

A Sustainable Australian Naval Industry

Australia, as an island continent, is a maritime nation. Our way of life is enabled by the sea.

Our security and prosperity vests in a Navy that can fight and win at sea. For the Navy to be effective, the Australian naval industry must be able to continuously deliver and sustain capable warships and submarines.

This paper puts forward an industry perspective on how to develop a sustainable and productive Australian naval industry. Australia has the ability to develop a naval industry that approaches or exceeds international benchmarks for efficiency and performance. This advanced industrial capability would be available without additional cost should the Government implement policies that enable higher industry performance.

Five key recommendations are proposed:

- 1. implement rolling ship and submarine building programs to sustain industry throughput*
- 2. build a capable in-country naval 'value chain' built on domestic and international sources of supply*
- 3. implement best commercial practice across the value chain for greater productivity*
- 4. increase in-country capability in submarine and ship integration to include warship design*
- 5. establish, maintain and execute a strategic science and technology program.*

Significant benefits follow. Simply put, the most important benefit of a sustainable and productive Australian naval industry is an improvement in Navy capability. The Government also receives more cost effective products and services. A wider value is realised through greater military and industrial self-reliance, jobs growth, and development of human capital, innovation and economic growth.

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OVERVIEW

ASC prepared this paper to inform defence industry policy from an industry perspective.

In the past decade Government has engaged industry extensively in policy preparation. This engagement is welcome and supported by ASC. Many of the concepts discussed in this paper are already well socialised and accepted as best practice in the industry. Consequently the naval industry can deliver the most advanced warships and submarines at sea in the world today. The next step is to create a sustainable industry that delivers an enduring capability to the Navy.

ASC is a unique stakeholder in the industry. It is an Australian owned, prime defence contractor engaged in designing, building and sustaining Australia's primary naval capabilities. From this position, it offers this paper in the spirit of thought leadership and to foster a conversation about the naval industry and Australia's future.

ASC's unique status enables a conversation to be held free from the constraints of managing competing interests between Australian and international customers. ASC has the additional responsibility, as the Ship Integrator, of leading the Australian industrial base for Australian interests. Of course, within this framework, ASC can pursue business opportunities, just as others will.

Building a sustainable industrial base takes strategic buy-in from all stakeholders. Like any industry, there will always be opportunities for a narrow set of interests to take advantage over the industry and overall public interest. However, international experience tells us that only aligned stakeholders can develop and sustain a domestic naval industry.

No impediment exists to Australia having an advanced manufacturing base centred on the naval industry. This paper explores the core assumptions underpinning this view.

Australia has a proven installed capacity, sufficient aggregate demand, a skilled and educated labour force and a competitive cost base. The challenge is to work up the productivity curve to establish a sustainable and cost effective industry. What is required is leadership, coordination of all participants in the value chain and an acceptance that every stakeholder must be tested for performance.

NAVY AND THE AUSTRALIAN NAVAL INDUSTRY

AUSTRALIA'S GEOSTRATEGIC SITUATION

Australia is an island nation with substantial maritime interests. More than 90 per cent of its trade is by sea. Maritime trade flows over lengthy sea routes through several strategic bottlenecks in South East Asia and the Middle East^[3]. Australia's maritime area of interest is substantial. It spans the Asia-Pacific region, a substantial part of the Indian Ocean and the Southern Ocean. Its vast size underlines Australia's importance in an enduring geostrategic situation (Figure 1).

ADVANCED CAPABILITY SUBMARINES AND WARSHIPS

Australia's strategic foundation is to employ submarines and warships that are technically superior^[28] to potential adversaries to ensure the security of maritime trade, protect our sovereign interests and support our allies. Our capability also needs to be maintained, at the leading edge and over the long term, for the service life of each warship and submarine, and during the transition to their replacements.

A SUSTAINABLE AUSTRALIAN NAVAL INDUSTRY

Australia's geographic isolation demands a strategic industry capability of delivering and supporting submarines and warships. The collective objective of Government and industry is to source the necessary military capability at the lowest risk and lowest price. All options must be on the table. The Australian situation suggests a competitive framework of Australian and international suppliers among strategically aligned nations in an effort led by Australian organisations to ensure the protection and advancement of our national interest. The function and performance of this framework can be measured by applying the value chain model to both delivery and sustainment.

The value chain model, described by Dr Michael Porter in his book *Competitive advantage*^[31], was used by John Coles in his *Study on the business of sustainment of the Collins submarines*^[4]. The model, which articulates the chain of activities performed to deliver the product, helps develop a productive and sustainable Australian naval industry. It can be applied to all phases of a vessel's life – design, construction and sustainment in service. The naval industry is a capability, the most important constituent being our people, and not separate "sustainment" or "build" markets.

LEAD BY THE SHIP AND SUBMARINE INTEGRATOR

Leading the industry, and the industrial components of the value chain, is the Ship Integrator; the industrial entity responsible for integrating all systems and equipment to deliver a safe, available, reliable and effective warship to the Navy. The Ship Integrator's core capabilities comprise advanced manufacturing, applied science and technology, engineering, knowledge management, project management and supply chain management. The Ship Integrator and ship designer are tightly related. Australia, like almost all western nations, does not have sufficient demand to justify design capability in all classes of ship however there are powerful arguments to extend this capability for specific vessels such as frigates, destroyers and submarines.

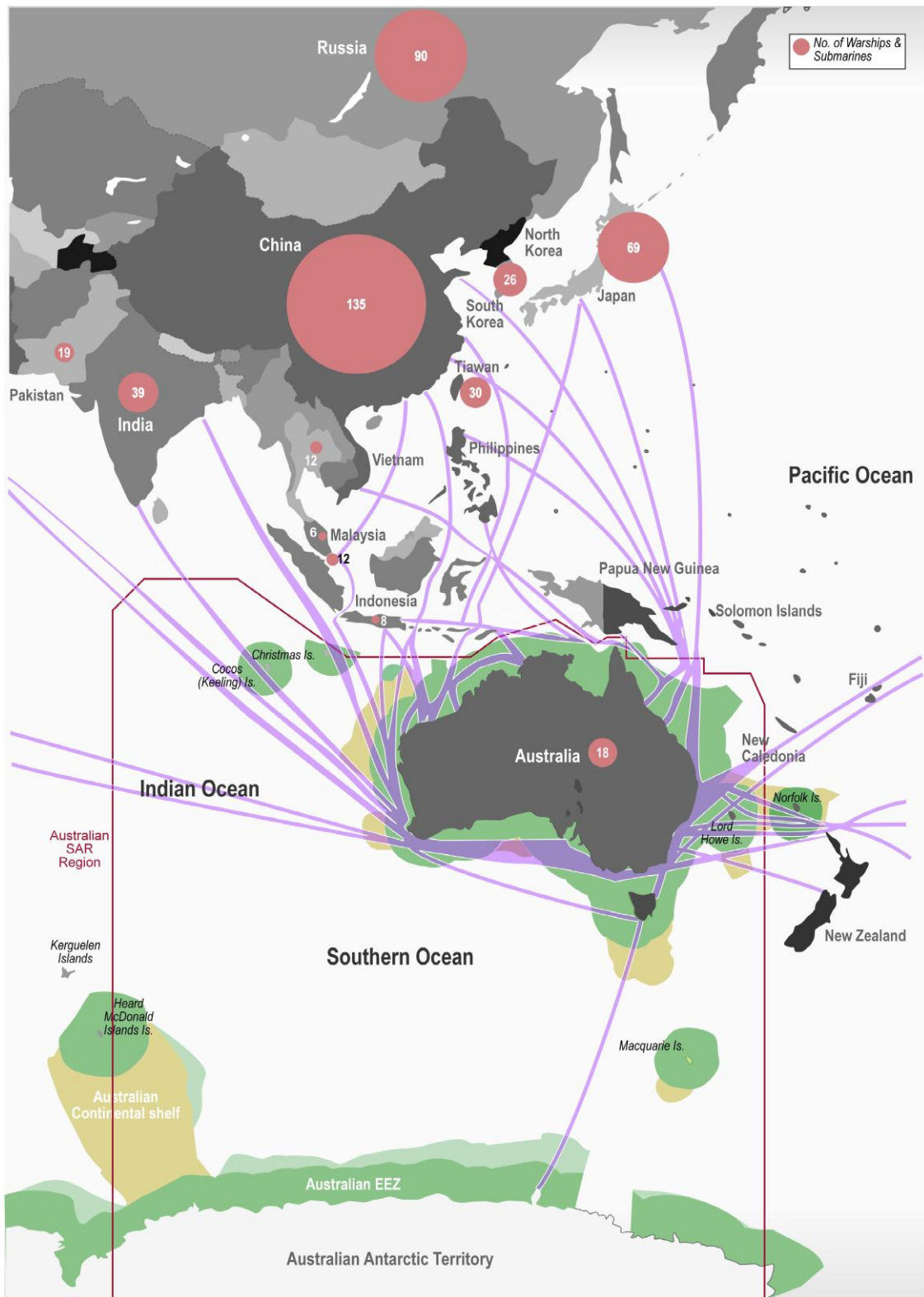


Figure 1: Australia's substantial maritime area of interest

A 100 YEAR PLAN

Australia's ongoing maritime security demands an enduring military capability. Warships and submarines age to the point where they become too expensive to operate and maintain. They become technically out-dated and militarily inferior. Events can conspire to delay approvals for replacements, creating a capability gap that cannot be easily filled. At worst, 'block obsolescence' sees an entire class of vessel become obsolete within a few years. This situation is perpetuated by the boom-bust cyclic nature of major defence procurement programs. It distorts the industrial base because demand on resources changes substantially with the peaks and troughs. The workforce must be laid off during times of low investment; then restored, with greater time and cost efforts, and attendant risks, when investment returns.

The production gaps between the Charles F Adam Class and Hobart Class Air Warfare Destroyers, and between the Oberon Class and Collins Class submarines, are examples of a lapse in investment. The block obsolescence was also a military capability shortfall. More recently, poor reliability, technical obsolescence and a lack of availability has impeded the utility of Navy's amphibious ships.

Naval capability must also be regenerated after the new equipment is delivered with an effort that can take more than a decade, often with overseas assistance.

To avoid unwanted project delays, risks and costs leading to capability gaps, projects for Navy's fleets of ships must be considered over a multi-generational time period – a 100 year perspective. Such a strategic plan would avoid the current boom-bust approach.

Further, performance of the Australian naval industry should be viewed and measured over both the short and long term. The consequences of decisions must be well understood ahead of time.

SOME CONSTRAINTS

Australia operates within a framework of international alliances and treaties, which are driven by, or drive the need for, inter-operable, common standards, and the use of equipment developed by other nations.

The most technically advanced warfighting equipment requires access to commercially sensitive intellectual property – very often classified technical data belonging to foreign countries including our closest allies. The trust of those countries must be maintained through limits to access, proven mechanisms to protect the information, and importantly, significant constraints on open tendering and who can be given access to the process.

As a wholly owned Australian company, prime contractor and Ship Integrator for high value and technically sensitive naval programs like the Collins Class Submarines and Air Warfare Destroyers, ASC can provide the necessary mechanisms to work within these constraints.

SUFFICIENT AND CONSISTENT DEMAND

SOME CONSIDERATIONS

Defence's historical approach to procurement has tended to result in industrial feast and famine cycles. Intense periods of investment and skill-development are followed by rapid decline and knowledge erosion^{[24][25][30]}. Figure 2 illustrates the shape of these cycles since the late 1980s. This approach is an ineffective use of both knowledge and capital. It leads to block obsolescence and lower capability in the long run for both industry and the Navy. Knowledge, skills and processes developed in one project are not leveraged for future projects. The cycle impedes progress along the inter-project learning curve, magnifies the impacts of 'last ship' syndrome^[17] and is a significant threat to sustaining a leading military edge and a viable naval industry. Importantly, the timing of projects is the most sensitive variable and (as discussed in more detail overleaf) the total expected demand to be placed on the industry, aggregated over time, is broadly sufficient.

A policy change that reduces volatility in industrial demand would provide sufficient and consistent work for industry and serve to remove the military capability gaps that accompany the troughs.

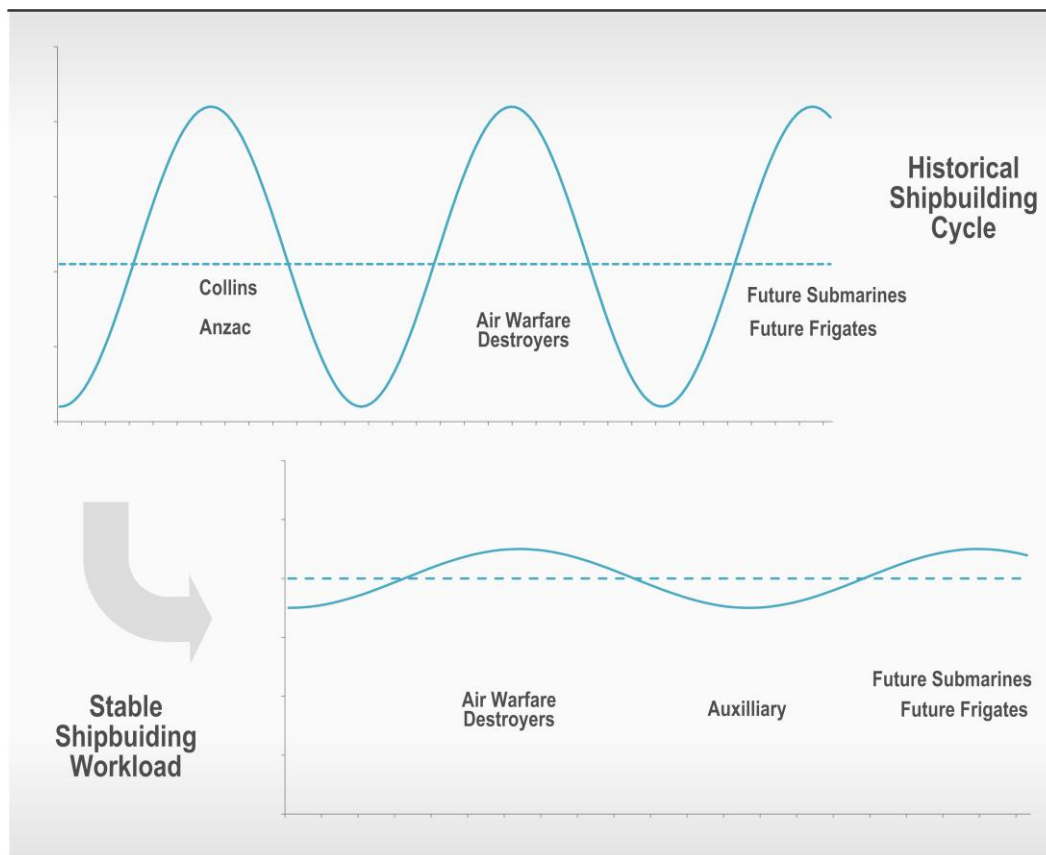


Figure 2: Australia would benefit from a stable long-term construction workload for industry

SUFFICIENT DEMAND FOR A VIABLE INDUSTRY

The clear relationship between stable future demand and the progress of industry capability is acknowledged in the *Defence white paper 2013*^[1] and the *Future submarine industry skills plan*^[23]. These important papers note that smoothing large expenditure peaks and troughs would stabilise Australian industry and improve productivity. Over the long term (Figure 3), the need for major warships and submarines is sufficient for a reasonably stable demand on Australian industry.

These are not new concepts: *The Australian naval shipbuilding and repair sector strategic plan*^[25] in 2002 offered a comprehensive analysis of the supply and demand for complex warships and submarines as well as for significant support vessels.

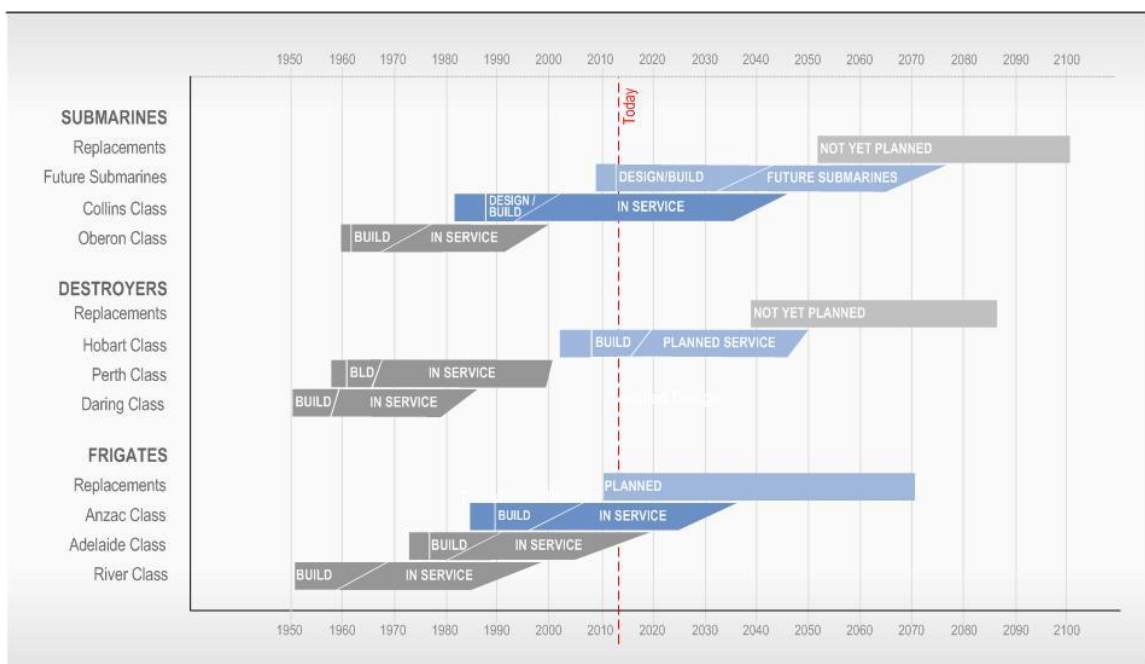


Figure 3: Demand for Australian submarines and major warships to end of the 21st century

CONTINUOUS DEMAND

Australia arguably may not have the scale to implement a continuous build strategy based on an individual class of vessel. Various studies ^[25] instead suggest giving thought to a mixed-class combat force, including at least the major submarines and warships, as the basis for a rolling build program. (The Sector Plan considered only six submarines in the force, not 12.)

Alternatively, two rolling build programs could operate through the Future Submarine Program (12 vessels), the combined numbers of the Future Frigate Program (8 vessels), and the eventual replacements for the new Hobart Class Air Warfare Destroyers. The question is whether these are considered separately or as a portfolio of programs across the naval industry.

There is high correlation between submarine and warship building; ASC's experience suggests that up to 80% of skills are interchangeable between these two market segments.

Since the entire Australian demand for naval vessels resides with just one buyer – Defence – long-term plans and arrangements for a relatively continuous build program ought to be consolidated within Defence’s Capability Plans,^[30] in collaboration with critical Australian industry participants as suggested by Mortimer^[23] and in other recent reports^{[25][30]}.

Demand for Australian industrial effort managed in a more stable and continuous flow would boost the industry’s ability to build on productivity improvements and minimise negative impacts.

A SUSTAINABLE ECONOMIC STRUCTURE

SOME CONSIDERATIONS

Australia's capacity to act in times of conflict can be reduced by shortages of imported materiel with long supply lines, offshore suppliers with mismatched interests, and by the compromises and constraints imposed by international suppliers and their parent nations.

Our Navy requires warships and submarines with an ever present capability advantage. They must be technically superior designs, well-constructed and well maintained. Over time the capability advantage will be eroded through technical obsolescence and may end in block obsolescence. Continuous investment in modifications and upgrades is needed from an industry that is sustainable, viable and efficient, for all classes of warships.

The industrial base must continuously enable Navy to field a superior military capability not occasionally but consistently. Commercial and industrial self-reliance, given our geographic isolation, requires a robust Australian component of the naval industry that is efficient and competitive with global industry.

Current warship production in the western world comprises small batches of vessels produced with similar processes and materiel. Construction labour costs are some 20% of the cost of a vessel; the remainder is materiel from the local and international supply chain (Figure 4). A capable Ship Integrator must be able to find value in both on-shore and off-shore elements of the complete value chain.

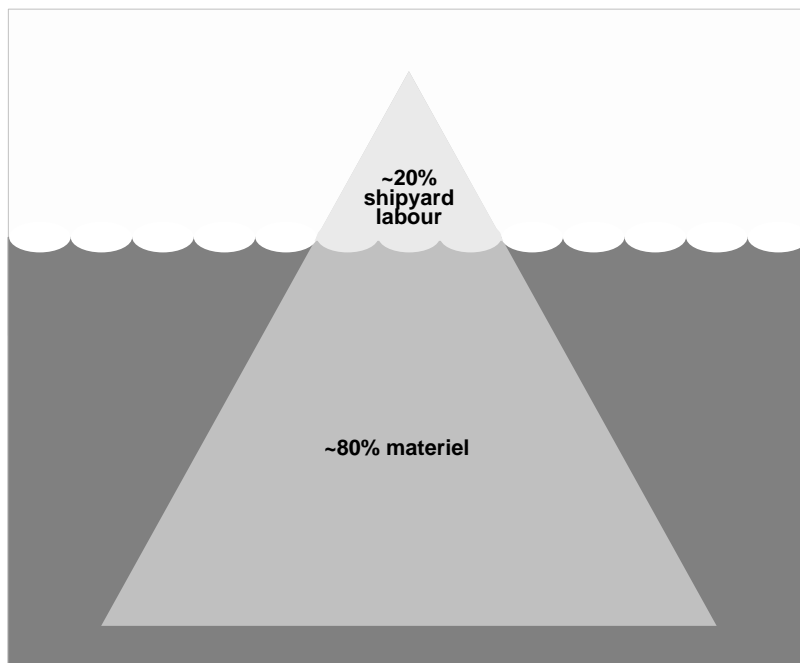


Figure 4: *The cost of constructing warships*

APPLICATION OF THE VALUE CHAIN

The crucial question becomes – who does what and how are their contributions brought together efficiently to achieve fully capable and available warships?

The value chain model [31] can be applied to represent activities and functions that deliver an outcome. The model represents best practice in the field. Value chains can be developed to describe both the delivery and sustainment of all naval vessels.

Coles[4] applied the value chain model to describe the end-to-end business of sustaining Collins Class Submarines. Coles categorised it in seven high level functions containing 22 activities, which he termed the Collins Sustainment Enterprise value chain (Figure 5). Each activity and function was checked for roles and responsibilities that were unambiguously assigned to: Navy as the Informed Customer, Owner and Operator (Capability Manager); the DMO as the Intelligent Buyer in support of the Informed Customer; and ASC as the main contractor in the supportive industry role.

Each activity was expected to have a single owner with no overlap in accountability, one participant organisation for each activity, and key measures of performance at hand-off points. The connecting processes described in the value chain also allowed a focus on minimising costs by removing duplication of effort. In reality, Coles found a lack of clarity in organisational roles, responsibilities and accountabilities across the entire submarine sustainment enterprise, leading to an inefficient business.

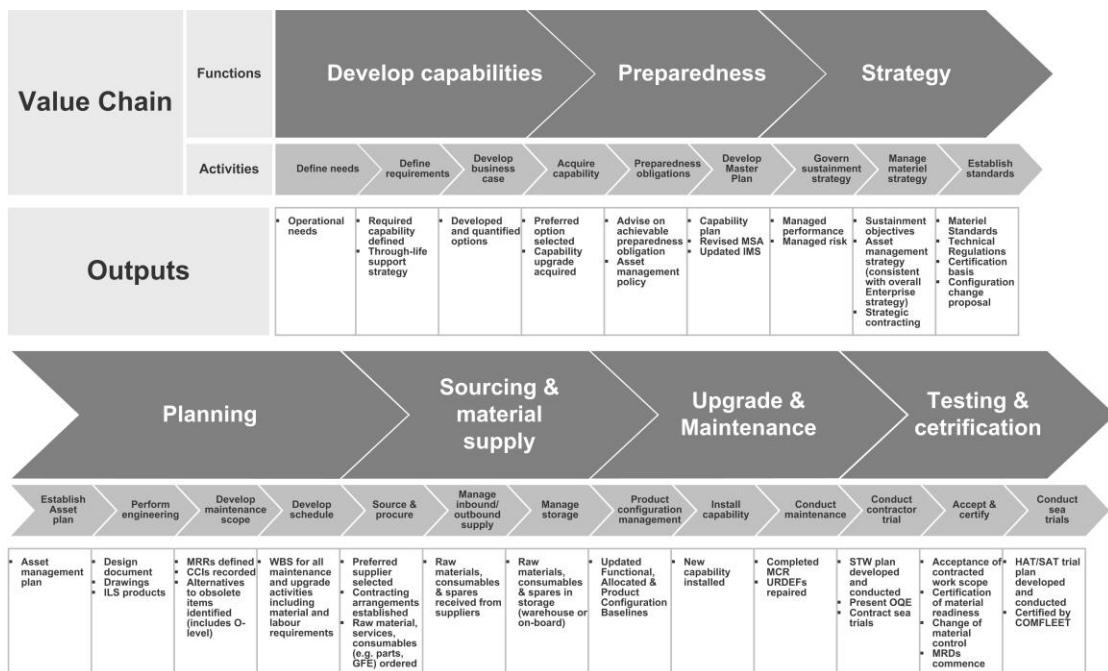


Figure 5: Good practice value chain as applied to sustainment of Collins Class Submarines (Coles)

The overlaps, gaps and conflicts in the Collins sustainment value chain have since been tackled by the Submarine Sustainment Enterprise, aided by a clear statement from Navy of its availability objectives. The changes are now delivering positive results, with better strategic planning and more responsibility for outcomes placed on those most able to accept it.

The high end of the Collins sustainment value chain^[4] involves capability development, preparedness, strategy, planning, sourcing and materiel supply, upgrade and maintenance (including engineering and production), and test and certification. ASC, as the Ship Integrator, plays a leading role in specific elements.

The model can be applied across the board to all classes of ships and in all stages of life cycle – acquisition (construction and delivery), sustainment and even disposal.

Australia's national security depends on a sound value chain. Each part is interlinked with hand-off points between participating organisations. A change in one element will have flow-on impacts to others and a subsequent effect on the productivity of the entire chain. The results of weakened value chains were highlighted in both the Rizzo^[19] (amphibious ships) and Coles ^[4] (submarines) reviews.

All naval programs should have well-structured and efficient design, build and sustainment value chains.

OPTIMAL PERFORMANCE: LEVERAGING INFORMATION

Warships and submarines are safely kept at sea by achieving the right availability and capability at an affordable price: reliable and maintainable assets that don't incur avoidable costs. This requires influence or control over the design, materiel selection, and construction and maintenance.

Most costs (about 80%) of a submarine or warship are locked-in during the design phase, mostly in materiel^[7]. About half the direct cost of maintenance is also in materials. In-country engineering know-how applied to improvements in design – along with more efficient production and supply chain activities – helps reduce the time lost to maintenance and unreliability of fleets in service.

Without the knowledge base employed in all elements of the value chain, links in the chain are weakened or even broken and value is simply lost.

The responsibility for successfully integrating all systems on a warship or submarine, and assure the product safety of the ship or submarine as delivered, must fall to a single entity. This is the role of the Ship Integrator, accountable as the “single point of truth” for all system and equipment data. The role requires a comprehensive library of design, build and sustainment information, the knowledge of how the warship or submarine is put together (integrated) as a whole system, and how it is certified and tested to increasing levels of sophistication.

This was ASC's role for Collins Class Submarines, Tenix's role for Anzac Class Frigates and ADI's role for Coastal Mine Hunters. Wherever defects in design, basic materiel, equipment and construction methods are uncovered it falls to the Ship Integrator to resolve and execute a remedy, as ASC has demonstrated.

The Ship Integrator is obliged to design and implement product and procedural changes that bring improvements. For this to be achieved efficiently and safely, the design, which includes whole of ship design data and associated design tools and personnel, must at a minimum be readily accessible to the Ship Integrator and preferably part of the SI capability itself.

CONTINUOUS PRODUCTIVITY GROWTH

Continuous growth in productivity is realised through innovation, competition, process excellence, performance based contracting and sustainment of an industrial capability. In other words, it is a process of continuous improvement. Through productivity growth, a viable and enduring sovereign industrial capability can be developed. It requires a strong leadership focus both from the customer and from those in industry with the responsibility for overall ship integration.

Western nations are approaching convergence in materiel supply, infrastructure capacity and labour costs, as well as the fixed and variable cost base. As markets rationalise, common materiel suppliers are emerging in such areas as propulsion and combat systems.

Across the international naval industry, order numbers for warships and submarines have become very small compared with the WWI and WWII eras. Shorter production runs at naval shipyards around the world, now focusing on high value-add low-volume work (Figure 6), have limited the learning curve benefits. Installed capacity in Western countries for naval production is declining as unit numbers of vessels per navy decline in favour of fewer but more potent naval combatants. For very small unit numbers (such as afloat support ships) careful planning is required to satisfy the throughput needed to maintain industry-wide productivity without distorting unit costs.

Productivity gains will not come from the scale of mass production but rather through:

- efficient organisation and management of enterprise participants and their respective elements of the value chain for the life of the vessels
- process improvement, information sharing and efficient integration of contributions of participating organisations in the value chain to ensure value is correctly handed off to the receiving participant in accordance with the agreed performance measures
- technical innovation in which new technologies offer a less costly and more efficient process (e.g. machine hull welding methods utilised on Collins Class Submarines)
- performance based contracting methods that enable scrutiny of participants, pathways for performance improvement and ultimately opportunity for better performing companies to assume more risk in line with proven capability.

When labour costs fall below 15% of the total for construction^[16], productivity becomes sensitive to the design, materiel chosen and production methods employed (though Labour costs remains obviously relevant and can never be allowed to inflate the project or broader industry cost base). ASC's shipyard labour costs during the construction of the Collins Class were of this order. The cost per tonne of these submarines has been shown to be below the average for modern conventional submarines built in the Western world since the mid-1980s^[7].

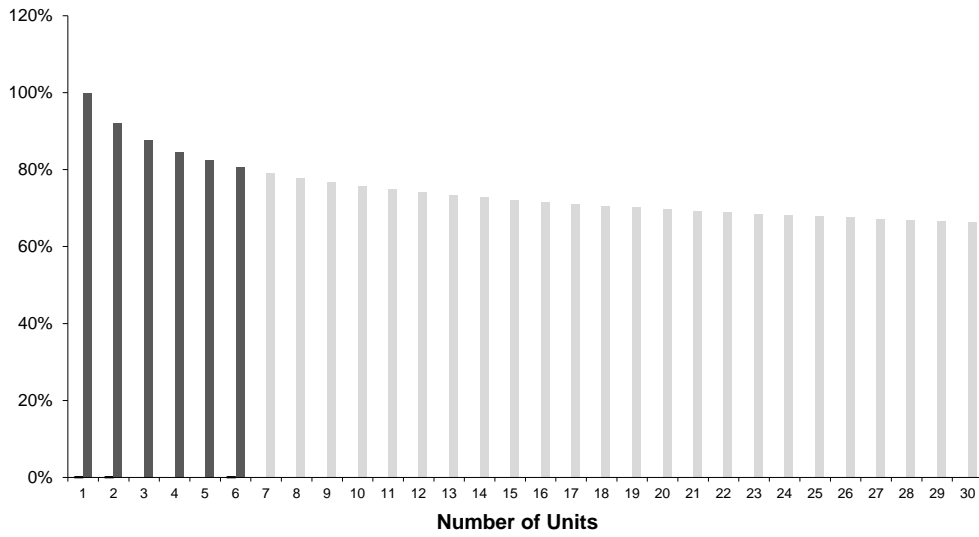


Figure 6: *The learning curve benefit of production runs of individual classes of warships and submarines in the modern era have become relatively small.*

The starting point of a productivity growth strategy lies in an easily built and maintainable design that meets performance objectives; it must include all participants in the value chain, ship integration, program and enterprise management.

THE NAVY, THE DMO AND THE SHIP INTEGRATOR IN THE VALUE CHAIN

Each element of the design, build and sustainment value chains must have a single organisation with a role and responsibility attached^[4]. This ensures leadership and good governance in the efficient delivery of services by avoiding ambiguity in activity ownership and tasking, overlaps and gaps. Defence (Navy as the asset's owner and DMO as agent) has clear and very significant roles in setting policy, requirements, contracting and developing and maintaining the certification basis of a warship. The Ship Integrator role includes asset planning, performing engineering tasks, developing maintenance scopes and schedules, procurement and management of materiel, maintenance and production, and contractor testing and trials. To undertake these roles the Ship Integrator must have core capability in areas of advanced manufacturing, applied science and technology, engineering (including design), knowledge management, project management and supply chain management.



Figure 7: Modern warship and submarine integration facilities at Osborne.

The Ship Integrator is a significant participant in the enterprise –bringing together industrial capability partners, the global technical support network and supply chain providers to deliver a safe warship over its complete life cycle.

The Ship Integrator must give effect to a unified productivity strategy to:

- state clear and unambiguous program objectives
- minimise overlaps and gaps for an efficient and productive delivery of services
- minimise organisational complexity and expedite decision making
- Perform production and maintenance activity as safely and efficiently as possible
- ensure the vessel is built to the design and act as the Technical Authority.

The Ship Integrator has responsibility for safely integrating all systems and equipment and leads the industrial elements in the value chain.

AN ADVANCED MANUFACTURING INDUSTRY BUILDING AUSTRALIA'S ECONOMIC STRENGTH

Substantial economic benefits arise from performing naval work in-country^{[3][8][10]}. Owing to its close understanding of the Navy's needs, local industry can continue to deliver a capability advantage not available from the overseas market, including the level of self-reliance sought by the Government^[1]. As a focus for advanced manufacturing, the sector also helps to grow the general economy by developing human capital and generating innovation and spill-overs into the broader national industry^[12].

Naval programs in Australia, especially those with significant design focus, bring together manufacturing efforts from several industry sectors across various states and territories. Such programs require large numbers of suitably qualified and experienced personnel. They use, and at times develop, advanced technologies and methods across a wide range of disciplines. These programs genuinely depend on innovation and they demand it.

Large long-term naval programs drive industrial development and build economic strength through innovation by developing new technologies, new techniques, job numbers and human capital.

TECHNOLOGICAL INNOVATION

Continuous broad-based innovation helps to maintain leading edge performance in war fighting capability. Innovation across the value chain identifies and develops areas of excellence from which the Australian naval industry can maintain and extend its competitive edge and support long-term corporate growth. In other words, innovation maintains a viable and sustainable industry. An outstanding example is the phased array radar technology developed in Australia and now being installed on the Anzac Class Frigates, with the solid backing of Defence and DSTO.

Central to this innovation is the need for continuous improvement managed by a well-structured and planned Strategic Science and Technology (S&T) Program, which collaborates within major naval enterprises, with external capability and industry partners, and with the wider Defence industry, Government agencies and academia.

Over the years, industry has initiated a number of S&T activities, including development of comprehensive plans and cost-benefit analyses. However, there has been no broad and strategic approach across the warship and submarine capabilities to support the investigation of new technologies and products, new manufacturing techniques, and S&T opportunities to ensure performance and sustainability is kept to the required standards. Ad hoc grants or funding sources, such as Concept Technology Demonstrators, have been welcome but are not on their own sufficient to establish the required industry capability.

However recent innovations in S&T have been employed on the Collins Class and demonstrate that success in applied science and technology is very possible:

- Radar Absorbing Material: Defence Science and Technology Organisation working with ASC, installed Australian designed and manufactured radar absorbing material on the submarines which did not suffer from the delamination of the overseas supplied material.

- Non-Destructive Testing: ASC collaborated with the Welding Technology Institute of Australia on an evaluation of phased array acoustic techniques compared to radiographic inspection for safer testing of welds.
- Sea-Water Quality: ASC collaborated with Defence Materials Technology Centre in a study to characterise the water quality and composition of seawater in several sites, with the aim of using this information to develop more targeted corrosion treatments.
- Ships Information Management System/Ships Information System: ASC designed and implemented a submarine information management software system for logistics now used by over 900 civilian and navy personnel.

Technological innovations based on focused Science and Technology programs and engineering development have proven leading edge products and solutions for unique challenges in Australia.

THE DEVELOPMENT OF HUMAN CAPITAL

Long-term naval programs in Australia generate significant human capital that migrates to benefit other industry sectors. High capital value naval programs provide both the need and the environment for large numbers of personnel to be either trained from first principles or to be up-skilled. Since the Anzac Class and Collins Class design/build programs, a handful of companies in the Australian naval industry have been accumulating a body of knowledge through focused learning programs for their personnel while providing real work on which to practise newly found skills.



Figure 8: *The Maritime Skills Centre, a centre for up-skilling the naval workforce.*

The Maritime Skills Centre in Adelaide is a specialist facility for the up-skilling of personnel in the naval industry. Leading companies including ASC helped establish tertiary learning programs such as an Engineering Masters Programme, and three postgraduate programs in Military Systems Integration, System Support Solutions and Marine Engineering. The last includes the development and delivery by expert ASC staff of courses specifically aimed at increasing in-country knowledge in the area of submarine design.

High capital value naval programs thus act as industrial technical universities. The knowhow of the most proficient and experienced personnel are used in concert with formal education and learning programs to grow and up-skill a workforce of technical professionals, trades and paraprofessionals. They pursue levels of competencies and disciplines not supported by mainstream education institutions.

Critical skills and disciplines for large naval programs, such as project scheduling, earned value management, risk management, asset management, supply chain management, systems integration, systems engineering, logistics and specialised trades, are primarily learnt on such programs.

BENEFITS OF A SUSTAINABLE NAVAL INDUSTRY

WHAT ARE THE BENEFITS?

The Navy's ability to fight and win is increased. Navy capability depends on having access to a vibrant and healthy local industry that delivers warships from build, maintenance, modification and repair to required standards. At times, rapid and local response is required for emergency repairs and for modifications, upgrades and preparations for war. The Australian naval industry must be ready in all respects when it is called upon during these times.

Sovereign independence can be realised through sustained and planned investment in the local economy. Sovereign independence gives the freedom to use the most appropriate military capabilities when needed, and to maintain and improve the equipment when necessary, including during times of rapid response. It means less dependence and risk of compromise from foreign companies and governments. It does not mean ignoring longer-term assistance from allies for access to advanced government programs when very difficult problems emerge. Such problems are bound to arise in technically advanced projects, indeed it is incumbent on the industrial leadership of a project to forge strong and healthy relationships with overseas capability partners.

Innovation improves the military capability at the leading edge. To maintain a viable and sustainable Australian industry, continuous innovation becomes embedded in the technologies, materials, engineering, manufacturing and management tools and methods. These progressively spill over to other sectors in the national economy. As a corollary, the military edge is sustained only by a continuous focus on innovation.

Human capital includes suitably qualified and experienced personnel, without which large projects cannot be accomplished. Companies in the advanced manufacturing sector act as technical universities by developing new technologies along with trained and experienced personnel that spill over to the broader society. A viable and sustainable local industry grows the human capital necessary in increasingly sophisticated projects.

Up-skilling people is a natural need for prime contractors and suppliers. The long-term nature of major naval projects drives this need and offers the time to develop the workforce, develop significant numbers of staff across a wide range of disciplines and achieve high competency levels in timeframes not generally achievable in the wider industry.

The Australian economy grows from investment in the Australian naval industry. The industry is an advanced manufacturing, high value-add sector. It serves a real need and develops economic growth through the full breadth and depth of contractor and subcontractor teams. Taken together with the spill-over effects of in-country construction, the human capital generated by large projects and innovation spill-overs from in-country design and development work, contribute substantially to the national economy^[12]. Customer demands for product performance beyond current technologies generate innovation and thus greater spill-overs^[12]. These benefits continue to accrue when conducting design changes in service, modifications, engineering improvements and maintenance in-country.

The benefits of a viable and sustainable Australian naval industry start with improving the Navy's ability to fight and win. Government receives the products and services it demands and a spectrum of economic spill-overs generate much wider, but less visible, economic value, realised through greater military self-reliance, development of human capital, innovation and economic growth.

WHY DO WE NEED THE BENEFITS?

1. The most important reason to pursue the benefits is to give our Navy the best possible equipment. Militarily capable, continuously available and highly reliable warships are more ably supplied from Australia. An industry more closely aligned with the Navy has a better understanding of its needs and can solve its immediate and long-term challenges. Innovation conferred by a sustainable industry in supporting and upgrading our military equipment will help keep that equipment at the leading edge – one of the factors that helps the Navy to fight and win at sea.
2. Some specific technical solutions can be conferred only by Australian industry and equally many others may only be sourced from offshore. Australian controlled interests are less constrained by foreign interests and are more able to develop, access and control sovereign Australian technology and are also more able to switch to alternate offshore suppliers if required.
3. Continuity of R&D and engineering development programs will be available from a healthy local industry, which allows us to maintain ships and submarines at the leading edge and avoid obsolesce.
4. A sustainable Australian industry, aided by better demand programming, will better understand the costs of acquisition and sustainment and improve the efficacy of Defence budgets.
5. Australia requires a core advanced manufacturing capability to act as technical university; developing human capital and intellectual property. Growth in human capital applies to competencies, qualifications and experience at all levels in the workforce.
6. Studies on the economic impacts of the Anzac Frigate^[8], Coastal Mine Hunters^[10] and the Bushmaster^[9] projects show that basic benefits to the national economy from in-country construction are nearly double the value of the investment. Economic analysis conducted in the UK^[11] and Sweden^[12] on major defence acquisitions and businesses, where design and development is performed in addition to construction, show even greater economic benefits.

POLICY RECOMMENDATIONS

1. **Implement a rolling ship and submarine build program to sustain industry throughput.** A process of continuous improvement, which is at the heart of productivity growth, is disabled by shutdowns in the value chain. Strategic transition between generations of warships and submarines also maintains the capability edge without interruption.

Stable, continuous long-term work programs and capability requirements that demand regular technical innovation will ensure a viable and sustainable industry and maintain the capability advantage that Navy requires. SEA1000 – Future Submarine and SEA5000 – Future Frigate projects present opportunities to establish this policy and carry it throughout the 21st century.

2. **Build a capable in-country naval ‘value chain’ built on domestic and international sources of supply.** Australian naval industry (and the Ship Integrator in particular) has a leading role and responsibility in specific elements of the design, build and sustainment value chains for each class of vessel. The participant in each element must be capable, viable and sustainable on a continuing basis.

A significant portion of the componentry and services constituent to modern warship design, production and sustainment is carried out by companies operating outside of Australia and the decision when to source from offshore markets must be driven by sovereign, technical and commercial risk, sustainment of minimum demand (as per recommendation 1) and overall value for money. The Ship Integrator, and other key industrial participants, must take decisions that meet clear program and industry goals. Different programs will generate different levels of Australian and off-shore supply and this is a healthy feature of the industry provided the overall industry is sustainable and capable.

3. **Implement best commercial practice across the value chain for greater productivity.** Sustained high performance is informed and implemented by benchmarking to best practice, performance-based contracts and, where appropriate, competition. Partnered to these measures are processes of continuous improvement and use of modern tools such as an Enterprise Resource Planning system linked to production planning systems; a Data Management System populated with correct and up-to-date procurement data; and delegated decision making.

When viewed from a Ship Integrator’s perspective, approximately 80% of the cost of a vessel and 50% of the cost of maintenance is purchased materiel. Further, the materiel that makes up a vessel is largely locked-in during its design. A key to controlling capability and cost is control over the design in the early stages, with the full life cycle costs in mind, and then throughout the service life of the vessels.

4. **Increase in-country capability for ship and submarine integration to include warships design:** System performance, construction costs, reliability and cost of maintenance are locked-in at an early stage by the design. It is both high value and militarily sensitive work. Throughout their 30–40 year service lives, submarines and warships must be modified to maintain their capability advantage and avoid technical obsolescence. An in-country design capability provides the freedom and means to directly control early stage lock-ins and thus modifications throughout the service life. This capability best resides within the Ship Integrator or closely partnered with the Ship Integrator. Design work on sophisticated projects brings with it significant economic benefits through spill-over effects, even into the commercial sector. The SEA1000 – Future Submarine and SEA5000 – Future Frigate projects present the only opportunity to establish this policy.
5. **Establish, maintain and execute a strategic science and technology program:** Central to innovation is continuous improvement managed by a well-structured and planned Strategic Science and Technology Program that coordinates the collaborative effort within major naval enterprises, with external capability and industry partners, and with the wider Defence industry, Government agencies and academia. The strategic time horizon should relate to that of the respective submarines and warships and should be updated regularly. The Ship Integrator works at the centre of this community to implement solutions at sea that offer superior, cost effective and safe performance.

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