

How to buy a submarine Part 2

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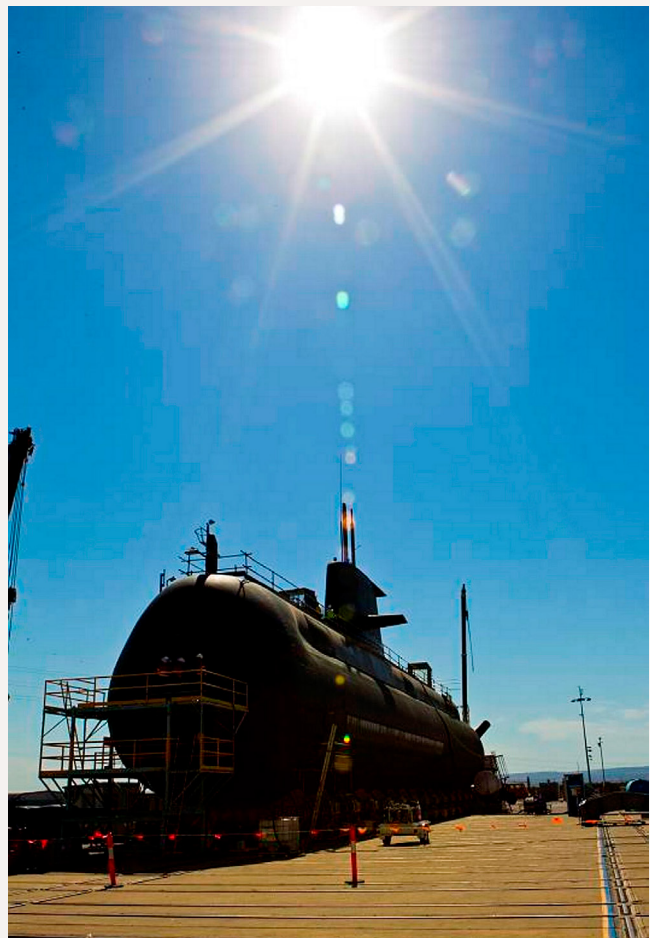
Executive summary

The building of a replacement for Australia's Collins class submarines will be the country's most expensive defence project to date. It's also likely to be the most complex, with a myriad of capability, commercial and industrial issues to be managed: the expertise for the design and construction of conventional submarines resides in Europe and Asia while Navy's preference is for American combat and weapon systems. Pulling those elements together while managing the technical risks is no easy task.

Local construction of the future submarine has been a bipartisan position for several years, and it has the support of industry and the bureaucracy. But there's no simple or fast way to produce a unique Australian submarine. If the government decides to go down that path, it will have to do so in the knowledge that it's a high stakes venture. This paper describes some of the approaches that could be taken and outlines their pros and cons.

Despite claims to the contrary, there's little doubt that the merger of a European design and American combat system is possible—after all, that's what the Collins is. But a sensible early step in the process would be to have government-to-government discussions with the potential players—especially in Washington—to determine what the actual constraints are, and what's merely unsubstantiated folklore.

Surveying the world market, conventional submarine design capability with the experience and maturity required for our purposes can be found in France, Germany, Japan and Sweden. The UK hasn't designed or built a conventional submarine in over two decades, but the trusted nature of the 'five eyes' intelligence relationship and its ongoing nuclear submarine programs means that it's also a potential partner.



A Collins Class Submarine undergoing maintenance at the ASC facility in Adelaide, SA. Image courtesy Department of Defence.

Of the possible European partners, France and Germany have established export markets, including the export of designs for construction elsewhere. The Swedish submarine industrial base is currently undergoing significant changes, but the close relationship between the Swedish and US Navy submarine arms makes them a credible contender. Japan is an established builder of large conventional submarines and there's high-level political support on both sides for a collaborative effort—and this is rapidly developing into one of the more likely options.

Then there's the Australian end of the arrangement. The most recent public statements from officials involved in the Australian program suggest that their preferred approach is similar to the Collins project—the standing up of a commercial entity specifically to execute the design and build. The advantage would be that a purposely created Australian-based entity could manage the interplay of participating European and American firms and their intellectual property. However, having created such an entity, the government would carry the majority of risk associated with the project from the start.

Other approaches are possible. Most simply, the government could go to the market and contract an existing international submarine designer/builder to undertake the project. Not only would this result in a cleaner commercial relationship, it would also give the Commonwealth a commercial counterparty with sufficient financial depth to shoulder a share of the risk in the project.

Finally, there's always the possibility that the government will weigh up the issues we describe in this paper and decide that it's all too difficult. In that case it'd need to decide whether offshore procurement options are able to deliver the required capability—or find an acceptable compromise between capability and risk.

Background

In April 2014, ASPI held a two-day conference on Australia's future submarine program entitled 'The Submarine Choice'. At the conclusion of the conference, we were left with three disquieting impressions.

First, the submarine project has the potential to be very risky and expensive—especially if we decide to pursue an entirely new design. Conference presenters drove home the message that Australia currently lacks two key prerequisites for success: ongoing collective experience and a highly trained design, engineering and submarine-specific building workforce.

Second, there's a worrying disconnect between Defence's plans and the government's thinking.

Third, it was clear that Defence's thinking on the submarine acquisition strategy was simultaneously prescriptive and vague—prescriptive about the sort of commercial entity it wanted to undertake the submarine project but vague about how to create such an entity.

With these three impressions in mind, we decided that it was time to revisit what Defence calls the 'Future Submarine' project, with a focus on the practical problem of building the boats. This paper is our attempt to do so. It thus represents an update of ASPI's 2009 paper *How to buy a submarine*, written when the enterprise was newly instigated.

To inform our thinking, a preliminary draft of this paper was offered to stakeholders for comment. Our thanks go to the many who took the time to respond. Apologies are also due, because it has proven impossible to include, let alone reconcile, all of the widely disparate views we received on many issues. Such are the differences of opinion surrounding this complex undertaking. Of course, the views expressed in this paper are solely the responsibility of the authors.

Where we are today

Work is underway to initiate a submarine construction program to replace the RAN's Collins class boats. Estimated to cost anywhere between \$20 billion and \$40 billion, the project aims to avoid a capability gap when the Collins class leaves service.

But long before HMAS *Collins* is lifted out of the water for the last time, there's another gap to be filled: the gap between where we are today and the awarding of a commercial contract to build the new vessels. Given that a truly off-the-shelf contract—the only

option in which things could move relatively quickly—seems unlikely, getting from requirements definition to concept design to detailed design and contract is likely to be a protracted affair.

Here's how things stand at the moment. On the basis of decisions taken by the previous government, Defence is progressing two options for the next-generation subs: an evolution of an existing design (in practice, the Collins) and a new design. For the moment—at least as far as is known from public announcements—the less ambitious military-off-the-shelf (MOTS) and modified MOTS options have been put on hold. This could change once the new government is fully briefed on the potential costs and risks of various options, but so far there's been no indication of a redirection of effort. And, based on the consensus among speakers at the ASPI submarine conference, it doesn't seem likely that the government will get advice from Defence to reopen those options.

An integrated project team (IPT) made up of Defence and industry personnel is working in South Australia to develop a design brief. The submarine IPT will assist Defence and the government to make an informed decision on the future submarine program. In the jargon being used, the IPT will help the Commonwealth be an 'informed customer'. Views from within the IPT were made public at the ASPI submarine conference in presentations by Simon Todd and Chris Edmonds.

At the time of the conference, it seemed likely that the next step in the process would see Defence formally invite selected firms to consult regarding the project. While the details of that consultation weren't set out, the apparent aim was the formation of a commercial entity to deliver the submarines. Uncertainty about how we get from where we are today to the formation of the commercial entity is understandable, and it would make sense to talk to industry so that subsequent steps can be fine-tuned. Nonetheless, as things stand there seems to be a critical gap in the acquisition strategy for what's likely to be the largest single defence project in Australian history. The work to bridge that gap has started, but seems to us to be somewhat fragmented.

We'll discuss the 'new commercial entity' strategy in this paper, as it's based on the most recent public comments from within the project. But we'd caution that it's not necessarily the best approach, and it's always possible that the government will take the project in other directions as it becomes more attuned to the issues it has to navigate. We discuss several other possibilities, including the more 'traditional' approach of running a competition to identify a prime contractor for the design and/or build phases.

At the same time the details of the future submarine project are being decided, the Collins fleet requires attention in order to keep it operating effectively until the follow-on boat enters service. Given the scarcity of resources available to Defence and industry (at least locally), it'd be advantageous if some synergies could be found. That's possible if—and probably only if—an evolved Collins forms the basis for the future submarine. Otherwise, some careful resource management will be required, and a 'minimalist' approach to Collins life-of-type extension work might be necessary. As the 2011 RAND study of Australia's submarine design capabilities and capacities told us, we can't assume that there's an inexhaustible supply of suitably qualified people available to do everything that we might want within the timeframes available—even without the parallel requirements of the Collins life-of-type extension.¹

A new Australian Submarine Corporation

As best we can determine, the commercial entity that Defence envisages is likely to be a firm created for the sole purpose of designing, building and (perhaps) sustaining the new submarines. Much like the original Australian Submarine Corporation created for the Collins project (now known as ASC Pty Ltd), the new entity will include key industry participants in the project as equity shareholders. This doesn't exclude the possibility of the 'old' ASC playing a substantial role in the 'new' Australian submarine company.

There's a balancing act here. Although this sort of arrangement means that participants will have some skin in the game, the scale of the project and the cash flow to participants will comfortably exceed the capital base of the entity. At some point, therefore, risk will revert to the Commonwealth. Indeed, a purpose-created entity will shield the parent companies by putting their more

substantive corporate assets beyond reach. One way to help manage the attendant risks is for the Commonwealth to have a ‘golden share’ or some other means of intervention to allow it to take control should the enterprise unravel—but, we should hope, not to intervene in the day-to-day running of the project.

It’s too early to tell what sorts of firms will be in the commercial entity and what sorts of activities will be relegated to subcontractors. But it’s probably a fair bet that the commercial entity will at least bring together the three core components of the project—design, integration and construction. Other possibilities would be a non-defence professional project execution firm (such as Bechtel), key subsystem suppliers, and specialist technical consultancy services from the US (such as Electric Boat).

And thought needs to be given to through-life support of the new boats. Setting up an entity to produce the boats and then letting a contract for support separately might give a higher overall cost of ownership than approaching with a ‘design for support’ remit. That might entail a contract to build and support the fleet, at least for the first part of its service life, in which there are incentives in place to produce a supportable platform. If so, a firm with submarine sustainment expertise—such as Babcock in the UK—might usefully form part of the team.

It can’t be taken as given that through-life support will be provided for as part of an integrated build and support project. Neither the air warfare destroyer (AWD) project nor the landing helicopter dock (LHD) project currently underway has availed itself of this opportunity. Indeed, the through-life support arrangements for these soon-to-arrive vessels are yet to be set—as was the case when the Collins began its unhappy in-service phase.

Commercial combinatorics

On paper, at least, there’s a range of potential firms in the three disciplines of design, integration and construction. Perhaps the broadest range of options exists for systems integration. Major US companies such as Boeing, General Dynamics, Lockheed Martin, Northrop Grumman and Raytheon are all plausible contenders, as is BAE Systems. Swedish firm Saab also has a strong local presence, has performed well in the Anzac frigate anti-ship missile defence upgrade, and has provided the combat system for the LHDs in construction and ship management systems in the Collins.

Accurate or not, there’s a widely held perception that a European firm would have difficulty obtaining the permissions required to integrate sensitive US subsystems and submarine technologies onto the vessels. Of course, that’s an easy assumption for officials and industry players to make. And for a number of players circling the submarine program, it’s a convenient one, too. In sorting through the many comments we received on a draft of this paper, we found black and white views expressed in both directions. The only way the Australian Government can get a definitive answer to the question of which international entities will be able to participate in the project is to start a government-to-government discussion with the British, French, German, Japanese and Swedish governments and, of course, with Washington. We need to ask the hard questions that allow us to identify any truly inviolable issues.

When it comes to construction, the possibilities are complex, to say the least. Through its ownership of ASC Pty Ltd, the Commonwealth already owns a yard that built submarines from 1990 to 2003 and has sustained them since. But it’s far from a foregone conclusion that ASC will be the builder of the future submarine. Despite having set up an internal cell (‘Deep Blue Tech’) to work on the Collins replacement, ASC wasn’t engaged by Defence on design work on the future submarine. Although ASC is involved in the submarine IPT, it’s just one of many firms contributing. Given the perceptions arising in decision-making circles from ongoing problems with the AWD project, the prospects for ASC’s involvement are now probably even lower.

Without going into detailed permutations, ASC could be kept as is or be broken up into as many as three pieces—submarine maintenance, submarine construction and shipbuilding—although how submarine building and sustainment are most efficiently organised will depend on which design is chosen for the future boats. All or any of the resulting pieces could be sold to the private sector or retained in public hands (including by retaining ASC infrastructure as a public asset). And if the government wants to

divest itself of all or part of ASC (as suggested in the Commission of Audit Report)², the best time to do so is probably going to be when the arrangements for the future submarine are established.

What's likely is that some of ASC's infrastructure (and adjacent assets owned by the South Australian Government) will be used for the new submarine project—by ASC Pty Ltd as submarine constructor, by a private-sector firm operating physically adjacent to the existing ASC yard, or by a private-sector firm that acquires ownership of all or part of ASC. There are any number of local and foreign firms that could play the third role, including BAE Systems, which already operates a shipyard at Williamstown in Victoria.

The situation looks even more interesting when it comes to choosing a design partner. Only two submarine builders spoke at the ASPI conference: DCNS from France and ThyssenKrupp Marine Systems (TKMS) from Germany. As well as building submarines for their national navies, both firms have extensive experience in helping other countries build and maintain conventional submarines (see Table 1). As is discussed below, the AWD project suggests, and foreign experience confirms, that having the designer also be the builder (or at least giving them significant direct oversight of the build) offers many advantages.

Table 1: European submarine exports, 1995 to 2014

Supplier	Customer	Submarine type	Contract signature (first delivery)	Comments
DCNS (France)	Brazil	4 × SSK (Scorpene derivative) 1 × SSN	2009 (2017)	The forepart of the first of class SSK will be manufactured in France before being transported to Brazil for completion, along with the build of the other three boats.
	Pakistan	3 × SSK Agosta 90B	1994 (1999)	First boat built in France, remaining two in Pakistan
	India	6 × SSK Scorpene	2006 (2016)	All boats to be built in India
	Chile	2 × SSK Scorpene	1997 (2005)	
	Malaysia	2 × SSK Scorpene	2002 (2009)	Built cooperatively by DCNS in France and Navantia in Spain
Kockums (Sweden)	Australia	6 × SSK Collins	1987 (1996)	Design elements and intellectual property
	Singapore	6 × SSK Challenger / Archer	2005 (2009) Archer	Refurbished ex-Swedish Navy Sjöormen and Västergötland classes
TKMS (Germany)	Greece	Up to 6 × SSK Type 214	2000	First of class constructed in Germany, next three in Greece
	South Korea	3 × SSK Type 214	2000	Assembled in South Korea. A follow-on batch of six is on order.
	Portugal	2 × SSK Type 214	2005 (2010)	German-built
	Turkey	6 × SSK Type 214	2009 (?)	Will be built in Turkey, with German technology packages provided
	Israel	3 × SSK Dolphin 2	2006 (2012)	German built, follows previous purchase of three Dolphin class
	Singapore	2 × SSK Type 218SG	2013 (2020?)	Evolved design with AIP, will be built in Germany

Until recently, it looked as though the German-owned but Swedish-resident submarine builder TKMS-AB—previously known as Kockums—was also a possibility. But here hangs a tale. The Swedish firm Kockums (designer of the Collins class) was sold to German firm HDW in 1999. In 2005, HDW became a subsidiary of TKMS. Since that time, what was Kockums has been operating under the name TKMS-AB in Sweden.

Earlier this year, the Swedish Government decided to bypass TKMS-AB and award work for the upgrade and replacement of its submarines to Swedish firm Saab. To secure the expertise necessary to execute the program of work, Saab has been actively recruiting TKMS-AB employees. Negotiations are now underway for Saab to purchase TKMS-AB and its facilities, thereby allowing Kockums' assets to be reunited with its workforce. If negotiations fail, Saab will build a new facility to undertake Sweden's future submarine work. Critically, the Swedish Government has retained the intellectual property associated with Kockums throughout the changes of ownership.

Notwithstanding this recent turmoil, Saab stands ready to play a role in Australia's ongoing submarine programs (including the Collins life-of-type extension) and has the backing of the Swedish Government to do so. Indeed, a strategic partnership between the two countries has been suggested. Meanwhile, TKMS-AB has been working on the evolved Collins option, and the first stage report is due by mid-2014. If the Saab acquisition of TKMS-AB proceeds, we presume that work on the evolved Collins will transition to Saab.

There's a question about the amount of effort that would be needed on a 30-year-old design to 'evolve' it into a 21st century warship, and many observers are of the view that it would practically amount to a new design—but one unreasonably constrained by Collins features such as the hull diameter. Less ambitiously, a technologically refreshed Collins design with a new propulsion system and updated combat system and sensors might be a useful benchmark against which other options can be tested for cost-effectiveness.

In any case, be it an evolved Collins or a new design leveraging Sweden's submarine replacement program, Saab has now emerged as a credible contender to design Australia's future submarine. In doing so, it offers continuity of design philosophy and synergies between the Collins life-of-type extension and its eventual replacement.

To be successful, however, Saab will need to overcome the legacy of disputes between the Commonwealth and Sweden/HDW over Collins intellectual property in the early 2000s. More importantly, the compatibility of Australia's and Sweden's submarine programs would need to be examined closely. We're both small nations, so effective collaboration would depend on the compatibility of resource demands, in terms of human capital and production schedules, and aspirations, in terms of submarine size and performance. As with all the potential partners, the ability of Sweden/Saab to manage third-party intellectual property will be critical, though the healthy relationship between the Swedish and US Navy submarine arms would help.

In terms of export experience, it's clear that the German and French firms are well ahead. The Swedish firm Kockums provided much of the design for the Collins class, and has refurbished six ex-Swedish Navy boats for Singapore in two tranches, but hasn't otherwise won export contracts for either submarines or designs.

Media reports have made a lot of the possibility of Japanese submarine technology feeding into Australia's submarine project. It's not clear how much is known in Australian circles about Japanese submarine systems and capabilities, but any knowledge gaps would need to be filled in before informed decisions could be made. That might be hard to do; Japan is only slowly working its way through the question of defence exports and may be reluctant to share its naval 'crown jewels'. Left solely to the bureaucrats in Canberra and Tokyo, the prospects for effective cooperation are low. But interest in collaboration seems to be growing at the highest levels of government on both sides, so more discussion of this option is in order.

The obvious strategy of simply placing an order with Japan's established submarine builders might seem unlikely, but it can't be ruled out given the shared enthusiasm of both Prime Ministers for a deeper collaborative relationship. Local Australian industry would fight to prevent overseas competition, and the political cost would be high in South Australia. The export of a complete

design also seemed unlikely until recently, given Japan's glacial pace of normalising its defence posture. But it would guarantee lucrative exports of key propulsion subsystems, such as diesel engines, along with many other vessel subsystems.

Another possibility is a collaboration that stops short of a complete transfer of a Japanese design, but involves the transfer of some subsystems and perhaps even some sensitive technologies or techniques. For example, Japan seems to have successfully integrated propulsion components from a range of suppliers (Swedish AIP in some Japanese boats, for example), and the know-how to do that could be valuable.

Finally, the Spanish seemed to have a shot at one stage, with Navantia's AIP-equipped S-80A design—a larger derivative of the French Scorpene—catching a few eyes. But although Navantia has exported a warship design to Australia—with the results described below—it hasn't exported a submarine. News last year that the Spanish AIP was underperforming and, worse, that the submarine design lacked adequate buoyancy, effectively counts Spain out as a design source for the future submarine.

So it looks to be a three-horse race for the role of design partner for the future submarine—at least as far as European design houses are concerned—between DCNS, TKMS and, as a late entry, Saab. But because of the possible complications with US-sourced systems mentioned above, the door's open for a 'three-eyes' Australia-UK-US arrangement, with a UK-Australia led design effort with only limited assistance from the European designer. How plausible would this be?

British submarines have been exported in the past. For example, Australia, Canada, Brazil and Chile were customers for the Oberon class. Canada subsequently traded in its Oberons for second-hand British-built Upholder class boats in the late 1990s. Since that time, the UK hasn't exported a submarine of any kind after transitioning its own submarine fleet to all-nuclear in the mid-1990s. As is discussed below, exporting a design is a complex undertaking.

Despite that, and although the UK hasn't designed a conventional submarine since the late 1970s (the Victoria/Upholder class), there's a noticeably British feel to the leadership of our submarine enterprise. Key appointments include the Defence Materiel Organisation's General Manager Submarines (David Gould), the head of the submarine IPT (Simon Todd), Submarine Design Manager (Chris Edmonds), ASC Pty Ltd CEO (Steve Ludlam) and head of the Collins Sustainment Review (John Coles), all of whom gained the bulk of their professional experience in Britain.

Either the experience gained from UK nuclear submarine programs is highly relevant or we've made a mistake. Nuclear submarines share some common design principles with conventionals, but their maximum speed and operational cycle are different, and they aren't energy-constrained in the same way as conventional boats, so we can't assume that we'd be getting the full suite of expertise required. In particular, we wouldn't have access to suitable expertise in propulsion systems—diesel engines, electric motors and generators, and batteries—which have proven so problematic in the Collins. Assuming that there's enough commonality to make the exercise workable, a UK-Australia partnership exploiting BAE Systems' reach back to the UK nuclear submarine programs can't be discounted. Other British firms, such as Thales (UK) and Babcock (which maintains the UK nuclear boats), may also have expertise to offer, although capacity might be an issue as design work on Britain's future nuclear deterrent submarine ramps up.

The extent to which a UK-based approach would be viable independent of European design expertise is important to determine. If it's necessary to draw extensively on European conventional submarine design expertise, there's a risk of repeating the error of the AWD project and leaving the designer outside of the core commercial entity.

Assuming the British option is feasible, we're left with a five-horse race between France, Germany, Sweden and, perhaps on the outside, the UK and Japan. And although the UK has no recent experience with conventional submarines, it's probably the best placed when it comes to managing American intellectual property, although American concurrence will be required regardless. We should also note that a shared language is a significant advantage when it comes to collaboration on complex projects.

Learning from the air warfare destroyer

To see what we're looking for in a design house to partner with, we can draw some useful lessons from the AWD project. In that endeavour, the Commonwealth partnered in a formal alliance with ASC as the builder and Raytheon as the systems integrator, but—significantly—not with Navantia, the designer of the chosen solution. The result, as reported by the Australian National Audit Office (ANAO), has been poor performance, cost increases and schedule delays. Because of the ANAO's focus, this section deals largely with production issues, but many similar issues will apply to planning, engineering and supply chain management.

The ANAO's recent report on the AWD program allows us to drill down to the root causes of the problem.³ Some of them are to do with low productivity in the Australian shipyards, but many have had to do with the translation of the design to the build stage. An analysis of the project's 'problem and issue reports' database shows that nearly half the records relate to design issues. Frequently, drawings had to be redone—up to four times in some cases—when they were found to be unfit for purpose. Given that Navantia had successfully constructed similar vessels in its shipyards at Ferrol, this seems to have been an unanticipated problem, despite spending more than \$200 million on pre-approval studies, including, presumably, a study of the effect of Australian design modifications.

The explanation for this surprising outcome lies in inexperience on both ends of the arrangement. This is the first time that Navantia has exported a design for building offshore, and it's used to preparing drawings for its own workforce. Workers in the Spanish yard are familiar with Navantia's design philosophy, the equivalent of 'shorthand' employed in its technical drawings and, most importantly, the tacit knowledge of ship production assumed by the designers.

In our local yards, the inexperienced Australian workforce struggled to translate Navantia's drawings into executable work. Exacerbating the problem, the local workforce also lacked critical skills at the production supervision level. In the case of the well-publicised problems with the poor quality of the blocks (prefabricated modules) built in Melbourne, Defence's 2010 advice to the Defence Minister is pretty clear:

... the poor build quality was largely the result of BAE Systems not having sufficient experienced production supervisors—workshop engineers and foremen—despite being one of Australia's most experienced shipbuilding organisations.

Source: ANAO air warfare destroyer audit report, 2014.

The future submarine project will face all of these problems and more. In the case of the AWD, we started a build with a first-time Australian shipbuilder and an inexperienced workforce. In the early days of a start-up build, low productivity is to be expected and should be allowed for in planning. But seven years on, productivity remains well behind planned levels. It's hard to avoid the conclusion that planning was overoptimistic and production management less robust than was required. As well as the disconnect between designer and builders, many design changes were made due to Australian requirements and materiel choices, and Defence's project management doesn't seem to have accurately assessed the impact of those changes.

It would be interesting to know how much extra capability has accrued from the changes, because they've certainly provided more than their share of difficulties. Cost/capability trade-offs are an important part of the development of any capability, not least those for which a 10% price variation amounts to hundreds of millions of dollars.

The recent announcement of remedial action on the AWD stemming from the White–Winter Report broadly reinforces the conclusions drawn from the ANAO report. Beyond that, it's difficult to say more because the government has chosen to withhold the White–Winter Report from the public eye—probably indicating the embarrassing depth of problems uncovered. It's regrettable that valuable data on such an important and expensive publicly funded project, with undoubted implications for future even larger and more expensive naval construction projects, is being withheld from view. Given the amount of new design work almost certainly required for the future submarine, it's hoped that the appropriate lessons have been learned, because if the future submarine is to come anywhere near the articulated requirements, it won't have much in common with boats elsewhere. And if we

stick with the expected European conventional submarine technology and an American combat system and weapons, we'll have to integrate subsystems from multiple suppliers.

We can at least reduce the number of problems if we refrain from pushing the envelope with our design, aiming for 'state of best practice' rather than 'state of the art'. In any case, it's clear that we'll be starting a harder journey from no better a local starting point than the AWD in terms of technical difficulty. The expertise and experience of external partners in integration work, and the ability to implement it in local yards, will be paramount. And the AWD experience makes a case for the designer to be a core member of any consortium.

Whichever of the arrangements discussed above are established, Australia will need the following elements of project management to be in place. First, senior engineering and design personnel from those firms chosen to provide major systems (including the hull and other structural components) must be readily available to the local yards for consultation in near real time.

Second, we need to recognise that we'll have to import production techniques as well as the design. There are at least a couple of ways to do that. One way is to import the shipyard foremen and production supervisors with the design, effectively training the Australian workforce under experienced supervisors who understand the design and production philosophy. Another approach—one that's been successful for other countries—is to take some of our workforce to the home yards of the designer to work alongside the already established workforce. This might also include building the first of class (or at least a substantial portion of it) in the overseas yard.

Third, for a program likely to last over two decades there'll need to be continuity of leadership and robust succession planning for both the contractors and government. To be successful, such a long-term undertaking requires a lot of institutional knowledge and a deep understanding of lessons learned along the way.

Finally, and as noted by the project office representatives who spoke at the ASPI conference, we need to ensure that we have a stable and suitably documented design, and a well-understood process for turning it into production work, before starting metal fabrication. While that might seem entirely obvious, the politics of providing shipyard jobs here in Australia has the potential to lead to shortcuts—which are bound to be troublesome and expensive in the longer term.

These requirements will be demanding on whichever submarine designer/builder is chosen, and will necessarily consume a lot of their engineering resources. In the case of companies that also build for export, the resources committed to an Australian build won't be available for work on boats for which build revenue will flow as well. We can therefore expect to pay for that opportunity cost.

The AWD project is the most recent example from which lessons can be drawn, and it hasn't been the most edifying experience. Earlier projects, both good and bad, can also provide valuable experience. The Anzac frigate project is generally seen to have been a success, with the later ships in the production run being produced efficiently by world standards. The Collins project contains many lessons, some positive and some not so positive.

Closing the gap

The challenge for the Australian Government is to somehow find a way from where we are today to one of the myriad possibilities implied in the foregoing discussion. No wonder Defence's preferred first step is to undertake consultations.

Without presuming what the forthcoming consultations might entail, there are a number of possible ways to progress the creation of a commercial entity to execute the submarine project. In order of increasing time and complexity, here are four (and a half) options among the many possible approaches. And of course there's always the 'old school' approach of going to the market to see who can best provide the required services and engaging them to do so.

Guessing contest

The most expedient way to proceed would be for Defence to talk with potential firms and then invite those deemed most convincing to join forces and create the submarine construction entity. Of course, the manifest lack of process and probity in such an approach means that this won't happen. Without some sort of orderly and transparent solicitation process that sets out the basis for selection, it would be a guessing contest with firms seeking to garner Defence's favour.

Beauty contest

Having talked to industry to scope the possibilities, it would be open to Defence to then formally solicit from firms their credentials for a role in the submarine construction entity as the designer, integrator or constructor. This is effectively what happened in the first stage of the AWD project, when the shipbuilder, combat system systems engineer and preferred designer were selected ahead of the actual design.

The advantage of such an approach is that bidders for the various roles get a clearer idea of the basis for decision-making. The drawback is that, rather than receiving bids for products at a price, the Commonwealth has to sort through what are effectively job applications based on claims of past performance and promises of future performance—as much a bragging contest as a beauty contest. Of course, if you're looking for partners to work with in delivering a class of vessels the size, performance and cost of which are yet to be nailed down, this is at least a necessary step in the process.

Design contest

The potential design contenders DCNS, TKMS and perhaps BAE Systems all have experience building submarines (albeit only nuclear vessels in the case of BAE). Saab hasn't built submarines, but has inherited much of the experience of Kockums. One way to more fully test the contender's credentials beyond a beauty contest would be to fund concurrent design studies to see how each would propose meeting the Australian design brief. Design needs to be viewed expansively as including cost estimates, production planning, schedule estimates, infrastructure requirements, training planning and the other elements required to deliver a capability.

Funded design studies have been used in the past in Australia and overseas, including in the early stages of the US F-35 Joint Strike Fighter Program and our own AEW&C project. The time and money spent would allow a better assessment of the designers and their compatibility to our way of doing business, and could be used to generate at least preliminary cost estimates.

MOTS-based contest

One of the dangers with all the strategies discussed so far is that they don't readily allow for a lesser risk/cost option. Instead, a designer or designers will be asked to work towards achieving the goals in a unique Australian design brief. And although this will allow cost-capability trade-offs to be made, it doesn't provide a fallback option if the costs and risks of the exercise grow too high. One way to remediate this would be to mirror the pre-second-pass phase of the AWD project, in which two designs were developed and taken forward for government consideration.

In the case of the future submarines, this could be achieved in several ways. For example, the successful design partner could be asked to concurrently adapt an existing design but only to the extent that it's within their engineering comfort zone and cost-effective to do so. Of course, where a modified design stops and new design begins is a difficult question (for example, was Collins a new design or a derivative design?) but it shouldn't be beyond human wit to come up with some heuristics to help delineate some boundaries. In effect, two design exercises would be done concurrently: one starting with our unique requirements, and another starting with—and not deviating too far from—an existing design.

Old school

The preceding options largely take as given the unashamedly interventionist approach of creating an entity to build the submarines. There was a time when things were simpler. At the risk of only a little oversimplification, the Collins and Anzac projects went to the market seeking solutions against a set of performance requirements. Consortiums formed, bids were lodged, and a winner was chosen.

Since that time, industry consolidation has reduced the range of potential bidders, and intellectual property has emerged as a sensitive issue. Nonetheless, there's something inherently attractive about the government working out what it wants and leaving industry to work out how best to deliver it, including the commercial arrangements between industry parties. Moreover, the outcomes of the experiment of having Defence on both sides of the contract in the AWD alliance hardly sells the idea of blurring the lines between customer and supplier. There's a lot to be said for a bilateral contract between the Commonwealth and a single prime contractor with a real balance sheet, rather than a thinly capitalised special-purpose vehicle deliberately brought into being as part of the acquisition strategy.

Apart from the vexed issue of intellectual property and the varying capacity of different US allies to integrate US systems, even the option of a funded design contest leading to a fixed-price contract would appear possible. So, how large an impediment is intellectual property? Until we ask, it's hard to know, given the self-interested claims and counterclaims. But it should be noted that the Collins is a European-designed submarine and it has a US combat system and US weapons. So we have a demonstration that a US combat and communications system can be fitted to a European-designed boat in Australia.

Next steps

The strategies outlined above are but a sample of the range of possible approaches that could be taken. Experience shows that getting the acquisition strategy right is every bit as important as any of the technical details in a defence project. In fact, if you get the former right, you should have the expertise and processes in place to help you manage the latter. Literally billions of taxpayers' dollars are at stake, not to mention a key ADF capability. It's critical that we get off on the right foot, as experience shows that it's much harder to change tack later. With that in mind, here are five suggestions for how to handle the manifest uncertainty surrounding the next steps in the submarine project.

Transparency

The submarine acquisition strategy is likely to be the centrepiece of a restructure of the entire naval construction sector in Australia—including a possible transition to monopoly continuous-build programs for both submarines and surface combatants. Before such a momentous decision is taken, broad consultation is called for, and we need to understand the real—as opposed to asserted—industrial and strategic payoffs. High on any agenda must be the question of how a monopoly supply situation would be regulated to ensure ongoing value for money. It'd be far preferable to make a decision about the wider shipbuilding sector in general, based on good-quality information, than to make a series of ad hoc decisions that severely constrain the choices for major projects such as the submarine.

A green paper from the government following the forthcoming industry consultations on the submarine program would be a good way to achieve this. If a systematic and comprehensive analysis of options is occurring within government, a green paper would be easy to produce. Conversely, if a green paper is a hard ask, we're surely in trouble. We certainly need a more convincing basis for decision-making than last year's Future Submarine Industry Skilling Plan, produced by the Defence Materiel Organisation.

Any project that's going to spend billions of taxpayers' dollars over decades will require bipartisan support, so efforts should be made to ensure that there's a political consensus. And the public deserves to have enough information to at least understand why and how the money is to be spent.

Probity oversight

The acquisition strategy for the future submarine program is sure to advantage and disadvantage potential industry participants to varying extents, so the potential for accidental and perceived bias can't be discounted. And if a 'new commercial entity' is the approach taken, then it'll be important to ensure that any conflicts of interest between the parties involved are closely managed. It's routine to appoint a probity adviser for major defence programs, and in the case of the AWD project no less than a retired Chief Justice was appointed to the role. In fairness to all parties, and to protect the Commonwealth's reputation, a similarly high-profile independent probity adviser should be appointed as soon as possible to oversee the propriety of the many actions and decisions that lie ahead.

Risk

The future submarine project will entail risks on multiple levels. The efficient management of risk will be essential to the successful execution of the project. Defence is only partially equipped through the Defence Science and Technology Organisation to understand the many technical risks inherent in the project. And a clear understanding of the commercial risks to the government and its counterparties is vital to the crafting of an acquisition strategy.

The Commonwealth is exposed to risks (cost, schedule, reputation and capability) in any procurement, and especially so for projects whose scale rivals or exceeds the assets of suppliers. The mitigation—which can only ever be partially effective—is to structure the arrangement so that the participants are exposed to substantial financial risk (as well as the reputational risk they inevitably bear), thus providing strong incentives to get things right. Of course, this will come at a cost: firms will build a risk premium into their price, effectively selling partial insurance to the Commonwealth.

On the other side of the coin, firms face risks in dealing with the government as a customer, such as uncertainty about the extent of the government's commitment to support an ongoing submarine build and sustainment enterprise in Australia. While eventual cash flow to investment ratios may be high, the initial capital investment will be substantial. The risk of a future change of direction—for example, limiting the build to fewer than 12 boats—will weigh heavily on the minds of firms contemplating buying in. A similar calculus will apply to individual staff, who will probably demand a wage premium to leave established firms or relocate to be employed by the new entity. Uncertainty from the government means risk for suppliers, with the result of a further risk premium being added to suppliers' prices.

An apportioning of risk will be intrinsic to the future submarine acquisition strategy—for better or worse. Glib generalisations that 'risks should be held by those best able to manage them' oversimplify the potential for cost-shifting and other unintended consequences, especially in complex contracting arrangements such as those in place for the AWD.

Given the centrality of contracting and risk apportionment for any commercial arrangement adopted for the new submarines, the government should seek external advice from beyond the defence sector. Fortunately, the Australian resources sector has extensive experience in multi-billion-dollar projects to draw upon.

Government-to-government consultations

With so much ambiguity surrounding the availability and compatibility of various international partners, the government should engage with its counterparts at the political level to achieve maximum access and cooperation on the future submarine project from our friends and allies. We also need to know exactly what the practical limits are on technology access and the extent to which 'two/three eyes' restrictions are real impediments. There's too much at stake to allow our options to be curtailed by untested assumptions and bureaucratic inertia at the working level. In the absence of negotiations at the political level, we'll never really know what's possible. In the case of US sensitivities, this is important enough a topic for it to be elevated to AUSMIN discussions—and, if significant British input is being seriously considered, the AUKMIN talks are the suitable venue.

Leadership

Somebody needs to be put in charge of the future submarine project near to or at the political level. At the moment, a number of people have responsibility for specific aspects of the project, but no one person has responsibility for driving and coordinating its many interdependent parts—not just the project management (the day-to-day running of which sits naturally within Defence with the General Manager Submarines and the SEA 1000 project lead) but also the politics of the project. The government needs to understand exactly what it's being asked to decide at every point. A strategic-level policy appointment needs to be made, with responsibility for guiding the project through government, leading international engagement, coordinating activities within Defence, ensuring interdepartmental collaboration and engaging with industry at the highest level.

A final comment

Around the world we've seen a steep increase in the cost and duration of development programs for cutting-edge military platforms. A unique Australian submarine would be no exception and there's always the possibility that the government will weigh up the issues we describe in this paper and decide that the likely costs outweigh the prospective benefits. In that they'd need to decide whether offshore procurement options are able to deliver the required capability, or find an acceptable compromise between capability and risk.

Further reading

ASPI has been writing about the future submarine program for some time now. The interested reader will find some of our previous thoughts in the following publications.

Sean Costello and Andrew Davies, *How to buy a submarine: Defining and building Australia's future fleet*, ASPI, Canberra, 2009.

Andrew Davies and Mark Thomson, *The once and future submarine-raising and sustaining Australia's underwater capability*, ASPI, Canberra, 2011.

Andrew Davies, *Subaqueana australis-the future evolution of Australia's submarines*, ASPI, Canberra, 2011.

Andrew Davies, *What price the future submarine?* ASPI, Canberra, 2012.

Andrew Davies and Mark Thomson, *Mind the gap: getting serious about submarines*, ASPI, Canberra, 2012.

Mark Thomson, *Thinking about submarines*, ASPI, Canberra, 2014.

Notes

- 1 *Australia's submarine design capabilities and capacities: challenges and options for the future submarine*, RAND Corporation Monograph, Santa Monica, CA, 2011.
- 2 *Towards Responsible Government: the report of the National Commission of Audit*, Phase 1, Part B, Section 10.1 privatisations. NCOA, Canberra, 2014
- 3 *Air Warfare Destroyer Program*, Australian National Audit Office Report 22, ANAO, Canberra, 2014.

Acronyms and abbreviations

ADF	Australian Defence Force
AEW&C	airborne early warning and control
ANAO	Australian National Audit Office
AWD	air warfare destroyer
IPT	integrated project team
LHD	landing helicopter dock
MOTS	military-off-the-shelf
RAN	Royal Australian Navy
TKMS	ThyssenKrupp Marine Systems
UK	United Kingdom

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