

Why Australia should build its own submarines

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The case for building the next generation of RAN submarines in Australia begins with the stand-out attributes that make submarines so important for Australia: they must be able to operate in areas without air or sea control to watch, listen, evaluate and act when necessary. Australia's future submarine will be a unique intelligence, surveillance and reconnaissance platform, giving early warning of an adversary's intentions and providing an excellent antisubmarine and anti-surface ship capability.

These capabilities are based on the submarine's key attribute—*stealth*—which enables access to sensitive or critical areas denied to other vehicles and surveillance systems.

The high pay-off areas for submarines are close to an opponent's operating bases and associated training areas. A long-range submarine is therefore required because of our geography, and a long-range submarine means a large submarine.



Collins production line with at least two submarines in various states of completion. Image courtesy of ASC Pty Ltd.

In simple terms, a submarine has to have sufficient buoyancy or volume to support its payload when it's underwater (that is, to be neutrally buoyant). If you add more fuel (or any other payload), you have to either take out an equivalent weight or increase the vessel's volume. Simply lengthening an existing design by adding hull sections to increase volume only works so far. As the ratio of the vessel's length to its diameter grows, it becomes noisier, less agile and less efficient, meaning that it requires more energy to move through the water.

At some point, increasing the volume of a submarine design requires an increased hull diameter. But once that threshold is crossed, you're no longer dealing with the same design. For this reason, it's doubtful that Australia's submarine capability requirements can be met by simply 'adapting' an existing in-service submarine design.

Moreover, my experience tells me that it's safer to put all the parameters on the table and design a submarine with the volume to carry the payloads required for the desired capability. Trying to stretch or otherwise adapt an existing submarine design—with the restrictions this places on the designer—is more difficult and a higher risk.

What about option J?

The recent discussion in the press on the possible acquisition of Japanese submarines by Australia to replace the Collins class raises a number of issues.

First and foremost, does Japan's Soryu class offer an off-the-shelf option to meet Australia's requirements? Despite what's been surmised based on the relatively large submerged displacement of the Soryu class, the current Japanese submarine appears to have less payload, endurance and mobility than the Collins. This isn't surprising, as Japan's requirements are different from Australia's.

So unless Japan changes its requirements to match Australia's—unlikely, given the increased costs to them—any Japanese boat is still likely to require modification to meet Australia's requirements, particularly for long ocean transits and patrols. Australia is also certain to want to install a US combat system, communications fit-out and weapons suite. Those changes will all carry cost, performance and schedule risks that are best handled as a developmental project rather than as an off-the-shelf acquisition.

Quite apart from the suitability of the design, a Japanese purchase would entail particular risks. We know that cultural differences between the Spanish ship designer-builder and Australian shipyards caused significant problems for the air warfare destroyer project. The prospects for difficulties arising from cultural differences with Japan are even greater. In Japan's case, accessing all the relevant technologies during the course of an overseas build of a complex vessel and understanding the design intent (critical to supporting the submarine) would be extraordinarily ambitious and inherently risky. A critical point to keep in mind is that Japan has no experience with foreign customers for military exports.

Taking a whole-of-life perspective

The lure of having submarines built overseas rests upon the assumption that it would be more expensive to build them in Australia. Setting that assumption aside (without testing its validity), it's important to remember that design and construction are only one-third of the cost of ownership. The balance arises when the boat is in service.

It's worth looking at how other countries approach the problem of maintaining a cost-effective submarine force. Germany, France, Japan, Sweden, the UK and the US all have national designers and builders for their submarine programs. Common characteristics of their approaches include the following:

- New designs are undertaken as developmental projects in a seamless process, avoiding traditional step-by-step design, which can lead to delays, design changes and cost escalation.
- The cost of ownership is considered front and centre at the design and construction phases so that it can be minimised.

- The builder and in-service support industries inject their knowledge into the design, thereby minimising the requirement for costly re-work or extra maintenance.

To fully optimise a submarine design from a whole-of-life perspective requires the designers, builders and maintainers to work closely together during the design and build phases. This is best achieved if they are co-located, as they tend to be in the countries mentioned.

There's an important lesson here for Australia's future submarine program. Coordination will be much easier if the build occurs in Australia, where the design will be supported throughout its life, rather than at an overseas shipyard with different standards and practices and a language barrier.

Whatever the design source, European or Japanese, Australia's future submarine will have substantial differences from the overseas navy's design. As it was for Collins, Australia will be the parent navy for the future submarine. The Coles review highlighted the vital importance of establishing through-life logistic support arrangements in Australia during the submarine construction phase. It is critical that Australia has full and unhindered access to the technologies and intellectual property underpinning the future submarine; otherwise, the effectiveness of the new boat will rely on the relationship with the overseas parent navy and its industry base.

The future submarine will provide our strategic deterrence for perhaps the next 50 or more years. Do we want a foreign government in control of the design and construction of such a critical national capability?

Experience with the Collins class demonstrated that the required transfer of technology can best be achieved through the construction of the submarines in Australian shipyards and that the associated risks can be managed successfully.



This photo shows the production of 'cans' (individual elements of pressure hull, lying on their side in right background) being assembled into a pressure hull section with 3 'cans'. Image courtesy of ASC Pty Ltd.

In addition to the challenge of establishing cost-effective through-life-support, building Australia's future submarines offshore would entail a number of additional costs:

- Transferring Australian engineers, construction personnel, submarine crews and their families to stand by for two to four year periods in an overseas shipyard across the 28 or so years needed to build 12 submarines would be neither cheap nor practical.
- The land-based test sites and maritime test ranges used to reduce risks during construction and for acceptance testing are also required in-service, which imposes additional costs for using overseas facilities in addition to building our own facilities.

Australia's use of US-sourced weapons and combat systems also poses sensitive problems for acceptance testing on a foreign test range.

Let's do it right!

Using the Collins program as an indicator, we have time to do it properly. The Collins contract was signed in 1987 and the first submarine was delivered in 1996. While there were issues to resolve, that was a nine-year design and build program for the first of class from a greenfield site. Today, we're in a much better position with submarine engineering and shipyard facilities than we were in 1987.

The complexity and critical national importance of the submarine capability demands dedicated, specialised management. I recommend the establishment of a Submarine Construction Authority, with appropriate industry and Defence expertise and authoritative leadership. Such an approach could build on the experience and lessons of Collins, avoid the mistakes of the air warfare destroyer alliance structure and repeat the success of the Anzac frigate and Huon minehunter projects.

An Australian design environment would aim to achieve and sustain ownership of the design for future development. That would not mean that we would design the vessel. Rather, we would select a submarine designer to do so while we develop Australian expertise and specialist manpower in parallel. The goal would be to transfer the skills and intellectual property needed to perform the in-service design authority role.

Advantages of an Australian design environment include:

- optimal access to both US and European technology
- the opportunity to minimise the total cost of ownership, including through cost-capability trade-offs and caps
- the strong demonstration of long-term investment in Australian engineering and shipbuilding skills
- the availability of the extensive computer-aided design systems developed during the build for in-service support and platform evolution
- maximum opportunities for Australian R&D and industry involvement
- best use of our limited resources to manage a developmental project.

What can we learn from the Collins project?

The Collins program has been much maligned in the media, but an objective look at the program provides both valuable lessons and encouragement that the future submarine can be successfully built in Australia:

- The Collins project was completed with an average schedule delay of about 26 months and within 3–4% of the original contract price, after allowing for inflation.
- If all the extra expenditure on improvements is included, the project came within roughly 22% of the original budget.

- The project's aim to expend at least 70% of funds spent on the platform in Australia was comfortably exceeded.
- Today, over 90% by value of in-service work is Australian.
- Construction standards, demonstrated by weld rejection rates and hull circularity, were excellent, exceeding international norms.
- Most of the detailed design work for Collins was done in Adelaide by a team of around 40 Australian and 20 Swedish designers as part of an overall design team of about 300. The designer, Kockums, oversaw this process.
- The submarine builder, ASC Pty Ltd, subsequently took over the role of in-service designer and now makes critical engineering decisions and determinations for Collins support.
- The industry spin-offs from the Collins construction program were significant and widespread.

Of course, there were a significant number of design and system defects requiring rectification in the newly built submarines. This work was done successfully by ASC, supported by the Defence Science and Technology Organisation, the US Navy and industry.

The submarine availability problems that have caused such poor ongoing public perception of the Collins arose from failures in in-service support arrangements rather than problems with the design and build. Moreover, the final report of the Coles review found a major improvement in Collins availability as a consequence of its recommendations being implemented.

I argue that, viewed against other contemporary submarine programs, the Collins project was better than average—that is, the reality is far better than the public perception. Australia now has 20 years of experience operating and supporting submarines in our unique environment to feed into the future submarine design process.

What about a hybrid approach?

It has been suggested in the Japanese media that we should take a 'hybrid' approach, constructing the hull modules for the future submarine in Japan and assembling them in Australia. But doing so would entail all the complications of an overseas build discussed above, while precluding the optimal use of modern modular assembly, in which all major systems are installed and set to work on their shock- and noise-absorbing deck sections before those sections are slid into the open hull section, like oven trays. A hybrid construction approach would also complicate accountability for any problems injected into the build and deny Australian shipyards in Victoria and New South Wales the platform and module construction work that they performed so well for Collins.

Moreover, we have an example of why an overseas build of modules is not a good idea: our experience with the bow and escape sections of the first Collins, which were built in Sweden. Both had a large number of weld defects, which took months of additional work in Australia and over \$20 million to rectify. The key point is this: it's very difficult to ensure that work done at remote locations is up to the exacting specifications needed. It would be a false economy to scrimp on overseeing quality: a hybrid build would be likely to increase, rather than reduce, cost and risk.

The case for building in Australia

There would be substantial benefits from building the next generation of RAN submarines in Australia. Indeed, local construction is especially beneficial for submarines compared with surface ships, given the submarine's unique design and strategic importance. The benefits would include the following:

- The project would be under the full operational, legal and security control of the Australian Government. This would enable the establishment of a dedicated Submarine Construction Authority with authority and control over all aspects of the project.

- The critical security arrangements needed to preserve Australian control over the sensitive technologies that provide the critical stealth edge in the region could be managed much more comprehensively, thereby protecting Australian and third-party technologies.
- It would be no more expensive. None of the prospective foreign suppliers is a cheap shipbuilder. In fact, it may be cheaper if the economic spin-offs from spending the funds in Australia are taken into account.
- Building in Australia would support broader investment in shipbuilding that could be repaid many times over across a continuous-build program. In this regard, the strategic argument for 12 submarines is in harmony with the industrial efficiency of a continuous build.
- Based on historical performance, the quality of construction is likely to be better and, in any case, would be under Australian control. We would not be at the mercy of decisions made in a foreign shipyard.
- An Australian build would transfer design, construction and commissioning knowledge and technology to Australia—all vital steps to establish the engineering and technical knowledge to support the through-life evolution of what will be a uniquely Australian design.
- If the project is appropriately structured, all the design and build records will be Australian owned.
- The design function could become a national capability, offering the benefits of an Australian design environment cited above.
- We would avoid paying another country to recruit and train additional workers and invest in construction facilities—all of which will be required in Australia for in-service support.

Conclusion

Submarines are a critical strategic capability for the uncertain times ahead.

Australia's requirements and geography demand at least 12 large submarines. Trying to stretch an existing design is a high-risk proposal with limited capability to grow to meet future changes. An integrated design process based on a designer experienced in producing designs for foreign customers, working with the Australian builders and the 'in service' industries, is the low-risk path. To be absolutely clear: the current focus on a Japanese-built solution is misdirected and a distraction.

Selecting the most appropriate design partner is the next key step. This should be done using a competitive process. Prospective designers should be asked to provide costed, fixed-price bids for the design and construction of the submarines in Australia in time to replace the Collins.

Two European designers have made unsolicited offers to build twelve ~4,000 tonne submarines in Australia for a predicted sail-away cost of \$20–24 billion. This translates to expenditure of around \$1 billion per year for the duration of the construction program. Japanese media have reported an offer of a similar price for 10 submarines built in Japan. While these figures are reassuring compared with the \$36–40 billion price tag regularly quoted in the Australian media, the only price that matters is the one offered in a fully developed and agreed tender. The path to this is via a competitive tendering process, keeping at least two designers in the race until the final lap.

I believe that the benefits of local construction are substantial. Building in Australia will be cheaper overall, provide better control of the project, guarantee quality, and achieve improved stealth from sensitive Australian and third-party research and development. Just as importantly, an Australian build program would develop Australia's in-service and design support, encourage hi-tech Australian industry and boost employment by creating high-quality jobs.

Time is now short. The Australian Government must act to set out the process, put it in place and drive it forward. The importance of the program warrants bipartisan political and private sector support.

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