Research Brief

RAND NATIONAL SECURITY RESEARCH DIVISION

# Australia's Domestic Submarine Design Capabilities

## Options for the Future Submarine

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**Abstract**

**Australia will need a domestic workforce of roughly 1,000 skilled draftsmen and engineers in industry and Government to create and oversee the design of a new, conventionally powered submarine for the Royal Australian Navy. Such a workforce does not exist in Australia today, but one could be cultivated over the next 15 to 20 years under the right circumstances. By collaborating with foreign design partners rather than relying exclusively on a domestic design workforce, Australia could shorten the duration and lessen the costs of designing a new submarine.**

In the mid-2020s, the Royal Australian Navy (RAN) will retire the HMAS *Collins*, the oldest of Australia's *Collins*-class submarines, when it reaches the end of its 30-year service life. Over the course of the following decade, the other five submarines that constitute the *Collins* class also could face retirement when their respective service lives terminate.

Australia intends to acquire 12 new submarines to replace the *Collins*-class vessels. This replacement submarine—known as the Future Submarine—will be designed to travel farther, stay on patrol longer, support more missions, and provide more capabilities than the *Collins* vessels.

Acquiring these new submarines will be the largest and most complex defence procurement in Australia's history, and the Australian Government is considering having the vessels designed domestically and built in South Australia. However, because Australia has never designed a submarine, the Australian Department of Defence (AUS DoD) sought outside help to assess the domestic engineering and design skills that industry and Government will need to design the vessels, the skills that they currently possess, and ways to fill any gaps between the two. In November 2009, the AUS DoD engaged RAND to conduct such an evaluation of Australia's capabilities and capacities to design conventional submarines.

### Australia's Submarine Design Skills Gap

RAND assembled a team that included a former CEO of the Australian Defence Science and Technology Organisation, a former director of the U.S. Navy Nuclear Propulsion Program's Resource Management division, a former director of the U.S. Naval Sea Systems Command's Submarine/Submersible Design and System Engineering unit, a former technical director of the U.S. Navy's *Virginia*-class acquisition programme, a former director of naval architecture at Electric Boat Corporation, and a former commanding officer of a RAN submarine to conduct the evaluation. After reviewing the current literature on submarine design and engineering, analyzing historical design workload data from the United Kingdom's (UK's) *Upholder* programme and the *Collins* programme, and surveying industry and Government representatives on current and expected design practices, the team estimated that designing a conventional submarine today would require an effort of 8 to 12 million man-hours (MMH) over 15 years from a workforce of fully proficient, experienced submarine design personnel. This translates into a labour pool that, at its peak, would involve 600–900 submarine-proficient draftsmen and engineers in industry plus 80–175 oversight personnel in Government.

The RAND team found that while Government employs enough oversight personnel to meet its peak demand in most skill areas (although the availability of some may be in question insofar as they are involved with other naval and commercial programmes), such is not the case for Australian industry. As the accompanying table

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shows, companies in Australia today do not employ as many experienced submarine draftsmen and engineers with certain skills as they would need to meet expected peak demands at the 8 MMH and 12 MMH levels.

How would the programme fare if Australia were to draw solely from this current industry pool of domestic draftsmen and engineers to design the Future Submarine? As the table shows, that pool totals 475 draftsmen and engineers, many of whom may be engaged in supporting the *Collins*-class or other naval programmes and thus unavailable for a new submarine design team. It is entirely possible that as few as 20 percent of today's workforce might be available to work on the new submarine.

To explore this issue, RAND constructed a simulation model to gauge how different numbers of draftsmen and engineers with various levels of proficiency would affect a 15-year design effort involving 8 MMH. The model found that if Australia were to assemble a design workforce numbering 20 percent of today's submarine-experienced labour pool (equal to some 100 draftsmen and engineers), the effort to design the Future Submarine would take an additional four years to complete (19 years versus 15 years) and involve 20 percent more man-hours. If the assembled design workforce numbered 40 percent of today's labour pool (equal to some 200 personnel), the design effort would require an additional three years and 15 percent more man-hours.

## Industry and Government Options for Closing the Gap

RAND's simulations suggest that Australia can avoid cost and schedule delays only by augmenting its current design workforce with 250–500 submarine-experienced personnel. The RAND team evaluated two basic options that industry could pursue to cultivate such submarine design expertise and an array of options that Government could adopt to close gaps in its engineering workforce. The team's analysis pointed out pros and cons in the options for industry and identified one preferred option that makes the most sense for Government.

**Industry Option 1: Hire and train personnel from within Australia.** This would require recruiting and training draftsmen and engineers with no submarine experience. Not only would this workforce need more man-hours and a longer schedule to design the new submarine, it would need to shrink as the design programme nears completion. However, the result would be a capability to design submarines solely within Australia.

**Industry Option 2: Infuse submarine-experienced personnel from abroad.** Adding submarine-experienced personnel from abroad to the design workforce—by recruiting

**Submarine-Experienced Draftsmen and Engineers Available in Australia Industry and the Peak Demands in Millions of Man-Hours, by Skill**

| Skill Competencies | | Number Available | Maximum Demand | |
|---|---|---|---|---|
| | | | 8 MMH | 12 MMH |
| Draftsmen | Electrical | 12 | 64 | 96 |
| | Mechanical | 45 | 39 | 58 |
| | Piping/HVAC | 5 | 58 | 86 |
| | Structural/arrangements | 47 | 89 | 134 |
| | Other | 96 | 39 | 58 |
| Engineers | Signature analysis | 4 | 20 | 29 |
| | Combat systems & ship control | 7 | 51 | 77 |
| | Electrical | 16 | 39 | 58 |
| | Fluids | 1 | 26 | 39 |
| | Mechanical | 37 | 26 | 39 |
| | Naval architecture | 19 | 64 | 96 |
| | Planning & production | 2 | 13 | 20 |
| | Structural/arrangements* | * | * | * |
| | Testing | 1 | 7 | 10 |
| | Management | 1 | 13 | 20 |
| | Engineering support | 160 | 26 | 39 |
| | Other engineering | 22 | 39 | 58 |
| Total | | 475** | 613 | 917 |

* Grouped with naval architecture.
** Demands from other programmes may result in few (if any) personnel being available to support a new submarine design.

internationally, by having Australia-based companies draw from their international offices, or by partnering with another country's design organization—would shorten the schedule and lessen the cost increase. The advantage of this approach would be that as the new design programme winds down, international personnel could return to their home countries. The disadvantage: New submarine design programmes in the United States and UK may preclude the availability of experienced submarine design personnel from those countries, and Australia may not be left with the total capability needed to design a new submarine.

**Preferred Government Option: Draw core personnel from the *Collins* class to start the Future Submarine programme, then grow new personnel.** This would draw a core group of technical personnel from the workforce supporting the *Collins* class and other maritime programmes and hire additional personnel both as replacements for that core and as a way to fill out the Future Submarine programme. This option would draw from the *Collins*-class experience, reduce the risk of under-resourcing the *Collins* class and other programmes, and likely incur reasonable costs in training. ■

This research brief describes work done for the RAND National Security Research Division documented in *Australia's Submarine Design Capabilities and Capacities: Challenges and Options for the Future Submarine* by John Birkler, John F. Schank, Jessie Riposo, Mark V. Arena, Robert W. Button, Paul DeLuca, James Dullea, James G. Kallimani, John Leadmon, Gordon T. Lee, Brian McInnis, Robert Murphy, Joel B. Predd, and Raymond H. Williams, MG-1033-AUS (available at http://www.rand.org/pubs/monographs/MG1033.html), 2011, 310 pp., $42, ISBN: 978-0-8330-5057-1. This research brief was written by Gordon T. Lee. 

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