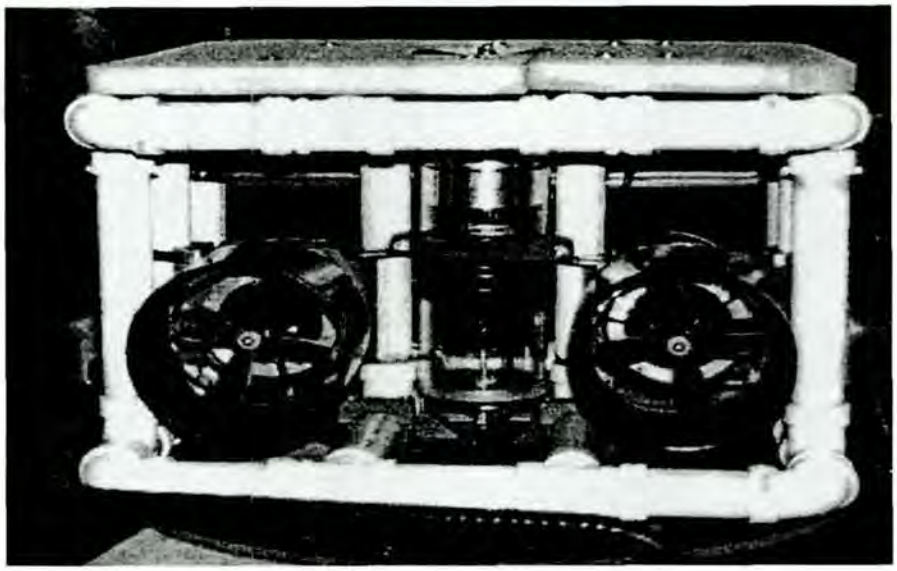

Figure 2: The Sea-Goat *ROV*

Lone ExPlorER

The ROV learning theme was continued in 1994 with the aim of improving the design and operation of the *Sea-Goat* vehicle; subsequently the Lone ExPlorER (LEPER) vehicle was developed. Although not totally successful, it did point to certain critical areas where design enhancement was needed. This experience and successful track record in ROV design, coupled with the facilities which were naturally created to support such work, led to a more technically ambitious undertaking which is described below.

Automated hull maintenance vehicle project

By way of background to the project, copper-based antifouling paints have been applied to Navy ships for many years to reduce the added hydrodynamic drag due to marine fouling on their hulls. Past studies have shown that 15–20% of the US Navy's ships propulsive fuel costs have gone into overcoming this marine growth-induced drag when allowed to remain attached to the hull. In-water cleaning of ship appendages using diver assisted systems is well established. The challenge, however, is to demonstrate an environmentally safe, remotely-operated cleaning system that captures all discharge from the cleaning system during in-water operations. The US Navy has a requirement to develop such a system and this requirement has featured as an integral part of the capstone design course. Subsequently, faculty and midshipmen, in co-operation with engineers at the Naval Surface Warfare Centre in Annapolis, developed an operating prototype of a remotely-operated underwater cleaning system. The prototype was found to be capable of removing heavy marine fouling from underwater surfaces while capturing, and delivering, the cleaning effluent to a surface pier location for possible treatment. The project continues.

Design requirement

The students were presented with a design requirement which set out the scope of the project. The design requirement was set as follows.

An Automated Hull Maintenance Vehicle (AHMV) is required whose goal, among other husbandry tasks, is to reduce, or eliminate, all copper discharges to the harbour during in-water cleaning of US Navy ships. The key element of this hull cleaning system should focus on an ROV which has the capability to self-navigate around the ship's hull and clean all the significant marine fouling. The design must incorporate an effluent arresting system to capture all discharge during the hull cleaning operations. Alternative effluent arresting systems should be investigated to find the most cost effective means of capturing the AHMV discharges for treatment, and copper removal, prior to its delivery to a pier-side location.

Design goals

The design goals were established arbitrarily around a pier-side environment with a minimal handling system for launch and recovery. The following design goals were set:

1. The vehicle and effluent system must be capable of operating at a maximum depth of 23m of seawater.
2. The vehicle should have the capability of cleaning the appendage surfaces at a maximum rate of 186m^2/h.

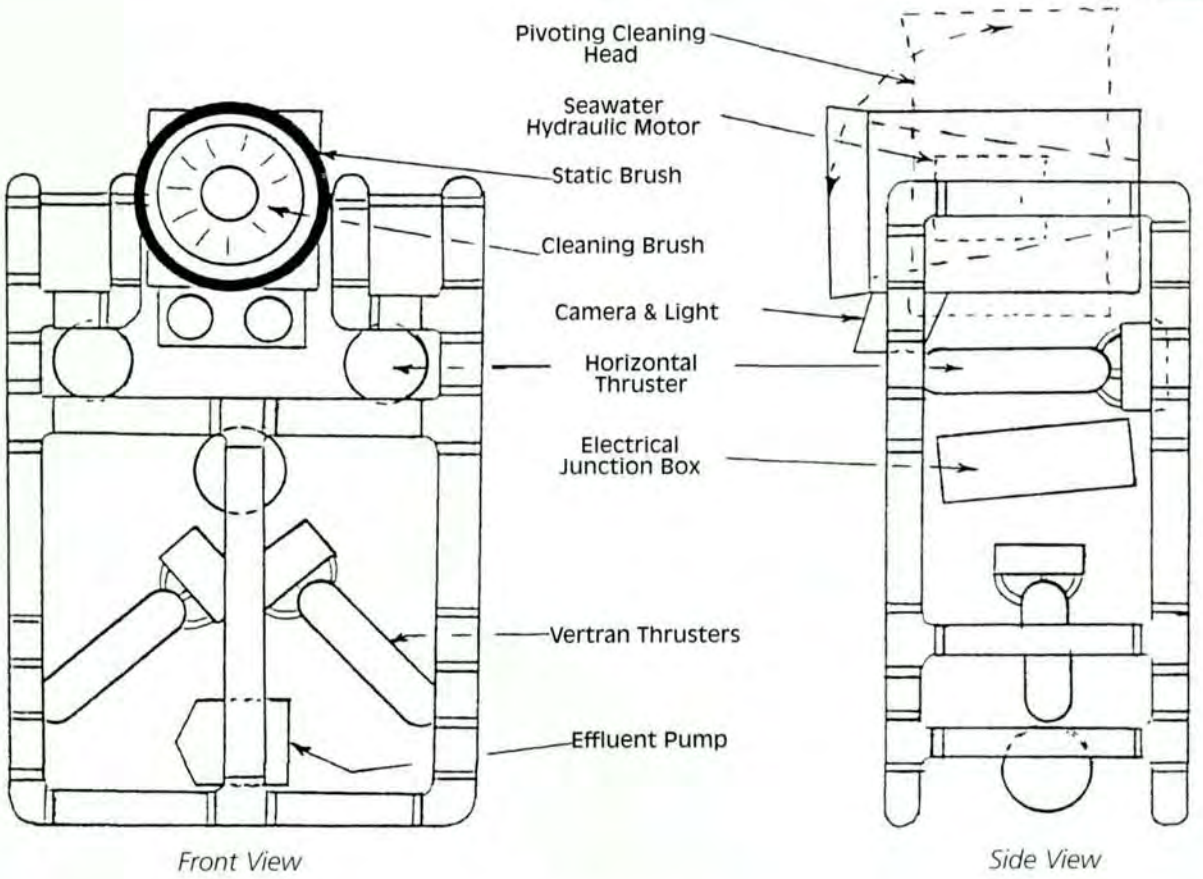

Figure 3: The 'HAMmer' vehicle.

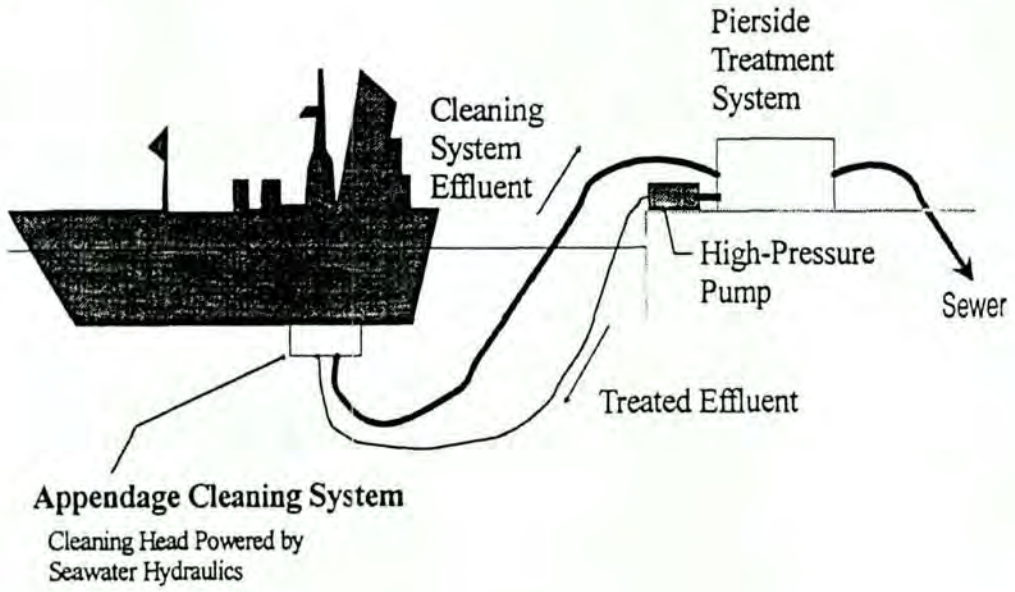

Figure 4: Appendage cleaning system.

3. The vehicle dimensions and weight in air should be minimised to ensure that it can be easily transported by two people: a weight of less than 68 kg (150 lb) and dimensions not exceeding 0.61m x 0.91m x 1.22m should be considered as a design goal.

Supporting requirements

The students were required to provide a complete analysis of all subsystems and elements, with detailed design specifications and calculations for the following:

1. vehicle frame, including rationale for material selection;
2. ballasting and subsystem locations;
3. vehicle propulsion;
4. vehicle handling system;
5. tether management system;
6. waterproof housing of electrical connections and thrusters;
7. effluent arresting system.

Vehicle evolution

A view of the cleaning vehicle developed, 'HAMmer' (Hull Appendage Maintenance Vehicle), is shown in Fig 3. A detailed description of the complete design process and the interaction of the students in this group project would be too lengthy for full discussion. However, the outline design considerations in developing the HAMmer prototype are described below.

Cleaning head/effluent capture

The heart of the vehicle is the cleaning head, powered by a seawater hydraulic motor, whose working fluid is the same effluent captured by the cleaning head and then circulated in a semi-closed circuit mode as shown in Fig 4. Nominally powered by high pressure (up to 13 800 kPa), low volume flow (up to 22 litres per minute), this unit weighing 10.9 kg can produce up to 3.5 kg–m of torque. For the purpose of evaluating this prototype, a commercially available power washer, capable of supplying approximately 7.5 litres per min at 2067 kPa (300 psi), was utilised to deliver fresh water from the surface to the seawater hydraulic motor. However, during normal operations it is anticipated that a high-pressure pump capable of handling seawater would be used to recirculate the treated effluent from the pier-side water treatment system.

By powering the cleaning head with seawater hydraulics, as shown in Fig 5, the quantity of effluent which must be disposed via a publicly owned seawater treatment system can be minimised. The cleaning head powers a 23 cm diameter circulating nylon brush which removes the marine growth through mechanical shearing action. A 33 cm diameter, static outer brush surrounds the cleaning brush to help capture any paint chips or marine growth that may be propelled outward as the brush is rotating. The entire brush/hydraulic motor assembly is housed in an effluent capture funnel which operates similarly to a vacuum cleaning head by collecting seawater effluent, including marine growth and heavy metals from the antifouling paint. Constructed of rigid, polyvinyl chloride (PVC) closed-cell foam, this capture funnel is capable of pivoting about its

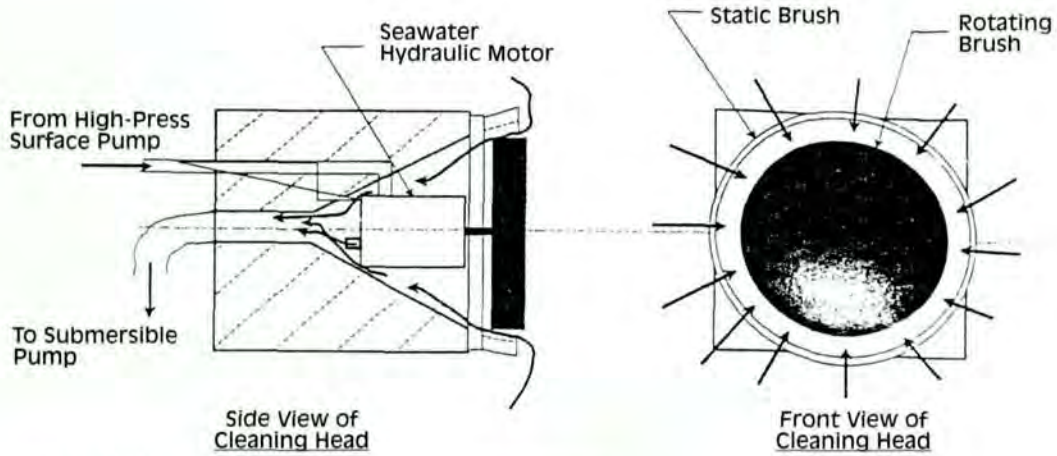

Figure 5: HAMmer cleaning head/effluent capture system.

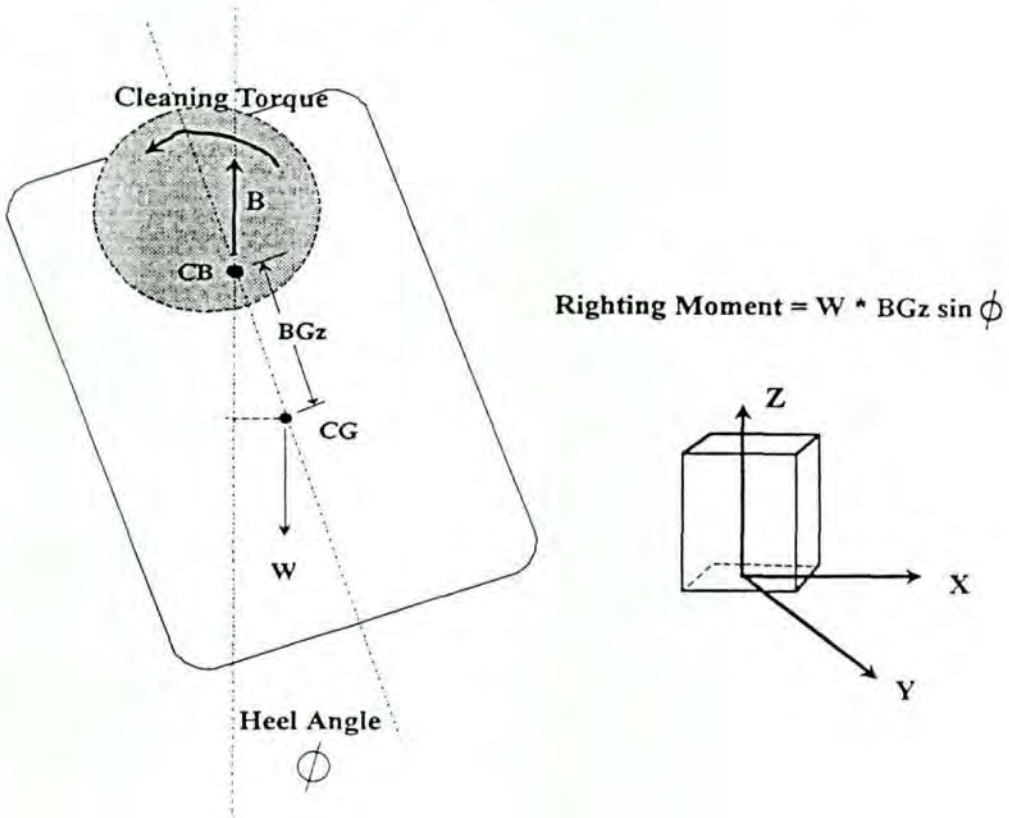

Figure 6: Inherent vehicle righting movement.

horizontal axis to allow the cleaning brush to make contact with any underwater surface from 30 deg below to 90 deg above the horizontal axis.

The copper-laden effluent travels from the cleaning head to a submersible pump located in the base of the cleaning vehicle and then via a corrugated plastic hose for pumping to a surface treatment system. The effluent flow, directed inwards into the cleaning head capture funnel, was adequate to ensure that antifouling toxins would not be released to the ambient water surrounding the ship's hull during cleaning operations. The exhaust from the seawater hydraulic motor is entrained into the capture funnel to mix with new effluent that is pumped to the surface for treatment. A video camera and halogen light were mounted on the capture funnel to allow a surface pilot to view remotely the brush action against the appendage surface.

Vehicle frame

The prototype vehicle frame, shown in Fig 3, was constructed with 5 cm diameter PVC tubing. The 46 cm x 84 cm x 137 cm open frame provided a stable platform for mounting vehicle components, including

Table II Hydrostatic properties of hull appendage maintenance vehicle

			Component position								
Component	Weight (kg)	Buoyancy (kg)	X, cm	Y, cm	Z, cm	X*W	Y*W	Z*W	X*B	Y*B	Z*B
Thruster No 1	5.23	1.91	25.38	0	76.14	132.83	0	398.49	48.46	0	145.38
Thruster No 2	5.23	1.91	-25.38	0	76.14	-132.83	0	398.49	-48.46	0	145.38
Thruster No 3	5.23	1.91	20.30	0	15.23	106.27	0	79.70	38.77	0	29.08
Thruster No 4	5.23	1.91	-20.30	0	15.23	-106.27	0	79.70	-38.77	0	29.08
Camera	0.91	0.50	5.08	15.23	96.45	4.60	13.81	87.48	2.53	7.60	48.11
Light	0.38	0.16	-5.08	15.23	96.45	-1.91	5.73	36.30	-0.81	2.42	15.31
Junction box	1.81	5.56	0	0	71.07	0	0	128.92	0	0	394.81
Frame	7.71	14.43	0	0	55.84	0	0	430.49	0	0	805.53
Pump	3.81	1.07	0	0	10.15	0	0	38.72	0	0	10.91
Seawater motor	13.11	2.04	0	10.15	116.75	0	133.11	1530.74	0	20.67	237.74
Pipe/cable	0.91	1.70	0	-15.23	30.46	0	-13.81	27.63	0	-25.83	51.66
Suction head	0.55	15.42	0	5.08	121.83	0	2.81	67.41	0	78.27	1878.52
Cleaning brush	0.79	1.80	0	17.77	121.83	0	14.10	96.69	0	32.07	219.90
Surround brush	0.68	1.07	0	17.77	121.83	0	12.17	83.43	0	19.10	130.94
Flotation	0.06	3.54	0	0	121.83	0	0	7.18	0	0	430.95
Ballast	2.72	0.11	0	15.23	0	0	41.44	0	0	1.73	0
Total	54.39	55.03			Sum	2.69	209.35	3491.37	1.73	136.02	4573.29

Locations of CG/CB from origin

CGx	0.05		
CBx	0.03	BGx, cm	-0.02
CGy	3.85		
CBy	2.47	BGy, cm	-1.38
CGz	64.20		
CBz	83.10	BGz, cm	18.90

Righting moment on vehicle

BG, cm	Weight (kg)
18.90	54.38549

Roll angle	Radians	Sine	RM, kg-cm	RM, kg-m
0	0	0	0	0
15	0.26	0.26	266.07	2.66
30	0.52	0.50	514.01	5.14
45	0.79	0.71	726.93	7.27
60	1.05	0.87	890.30	8.90
75	1.31	0.97	993.00	9.93
90	1.57	1.00	1028.03	10.28

the vehicle head assembly, propulsion systems and junction box. Two primary factors dictated the configuration of the frame. The first was the overall size constraint indicated in the design requirement. The second, driven by the need for vehicle stability in water, was the desire for the vehicle's own righting moment to counteract the torque generated by the cleaning head. The vehicle components were configured such that the torque generated by the circulating brush, as it removed the marine growth from the hull appendages, could be offset by the inherent righting moment generated by the vehicle as it heeled about its centre of buoyancy (see Fig 6). The torque, generated by the viscous forces, focuses on a rotating brush of this type when used underwater, has been found to exceed 1.1 kg-m at 1000 rev/min.[4] This torque is in addition to that which is generated as the brush comes into contact with the fouling surfaces. Other techniques were considered to counteract this cleaning-generated torque, such as dual counter-rotating brushes or concentric counter-rotating brushes. However, the desire for simplicity in the design eliminated these approaches as options. A frame design was selected which maximised the separation of the centre of gravity (CG) and centre of buoyancy (CB) of the vehicle, as indicated by the line BG in Fig 6. This was accomplished by locating the lightweight components at a position on the frame as close to the top of the vehicle as possible; the dense heavy components were located at a position on the frame as close to the bottom of the vehicle as possible.

Although it is always desirable to make the entire vehicle assembly as near to neutrality buoyant as possible, or slightly positive, ie:

$$\sum \text{Vehicle subsystem weights} - \sum \text{Vehicle subsystem buoyant forces}$$

the position of subsystem components on the frame had a critically significant impact on the stability of this vehicle. This is true, since the relative positions of the CG and CB established the existence and magnitude of a righting moment inherent to the vehicle, that was to be used to counteract the torque from the cleaning head. In this way, the righting moment could be used to our advantage by making the vehicle remain in the desired orientation for cleaning.

The relative positions of the individual subsystems, along with their known weights (in air) and volume displacements, were used to locate the positions of the CG and CB relative to some arbitrary set of axes as:

$$CGx = \frac{\sum Xi \times Wi}{\sum Wi}; CGy = \frac{\sum Yi \times Wi}{\sum Wi}; CGz = \frac{\sum Zi \times Wi}{\sum Wi}$$

and

$$CBx = \frac{\sum Xi \times Bi}{\sum Bi}; CBy = \frac{\sum Yi \times Bi}{\sum Bi}; CBz = \frac{\sum Zi \times Bi}{\sum Bi}$$

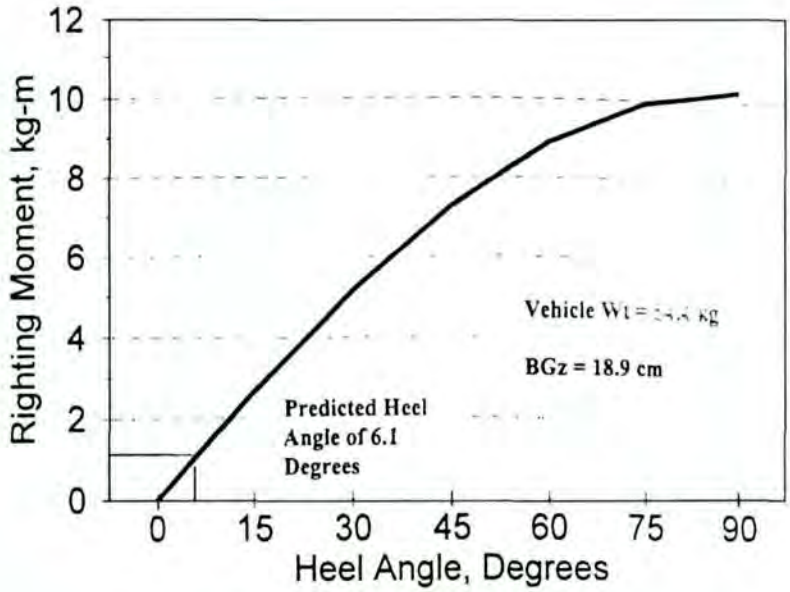

Figure 7: Characterisation of inherent righting moment.

where Wi is the weight (in air) of the ith component; Bi is the buoyant force due to the displacement of the seawater by the ith component; Xi, Yi and Zi are the positions of the centroid of the ith component from some arbitrary origin.

Table II shows the weights, displacements and resulting locations of the vehicle hydrostatic characteristics for this design. By maintaining component symmetry about the X and Y axes, where possible, the centres of buoyancy and gravity were held close to the vertical centreline of the vehicle. Following numerous trials and refinements to the vertical positions of the vehicle components to maximise manoeuvrability and counteract cleaning torque, the vehicle CGz was established at approximately 64.2 cm from the base of the vehicle and the CBz was established at approximately 83 cm from the base. The vertical separation of these two hydrostatic centres (distance BGz) of approximately 19 cm established a righting moment equal to the product of this separation distance, the sine of the angle at which the vehicle heels, and the total system weight, ie:

$$\text{Righting moment} = (\text{BGz} \sin \phi) \times \sum \text{Vehicle subsystem}$$

where ø is the angle at which the vehicle heels away from the vertical axis. The magnitude of this righting moment is shown in Fig 7. This moment will tend to counteract the torque from the cleaning head, causing the vehicle to remain in a vertical posture. It should be noted that the 1.1 kg-m of torque due to the brush rotating at 1000 rev/min underwater will be counteracted by a vehicle with only a 6 deg heel angle. This high level of vehicle stability was confirmed during operational testing described later in this article.

Vehicle propulsion

The vehicle propulsion had to satisfy two separate needs: firstly, to ensure that the rotating brush remains in firm contact with the appendage surface, while moving in a vertical and lateral pattern (similar to mowing a lawn); secondly, to propel the vehicle in this cleaning pattern. It should be noted that the major attractive force between the cleaning head and the appendage surface is maintained by the accelerated water flow generated by the rotating cleaning brush and the inward flow generated by the submersible pump, as shown in Fig 5. This increased flow velocity creates a low pressure region between the cleaning face and the appendage surface as the cleaning head is in operation.

Thruster configuration

Two 120 VDC horizontal thrusters were mounted on the vehicle frame, in close proximity to the cleaning head, to supplement the normal force holding the cleaning head in contact with the appendage surface. These thrusters can also be used by the surface pilot to propel the vehicle in open water.

Two additional thrusters were mounted in a vertran configuration, with their force vectors directed through the CG of the vehicle to provide manoeuvring capabilities. This configuration allowed up and down movement when the thrusters acted uniformly, or left to right when their thrust acted counter to each other.

Vehicle prototype testing

During June 1995, a pier-side evaluation of the HAMmer prototype vehicle was conducted at the Naval Surface Warfare Centre in Annapolis, Maryland. The simulated evaluation was conducted

on a test plate, which was a damaged section of a US Coast Guard hull that had been submerged for over a year in the brackish waters at the mouth of the Severn River near Annapolis, Maryland.

Tests were conducted to evaluate the performance of the cleaning system in the following areas:

1. position keeping when engaging underwater surface for cleaning;
2. vehicle mobility;
3. effluent capture capability;
4. cleaning effectiveness.

Position keeping

To facilitate the cleaning operation, the vehicle is required to remain securely attached to the appendage surface as the rotating brush removes the marine growth. Three different vehicle actions contribute to the attractive forces between the cleaning head and the appendage surface:

1. The accelerated water flow generated by the rotating cleaning brush creates a low pressure region between the cleaning face and the appendage surface as the cleaning is in operation.
2. The inward flow to the capture funnel, generated by the submersible pump as it pulls effluent, contributes to an increased flow velocity and thus reduced pressure between the cleaning head and the appendage surface.
3. The horizontal thrusters propel the cleaning head directly against the surface.

To quantify the effectiveness of each of these actions, the force required to pull the vehicle away from a simulated appendage surface was measured when each of the systems acted alone, and as they complimented each other. The action of the brush alone contributed a normal force approaching 18.1 kg when it was rotating at approximately 400 rev/min. This single force was found to maintain the cleaning head securely attached to the appendage surface without the need to operate the horizontal thrusters. The low pressure region established between the cleaning head and the appendage was observed to 'pull' the vehicle to make contact with the surface when the cleaning head was within approximately 15 cm of the surface. This observation (the apparent 'suction' of the cleaning head to the appendage surface) was seen to simplify the pilot's task of maintaining vehicle position against appendage surface by eliminating the need for the horizontal thrusters during in-water cleanings. When coupled with the horizontal thrusters, the cleaning head was found to exert a normal force against the appendage surface in excess of 27.2 kg.

Vehicle mobility

The surface pilot was instructed to manoeuvre the vehicle in a step pattern over the test plate to simulate the anticipated vehicle motion when cleaning an underwater surface. Up and down motions were found to be easily accomplished by the pilot, whereas side to side motions were less responsive due to the effects of the strong normal forces between the cleaning head and the appendage surface described above. It appeared that the vertran thrusters used on this prototype gave insufficient lateral thrust to overcome the strong adhesion observed between the vehicle and the surface being cleaned. During these prototype trials this problem was corrected by reducing the rotation of the cleaning brush, resulting in a reduction of the attachment force.

Effluent capture

During pier-side testing the submersible pump located on the vehicle was found to deliver approximately 57 litres per min, via a 3.8 cm diameter corrugated hose, to a clean surface outlet on the pier approximately 1.5m above the waterline. The effluent was visually discoloured during a simulated cleaning operation, indicating the effectiveness of the funnel in the cleaning head in capturing marine growth, including algae, barnacles and antifouling toxins, for delivery to a surface water treatment facility.

Cleaning effectiveness

The cleaning tool was found to remove all algae and barnacles from the irregularly contoured test plate surface in a single cleaning pass, leaving behind only a thin basal layer where the barnacles had been attached.

Vehicle performance summary

The prototype was found to be capable of removing heavy marine fouling from underwater surfaces, while capturing and delivering the cleaning effluent to a surface pier location for treatment. The vehicle was shown to be capable of being manoeuvred, by a surface pilot, over an irregularly shaped, submerged surface. Position keeping capabilities were found to be enhanced by the combined actions of the vehicle thrusters, effluent pumping, and the rotating action of the cleaning tool. Improved performance of the vehicle could be achieved by using more powerful vertran thrusters to increase the responsiveness of the vehicle's lateral motions.

Conclusions

This paper has described the content and structure of the underwater engineering curriculum at the US Naval Academy. The curriculum has evolved over a number of years, primarily due to the success of the

specialist student projects that have been undertaken. These, and other student design projects, have given the students a valuable learning experience not obtainable through traditional classroom lectures. By allowing the student to experience the joy and heartbreak of engineering design, including opportunities for making and learning from mistakes, the student gains, first hand, a greater understanding of the engineering design process. This focus on design, through special student projects, is highlighted by the successful demonstration of the prototype HAMmer vehicle. The following quotation best summarises the educational philosophy adopted at the Naval Academy:

> *'Tell me, and I will listen but soon forget. Show me, and I will remember. Allow me to do it myself, and I will* understand'.
> (Source unknown.)

ACKNOWLEDGEMENTS

The authors would like to acknowledge their students who over the past years have enthusiastically supported the many pilot schemes and courses that have gone into the creation of this very successful underwater engineering track. Also, we would like to acknowledge Dana Lynn from the Naval Surface Warfare Centre and John Kunsemiller of the Naval Civil Engineering Laboratory for their support of the Hammer project.

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Authors' Biographies

Dr J G Hawley joined the School of Mechanical Engineering at the University of Bath in October 1995 after completing 10 years as a commissioned officer in the Royal Navy. He served at the Royal Naval Engineering College (RNEC) between 1986–93 where he led and directed the College's research on advanced underwater heat engines. He was awarded his PhD from Exeter University in 1993 for work concerned with the design, construction and performance evaluation of a novel non-air-breathing diesel engine system and he was awarded the IMarE's Denny Gold Medal for a paper featuring that work. In 1993 he was appointed to the United States Naval Academy (USNA) in the Department of Naval Architecture, Ocean and Marine Engineering where he lectured on Thermodynamics, Underwater Engineering Systems and Environmental Ship Systems. Dr Hawley is currently leading the advanced automotive diesel engine emissions programme in the School of Mechanical Engineering at the University of Bath.

Dr M L Nuckols has taught ocean engineering at the US Naval Academy since 1984 and served as the Chairman of the Department of Naval Architecture, Ocean and Marine Engineering at that institution. He is presently the Chairman of the Life Support and Hyperbaric Systems Committee for the Ocean Engineering Division of the American Society of Mechanical Engineers, and is a member of the ROV Committee of the Marine Technology Society. Professor Nuckols won the MTS '1992 Academic Excellence Award' for his involvement with Naval Academy students in ROV design. He earned his doctorate at Duke University in 1981 and is a Registered Professional Engineer.

Book Review

The Bond Store Tales

Ross Gibson; Historic Houses Trust of NSW
Price $19.95
Reviewed by John Connor

The Bond Store Tales is a book based on the Museum of Sydney's Bond Store Gallery, an exhibition which tells the story of Sydney's first fifty years as a port through a series of video-taped dialogues in which actors play the parts of people from Sydney's maritime and mercantile past. The Museum of Sydney, built on the site of Governor Phillip's original Government House, is a new and innovative museum run by the Historic Houses Trust of NSW (which also manages historic buildings such as Vaucluse House) in central Sydney.

The book reminds us that early Sydney was not an isolated enclave clinging to the edge of a continent, but a maritime hub linked by the highways of the sea to the surprisingly developed international trading system of the late eighteenth and early nineteenth centuries. Items that passed through Sydney in the first fifty years of the colony ranged from Cheddar cheese, Irish pork lard and Scottish oatmeal, to Chinese tea, Mauritius sugar, and Jamaican rum.

A bond store, the book explains, is a warehouse where goods are stored by customs officials awaiting the payment of duty, and in early Sydney, two warehouses in the Rocks acted as bond stores. The name is an apt title for the book, for it is filled with an array of stories in the way the original bond stores were filled with goods of every kind from every part of the world.

The Bond Store Tales consists of stories told by characters using objects traded through early Sydney as their starting points. Among the characters we meet are a bar maid with a barrel of rum; A French woman who tells of playing chess with sandalwood chess pieces with an imprisoned Matthew Flinders on Mauritius; an Aboriginal sailor who worked on a whaling ship (as several did); and a Marine lieutenant (also based on a real incident) who accuses a fellow officer of stealing a newly-arrived bolt of red cloth by claiming it with a receipt forged for him by a convict. I recognised Noah Taylor among the actors portraying the characters, and I am sure if I watched more Australian soap operas I would have recognised more faces and names. Each of the stories is followed by some notes which give a historical background to the story.

There are two things about The Bond Store Tales which make it different from the average history book: the first is the innovative way special types of paper have been used in the book design, the second is the post-modernist philosophy with which the book has been written.

My wife, who is a graphic designer, was so impressed by the book's striking appearance that she took it to her work and passed it around the studio, and I did not see it for a week. The dust cover, which shows an oil painting of a shipwreck, was printed on a special translucent glossy paper to help reproduce the qualities of an oil painting. The first two pages, showing storm clouds and a sea bird, were also printed on translucent paper, so that when they are laid on top of each other, they form a complete picture. The storm theme is continued by the inside photographs and illustrations, which are all coloured a blue-green reminiscent of stormy seas. This innovative presentation was made possible by sponsorship from Heidelberg, a major printing company.

The Bond Store Tales is a product of the post-modernist theories currently in vogue with some historians. Post-modernism argues that everything is relative, and that there is no difference in historical writing between fact and opinion. As the introduction states, 'this book does not present a conventional history, it does not set out to prove anything once and for all. It cannot establish any truths that put an end to argument'. The reader is 'invited to flick through it [the book] back and forth, to draft together your own interrelations of characters and narratives[,]... to generate theories and meaning out of the contentions and combinations' and 'to generate ways to chart the truths of daily life looming out of the fictions of possible interpretation'.

This reviewer would argue that any historian who believes that they are no closer to the truth after they have completed their research than they were before they started should find themselves a more productive career. In the reviewer's opinion, post-modernist history excludes the general reader by using jargon words and by not using a chronological or thematic framework to assist understanding.

The Bond Store Tales offers the reader no understanding of the changes that took place between 1788 and 1840 in the port of Sydney, in the objects being traded, or in the type of people involved in the trade. The author, Ross Gibson, has not understood the difference between a museum exhibition and a book. A museum exhibition, like the Bond Store Gallery at the Museum of Sydney, should aim to give no more than a simple understanding to the visitor. The aim of the Bond Store Gallery is to have the visitor understand that Sydney was a colourful port involving goods and people from all over the world, and the Gallery does this effectively. However, a book based on a exhibition has the ability to give the reader more information, and the The Bond Store Tales should have taken the vague understanding formed from visiting the exhibition and given it more detail, so that the reader would gain a deeper understanding of Sydney as a port.

The Museum of Sydney is a fascinating museum, and the Bond Store Gallery should be visited by anyone who has an interest in Sydney's maritime history, but it is hard to recommend the book to anyone but the disciples of post-modernist history.

HMAS **JERVIS BAY** *exercising with HMAS* **GLADSTON** *off Cairns (LCDR P. White).*

Proposed Changes to the Constitution – to be discussed at the Annual General Meeting

9.(4)

Current:

Except with the authority of the Council no payment of a sum exceeding fifteen dollars shall be made from the funds of the Institute otherwise than by cheque drawn on the Institute's bank account, but the Council may provide the Treasurer with a sum to meet urgent expenditure, subject to the observance of such conditions in relation to the use and expenditure thereof as the Council may impose.

Proposed:

Except with the authority of the Council no payment of a sum shall be made from the funds of the Institute otherwise than by cheque drawn on the Institute's bank account.

23.(1)

Current:

The Officers of the Institute shall be –

(a) A President;

(b) Two Vice-Presidents;

(c) A Treasurer

(d) A Secretary; and

(e) A Journal Editor

Proposed:

The Officers of the Institute shall be –

(a) A President;

(b) A Vice-President;

(c) A Treasurer;

(d) A Secretary; and

(e) A Journal Editor

23.(3)

Current:

One of the Vice-Presidents shall be known as the Senior Vice-President.

Proposed:

Deleted.

24.(1)

Current:

The Council shall consist of –

(a) The officers of the Institute; and

(b) Ten other regular members, known as ordinary Councillors, all of whom shall be elected at the annual general meeting of the Institute in each year.

Proposed:

The Council shall consist of –

(a) The officers of the Institute; and

(b) Five other regular members, known as ordinary Councillors, all of whom shall be elected at the annual general meeting of the Institute in each year.

27.(4)

Current:

Any six members of the Council constitute a quorum for the transaction of the business of a meeting of the Council.

Proposed:

Any four members of the Council, at least two of whom must be Officers of the Institute, constitute a quorum for the transaction of the business of a meeting of the Council.

30.(3)

Current:

The annual subscription of a member is due and payable on or before the first day of January in each year and ending on the thirty first day of December next following.

Proposed:

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