Achieving our strategic sting:

Bringing on the next-generation submarines

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My previous article, *Australia's strategic sting: Maximising our future underwater warfare capability (Defender*, Spring 2007), argued for Australia retaining a strategic capability edge by replacing our Collins class submarines with a next-generation future underwater warfare capability. In summary, the article came to the following conclusions:

- a compelling case exists for the acquisition of a new and expanded undersea warfare capability centred on a long-range, sophisticated submarine;
- the ability of the Collins class boats to deliver the required capability in the transition period needs critical examination;
- future submarines will be required to operate in a more demanding environment, at greater range and to achieve an expanded number of strategic effects; and
- such a capability will be a critical and unique asset in Australia's defence, not least because it will provide the *strategic sting* needed to deter and perhaps punish potential aggressors.

This article follows on from these conclusions and addresses the principal design, industry and personnel issues arising from them.

Key design issues

Given the importance of a submarine capability as a core defence requirement for Australia beyond 2020, Australia's regional pre-eminence as a designer, builder and operator of submarines is a comparative regional advantage that should not be lost. Japan and China are the only other regional countries with the capability to design and build submarines. Australia's submarine design authority vested in ASC should be maintained as a matter of national strategic priority.

Because of Australia's continental and regional geography, and extensive maritime and other strategic interests, the design and operational characteristics of our submarine capability represents a unique combination of factors:

- Long transits from home bases in Australia to a distant patrol area, combined with the likelihood of short-notice contingencies, will demand high levels of mobility and long endurance.
- The nature of the littoral operating areas, stretching from the Arabian Gulf to the North Pacific demands both high agility and prolonged covert operations in such areas.
- Australia's submarine force will require a very low signature in all spectrums, and at high speed, thereby imposing new demands on a conventionally-powered submarine design.

The option of nuclear propulsion therefore needs to be sorted out up front.

The requirements for long transits and covert operations, and the potential for adversarial submarines to be nuclear-powered, could justify the introduction of nuclear-powered submarines into the ADF order-of-battle. However, this is not a practical proposition, particularly with regard to the timescales envisaged for the future submarine project. Furthermore even discounting the time problem, or the significant political and public concerns that would need to be overcome before implementing such a project, Australia lacks the critical regulatory regimes, industry capability, nuclear-technology infrastructure and educational institutions to prepare and sustain appropriately qualified personnel. Unless and until Australia adopts nuclear power for electricity generation, these essential criteria are unlikely to be economically or professionally achievable.

Development of this option would therefore be a distracting and time consuming debate and misuse of our very limited resources to manage the next-generation submarine project. Lingering to indulge in such a debate has the potential to derail the timely acquisition of a future submarine capability, leading to a significant capability gap.

If we accept that purchasing or developing a nuclear-powered submarine is not feasible, the range of realistic options available becomes clearer. If we also accept that no Western country now builds the long-range conventionally-powered submarines we need, the options available become even clearer. Based on these common-sense and well-accepted assumptions, a submarine developed in Australia from the Collins experience and pedigree surely provides the lowest risk path – the nearest to an off-the-shelf solution.

Such a development path will, however, still entail substantial changes with the most visible being the external hull shape. In a (publicly available) 2006 DSTO paper, *Some Aspects of Submarine Design Part 2: Shape of a Submarine 2026*, the fluid mechanics and engineering expert Professor Peter Joubert discussed the factors and trends involved at some length. These include his belief that a new hull shape is required to:

- move as silently as possible with the lowest practical resistance, thus enabling a greater top speed and lower fuel consumption at transit speeds;
- give the best possible flow over the forward passive sonar; and
- provide more flexible interior volume with more deck space.

Externally, he suggests this will lead to an increase in the hull's diameter but a shorter length. It also involves major reshaping of the bow and, among other things, moving the forward torpedo tubes elsewhere.

Internally, new technologies will also be critical to achieving a capability edge; perhaps the most challenging areas are associated with acquiring, storing and using energy for two different circumstances; transit to a patrol area and covert patrol when on station.

Overall, there will be a number of new issues for the designers and operators to weigh up and consider in the trade-off process. Some examples include:

- reconfigurability – the flexibility to adapt for the role of the day;
- carrying capacity – the ability to accommodate and sustain the additional personnel and equipments associated with particular missions;
- the employment of unmanned underwater and aerial vehicles; and
- achieving sufficient design margins, especially regarding space and stability, to allow for future growth.

In regard to managing the design, this will necessarily be a developmental project and should be appropriately managed and resourced. Key lessons from the development of the Collins boats include the need to:

- recognise and accept the developmental nature of the project, especially in allowing an appropriate contingency in time, funding and scientific support to cope with the unknowns that are bound to arise;
- assign the risks so that they can be actively managed by those best able to do so – probably using a relationship-style of contract, not a 'black letter law' performance specification contract; and
- minimise the high-risk software-based systems by adopting the low-risk path of evolving them from current weapons, combat, C3I and ship control systems.

Air independence

Given the threat environment arising from the overall strategic setting, it will be critical that the future submarine is able to operate completely covertly whilst in a patrol area without the need for snorting to recharge batteries or refresh its internal atmosphere.

We should be looking to second-generation air-independent propulsion (AIP) technologies and alternatives such as the nuclear batteries now under development in the laboratory. There is a major developmental project entailed in achieving an operational capability – and this is an early candidate for DSTO and industry-partnered research and development. The problem appears to be surmountable if reports of Russian developments are correct.

ASC's design capacity

ASC is the design authority for the Collins class. Provided its ownership is appropriate, it is uniquely placed to be able to access the critical, sensitive technology from both US and European suppliers and combine this with its real-world experience with the Collins class. No other potential designer offers this opportunity.

The capacity of ASC to act as the design authority for a new submarine will depend on continuing efforts to build its internal capacity. This involves judicious hiring of experienced personnel, suitable design development tasks for the through-life development of the Collins boats, a continuing relationship with Electric Boat (as the major US submarine builder and design authority) and support of a European design house to provide the technology unique to a conventional submarine.

Capability prototyping in Collins

Collins class technology refresh/spiral development programs could serve to reduce the risk of design development work and prototype testing associated with the future submarine capability. To be effective, this program must not only maintain the capability of the Collins class, but also provide a test bed to push technology boundaries where appropriate, for example, with emerging battery technologies, second-generation AIP systems and propulsion motor technology.

Research and development

We should be seeking a technology 'leap' to counter the regional growth in maritime technologies. By the time for first-pass approval for the project in 2011, we must have identified those technologies that offer this potential. These must then be developed to enable a contract to be placed in 2016 that can incorporate such 'leap' technologies into the future underwater warfare capability.

A through-life R&D program involving DSTO, ASC, industry and technology partners will be essential to sustain the capability edge and is part of the parent navy obligation. The program should deliberately foster and support small to medium enterprise companies in Australia, as these companies have been the source of much of the leading-edge innovation available in the Oberon and Collins programs.

Establishing the teams and relationships will take time. This work will provide a key input into the design trade-offs to be considered in finalising the specifications and letting the contract in 2016. These programs also provide the essential entrée to our selected partners' R&D in these sensitive areas – part of the essential currency for a joint R&D project.

Key design drivers

In priority order, the key design drivers for a future submarine capability are:

- stealth;
- mobility;
- range and endurance;
- payload including weapons, countermeasures and unmanned vehicles;
- sensors and connectivity;
- manning;
- handling characteristics; and
- through-life supportability and growth potential.

Timescales

By 2025 HMAS Collins will be 30 years old and obsolete. The other boats will be only years not half-decades each behind. If we are to avoid a critical capability gap, the future underwater warfare capability must be operational no later than 2025. There may be a good argument for advancing this time scale to avoid a capability gap due to Collins shortfalls. It may also need to be advanced so we do not repeat long periods with major capability deficiencies, such as the decade-plus gap between the retirement of the last of the Charles F. Adams class DDGs in 2001, and the introduction into operational service of the first of the new Hobart class Air Warfare Destroyers in 2013.

Similar to the Oberon experience at this time of life, it will not be cost-effective to sustain or replace ageing systems, nor is it an option to extend the life of type of the Collins boats. The class simply lacks the design margins (space, ship stability, power, cooling, etc) to sustain significant capability enhancements that would meet the increasingly demanding environment and new requirements. A life-extension program is therefore likely to be a poor return on investment. Australia must therefore field a new underwater warfare capability no later than 2025. Assuming our recommendations on the acquisition strategy are followed, the timescale (counting back) could be:

- ***2022–2024: What have we got?*** Three years of pre-acceptance trials should be the minimum. This is a critical part of the risk mitigation strategy and must not be regarded as a 'just in case buffer' or project float. During this period the submarine and its systems, such as unmanned underwater vehicles, will undergo extensive trials to identify the inevitable, unexpected problems, resolve them, and provide a submarine ready to commission and commence operational work-up.
- ***2016–2021: Build it.*** Five years to finalise the design and construct the first submarine. The contract must be let in 2016 meaning second-pass approval no later than that year.
- ***2011–2015: Resolve design, technology and acquisition issues.*** Four years to complete the design studies/trade-offs, develop the technologies to the point that they can safely be incorporated into the design and prepare the contract documentation for the design and build, and supplier, contracts.
- **2011:** ***First pass*****.** Initiate funded R&D, and development of a number of selected technologies by ASC, DSTO and selected industry partners, to enable a final selection to be made at Second Pass. This activity reflects the unique technology research requirement of a development project.
- ***2008–2010: Determining capability.*** Two years to establish the project teams, finalise the requirements and acquisition strategy, initiate the R&D teams, design teams, industry partnerships and Government-to-Government relationships, whilst completing the initial studies to inform the design and trade off processes. By 2011 we must have identified those technologies likely to lead to the capability edge we seek.

The above timescale and process assumes, of course, an acquisition strategy based on developing the future submarine from the Collins class, using ASC as the design authority and builder, and having the support of US and European designers and equipment suppliers. There are other models but none that can achieve the end point with a lower risk profile in the timescale needed.

Accessing intellectual property

Access to and control over intellectual property (IP) is a key determinant of shipbuilding and repair capacity, particularly in relation to vessel design and combat systems, and their ongoing development and upgrades. Australia needs to be able to access the 'best of breed' in submarine systems and design to achieve the capability we require. These will be drawn from Western European designers and our current submarine capability partner, the US Navy. All parties involved are particularly sensitive and wish to protect their IP regarding submarines. Governments who fund much of the R&D are very sensitive to exposing their leading-edge submarine technology to third parties. Australia must be able to demonstrate that it is able to protect this information from other third parties. This has significant implications for the future ownership of ASC.

Selecting the right partners is therefore important; a critical test in this selection process is the depth and capability of their ongoing submarine R&D programs. This capability for original work is important in optimising the design, maintaining the leading technology edge in through-life capability development, and solving the inevitable 'unexpected' in-service problems that are the lot of a parent navy. This 'team' capacity will also be a major factor in identifying valid design options for our future underwater warfare capability.

However, noting the unique features of Australia's requirements and difficulty of accessing submarine IP, there are a number of areas where Australia will have to develop its own solutions.

The Defence Science and Technology Organisation working in conjunction with the US Navy and industry have already demonstrated this capability in resolving many of the issues associated with the Collins program. But much of this Australian capability has now dissipated. It will require time and incentives to re-establish an indigenous R&D capability in a number of key submarine technologies. Given the lead times for such activities, this is now an urgent requirement.

Lessons from Collins

The principal aim of the Collins program was to acquire a new class of submarines suitable for operations in the mid-1990s and beyond. Compared to a 'build-to-print' program (such as construction of Upholder class submarines based on 1970s technology), the Collins program involved a number of innovations and acceptance of risk to ensure the capability sought was appropriate to the future strategic environment. It is now clear that, despite its complexity and controversy, the aim was achieved and Australia acquired a world-class conventional submarine capability augmented by a strong industrial support base. In so doing, the foundation necessary for the future submarine capability program has also been established.

The Collins program demonstrated that Australia has the capacity to manage a complex submarine construction program as well or better than a European or US supplier. Deficiencies in the build phase related more to design and contractual problems, including with overseas suppliers, than

to shortcomings on the part of Australian industry. While a future program will also involve a number of innovations and acceptance of risk, there will also be initiatives based on experience with the Collins project that will mitigate risk.

Conclusions on design issues

- Australia should build on the capacity established by the Collins project to design and build the future submarine.
- The Collins class boats can be used as a trials platform to reduce the risk of introducing new technologies for the future submarine.
- Time is tight, early agreement on the acquisition strategy and initiation of studies and R&D is now critical.
- Initiation of long-lead activities cannot await the conclusion of the Defence White Paper process, should this be delayed beyond 2008.
- The Collins project, despite its complexity and initial controversy, delivered an excellent strategic capability for Australia in the end. A future submarine project will have a much stronger starting point as a result. The Government and Department of Defence should have strong confidence in Australia's capacity to manage and deliver the future submarine capability.

Key industry issues

The global marketplace for submarine construction has undergone considerable consolidation in recent years particularly in the UK, Germany and USA. While a number of countries construct submarines under licence, only Germany, Russia, France and Spain are active in the export market. As noted previously, none of the Western suppliers are building a submarine that meets the capability required for the conventionally-powered, long-range, high-technology, next-generation submarine Australia needs

Commonwealth investment in the Collins class has greatly boosted the skills base of naval shipbuilding in Australia. The base was further enhanced by the selection of ASC to construct our new Air Warfare Destroyers. Recognition and commitment by government of the strategic importance of the naval shipbuilding industry, and relevant industry at large, has given the industry greater confidence in its future and should encourage investment in its workforce, facilities and innovation.

In addition to the design support provided by the US and European designers, competitive teaming through commercial alliances between overseas suppliers and local industry for the supply of systems and components offers the best prospect of ensuring efficient Australian construction. Early selection of industry partners may be required where substantial development of the system is required in order to meet the requirement, and to encourage mutual investment and sharing of risks.

The future ownership of ASC must facilitate access to submarine IP in the complex and sensitive scenario outlined above. This is essential to maintain the new design through its life, including the need for future modifications. To avoid future conflicts of interest and to demonstrate that Australia is able to protect sensitive third-party technologies,

it is essential that ASC be fully owned and controlled by Australians.

We should not rush the ASC sale process as it is important to get it right. The ground rules for accessing the critical IP should be fully understood and compliance with them needs to be a pre-condition of the sale. We would also get full value for ASC if it were sold with the future submarine project on the books.

Conclusions on industry issues

- The global market for conventional submarine design and construction has shrunk considerably since the Collins class was designed.
- Australia's industry base has grown significantly during the same period.
- ASC is the clear choice to design and build our future submarine but it will require support from the USA and leading European designers.
- The pre-conditions involved with ASC's access to these technology sources should be understood and compliance with them should be mandatory in the sale of ASC.

Personnel issues

The lack of submarine personnel with the skills and abilities to manage and support the ADF as an *informed buyer* of the future underwater warfare capability program will be a significant issue. Currently, the RAN has a severe shortage of submarine crews and senior submarine-qualified engineers and operators. Very few of those in the Service have the experience, networks and understanding to guide a complex project through the labyrinthine processes of the Canberra bureaucracy.

The transition from the Collins class to a future submarine capability will also pose significant personnel challenges for the operational submarine force. Manning the operational submarines and generating the surplus crews to transition to the new capability will be a demanding challenge. And this will have to be achieved against the backdrop of prolonged shortages where insufficient crews to man the operational submarines has in turn resulted in fewer training days at sea. Overcoming these entrenched problems will therefore mean a priority allocation of scarce RAN manpower resources to the overall submarine capability and to keeping those involved challenged and satisfied.

It is probable that this can only be sustained by the establishment of generous conditions of service to attract and retain submarine personnel. In the greater scheme of things the numbers of personnel required is not large; less than 500 for the entire Collins force. In this regard the Navy could learn much from the offshore energy and other industries operating in remote and difficult conditions. The current navy paradigm of 'all of one company' is not delivering the numbers of personnel needed and may never do so again. We need to accept that submarine service is very different – and the analogy with Special Forces service is compelling. Service in submarines needs to attract a priority in resource allocation commensurate with the strategic weight and objectives required of the submarine force by Government.

Similarly, the civilian submarine technical capability in Canberra has also been substantially reduced from that previously available to mount and conduct the Collins project. Filling these gaps in a timely fashion will require lateral solutions to make use of the skills available from industry and within the Department of Defence.

Conclusions on personnel issues

- The shortages of skilled personnel in the Department of Defence and the Navy to operate submarines, and oversee the next-generation submarine project, are a significant limitation and must be factored into the acquisition strategy.
- A sustained, priority allocation of the RAN's scarce manpower, and targeted and enhanced conditions of service, will be required to recover from the current personnel shortfall, sustain the new project and transition all involved into the future submarine.

Achieving a strategic sting

No serious strategic commentator in Australia is really arguing against the development of a future underwater warfare capability centred on next-generation submarines. The notion of foregoing our existing capability edge in underwater warfare by not replacing it is not seriously entertained by anyone. Few doubt that retaining and improving our underwater warfare capability would provide Australia with a continuing capability edge in this regard and serious strategic sting more broadly.

Where there is debate it largely revolves around cost, method and, to a lesser extent, theoretical rather than practical alternatives to the strategic reach, weight and covert ability achieved by submarines.

To avoid a capability gap and retain an effective undersea warfare capability the future submarine must commence sea trials no later than 2022 and possibly sooner. Planning and initiation of long-lead activities, such as R&D, are now on the critical path to inform decisions that need to be taken in 2011 on technologies likely to be available for a contract that needs to be let in 2016.

The design, development and construction of the future underwater warfare capability will be a uniquely Australian enterprise. It will also be a developmental project based on the Collins class pedigree, with strong support from US and Western European submarine designers.

The shortage of experienced submarine personnel to crew the operational force and staff the future-submarine project is a major limitation. This situation requires urgent and sustained attention, and priority, in order to rebuild the force and expand it so it can introduce and transition to the future submarine force.

The time and effort needed to achieve this capability should not be underestimated. Time is short if the Australian Government of 2030 is to have a strategic sting able to monitor, deter and if need be severely punish a potential aggressor. ◆

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